Alaska Department of Fish and Game
Division of Wildlife Conservation

Federal Aid in Wildlife Restoration
Research Final Report
1 July 1990 - 30 June 1994

Nutritional Status of the Southern Alaska Peninsula, Nelchina and Other Southcentral Alaska Caribou Herds

by

Charles C. Schwartz

Grant W-23-4, W-23-5
W-24-1, W-24-2
Study 3.36
December 1994

Tim Lewis Rue

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SUMMARY

The regional caribou (*Rangifer tarandus*) biologist position was vacant for the majority of this report period. During the interim, Moose Research Center (MRC) staff monitored the captive caribou at the MRC. Results of these studies are reported in the Annual Moose Research Center Reports. Other field activities scheduled were not resumed. Results from previous activities have been reported in annual reports.

Key Words: Caribou, *Rangifer*, nutrition, Nelchina herd, Southern Alaska Peninsula herd, Mulchatna herd, body condition score, bioelectrical impedance, calf recruitment, calving chronology, gestation length.

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BACKGROUND

Since the early 1970s, dramatic fluctuations in the size of many Alaskan caribou (*Rangifer tarandus*) herds have necessitated restrictive management responses, resulting in dissatisfied user groups and criticism of both state and federal management programs. In Southcentral Alaska the Nelchina caribou herd (NCH) grew to high levels during the early and mid-1960s and then declined to very low levels in the early 1970s. The NCH has since rebounded, now numbers more than 45,000, and continues to grow. In contrast, the Southern Alaska Peninsula caribou herd (SAPCH) has declined from a recent high of more than 10,000 animals (1983) to a current low of about 3,200. While apparently no longer in decline, calf counts and census data from summer 1992 indicate that SAPCH numbers have, at best, only stabilized.

The appropriate management strategy for the herds at either extreme is not easily determined. Uncertainty as to the importance of density dependent food limitations in population regulation for this species confounds the issue (Pitcher 1991). The role of nutritional factors, predation, climatic conditions, and human harvest in regulating Alaskan

caribou herds has been the subject of considerable debate, particularly for the NCH (Skoog 1968, Bos 1975, Doerr 1979, Van Ballenberghe 1985, Bergerud and Ballard 1989). However, a direct relationship between body condition and reproductive performance of female caribou has been documented in numerous studies (Dauphine 1976, Thomas 1982, Reimers et al. 1983, Skogland 1984, Allaye-Chan 1991, Cameron et al. 1992). Our understanding of these relationships remains incomplete, and we need additional information to guide management.

Population and animal (physiologic) indicators (Franzmann 1985) reflect the relationship between a herd and its environment; changes in nutritional status lead to changes in biological and population parameters. Population indicators, such as calving chronology, birth rates, survival rates, age of sexual maturation, and various demographic parameters can be determined through standard survey techniques and carcass analysis. Individual animal indicators, which should be more sensitive to nutritional perturbations, have been more difficult to measure. Recent advances in non-lethal *in vivo* methods of measuring body condition, such as bioelectrical impedance (BIA) and body condition scoring (BCS), may provide practical methods for managers to monitor physiological indicators (Lukaski et al. 1985, Hall et al. 1989, Hundertmark et al. 1991, Gerhart 1992). Herds under varying nutritional regimens inhabit southcentral Alaska, allowing comparative analyses of various nutritionally mediated parameters. Spatial (between herd) and temporal (over time) comparisons of potential nutritional indicators such as body condition, birth weight, growth, and calving chronology will allow us to evaluate the efficacy of these new techniques in herd management.

Factors other than density-dependent nutritional limitation, particularly predation and human harvest, are significant in regulating populations of caribou herds. However, adequate nutrition is essential for the production and survival of animals at a high enough rate to allow herds to be productive and provide a harvestable surplus. The primary focus of this project is to evaluate the nutritional status of caribou herds.

GOAL

The goal of this study is to develop a practical and economic procedure to evaluate and monitor the nutritional status of southcentral Alaskan caribou herds.

OBJECTIVES

Objectives for this study are to:

1. Determine which potential animal and population indicators reflect nutritional status by characterizing indicators from herds of varying nutritional status.

2. Experimentally determine the effects of nutrition on calving chronology, birth

weight, body composition, blood and urine chemistry, and neonatal survival.

3. Experimentally determine if differences between herds in calving chronology, birth weights, and growth are mediated by heredity or nutrition.

4. Determine if undernutrition is contributing to low calf recruitment and declining population size in the SAPCH.

Working Hypotheses

1. Undernutrition in caribou herds will be reflected in a measurable and predictable way by selected biological and population parameters.

2. All caribou herds in southcentral Alaska comprise a single genetic population and have similar potential for growth, condition, and calving chronology.

3. The SAPCH is currently nutritionally limited to the extent that calf survivorship, growth, physical condition (including normal patterns of seasonal fattening and weight loss) and timing of calving are negatively impacted.

METHODS

Job 1. Jaw Collection and Age Specific Growth

This job remained inactive during the project.

Job 2. Body Composition and Growth as Nutritional Indicators

During April-May 1990, October 1990, April-May 1991, and April-May 1992; 64, 17, 61, and 86 caribou were live-captured, respectively, from southcentral Alaska caribou herds.

During this study period we captured caribou using a skid mounted net-gun on a Hughes 500D helicopter and immobilized them by intramuscular injections of rompun (xylazine). We weighed the animals and took a series of body measurements (total length, mandible length, chest girth, metatarsal length). A subjective index was applied to each animal to evaluate body condition. We collected blood for packed cell volume determinations.

We took bioelectrical impedance measurements from each subject. Animals were placed on their sides with legs perpendicular to the body, and we inserted electrodes under and parallel to the skin at the joint immediately proximal to the hoof. Electrode tips were pointed distally. We obtained resistance (R) and reactance readings using a bioelectrical impedance analyzer (RJL, Inc., Detroit, MI). Total body length was recorded from base

of tail to tip of nose.

We assigned body condition scores (1-4, 4 being high) based on the amount of soft tissue covering bone at each of 3 sites: ribs, hips, and along the spine. Scores were summed for an overall BCS. We calculated body reserve index (BRI) (weight * BCS) after Gerhart et al. (1992).

We estimated percent body fat by three different methods. Gerhart et al. (1992) used stepwise linear regression to examine the relationships between multiple independent variables and the dependent variables total body water (TBW) and body fat. They found that TBW, which exhibits a tight inverse relationship to body fat, was more strongly correlated with body weight (BW) (r^2=0.95) than with impedance expressed as length^2/resistance (r^2=0.78). However, use of only BW to predict TBW would not be sensitive to the relationship between skeletal size and body weight. TBW in this study was then estimated by using the equation

$$TBW = 34.3 + 0.2 * L^2/R$$

where L^2 = body length^2 and R = resistance. The fat-free body mass (FFM) was calculated using the interspecific hydration coefficient for lean tissue (0.723) with an arbitrary correction for ruminants. We then estimated percent body fat by the equation

$$\% FAT_1 = 100 * [IFBWt - (TBW/.77)]/IFBWt$$

where IFBWt = calculated ingesta-free body weight (live weight * 0.82).

Gerhart et al. (1992) also provide predictive equations to directly calculate body fat from the BRI, and using the impedance value. For comparative purposes we used both methods here. Two additional estimates of percent fat were then calculated as

$$\% FAT_2 = -4.9 + 0.02 * BRI,$$

and

$$\% FAT_3 = -6.3 + 0.1 * L^2/R.$$

Job 3. Estimating Age of Sexual Maturity Among Herds

This job remained inactive during the project.

Job 4. Calving Chronology Surveys

In late May of 1990-1992, we flew low-level aerial surveys over the Nelchina herd calving grounds to document calving chronology. The sampling scheme and data analysis techniques have been described by Becker (Pitcher 1991:35) and were designed to detect annual shifts in peak of calving within and between herds. Limited surveys over portions of the Mulchatna herd's range delineated calving areas and gained general calving dates to facilitate more intensive future chronology work.

Job 5. Effect of Nutrition on Calving Chronology, Birth Weight and Neonatal Survival

Staff captured 8 Nelchina herd caribou, 6 females and 2 males, in September 1990 and transported them to the Moose Research Center on the Kenai Peninsula. The two bulls died and were replaced by 3 males from Kenai herds in summer and fall 1991. All Kenai caribou are the product of recent transplants from the Nelchina herd and of the same genetic stock as the bulls they replaced. We kept subject animals in a 4-ha enclosure and fed them a pelleted commercial reindeer ration *ad libitum*. Caribou supplemented that diet with natural forage (lichen were not available). During the rut, animals were restricted to a 700 m^2 holding pen to facilitate observation and documentation of breeding date. We weighed the animals up to five times per year.

Calving activity by captives was closely monitored and birthing dates recorded. We weighed, measured and ear-tagged the newborns within 12-hours of birth. Subsequent neonatal survival was ascertained. We calculated gestation length in cases where breeding date was known.

RESULTS AND DISCUSSION

Job 1. Jaw Collection and Age Specific Growth

No data were collected addressing this objective.

Job 2. Body Composition and Growth

We determined body condition parameters for 86 caribou from 5 different southcentral herds in spring 1990-92 and compared them with similar data collected in 1990 and 1991. Data were summarized by McCarthy (1992).

Job 3. Estimating Age of Sexual Maturity Among Herds

No data were collected addressing this objective.

Job 4. Calving Chronology

No additional data were collected addressing this objective. Previous information was summarized by McCarthy (1992).

Job 5. Effect of Nutrition on Calving Chronology, Birth Weight and Neonatal Survival

This is the only study objective listed under this study that has continued uninterrupted since it began in 1990. The objective has been moved to the study on "Evaluation and Testing of Techniques for Ungulate Management" (Study 1.45), started in 1992 under W-24-1. Data are being analyzed and will be reported annually under Job 7 of this study.

RECOMMENDATIONS

We need to improve our techniques for examining population indicators, such as calving chronology and birth rates, so the sensitivity to modest variation is enhanced. Current methods of monitoring calving chronology in southcentral herds will probably not allow us to detect shifts in peak calving dates with the degree of precision necessary to meet this study's objectives.

To allow examination of the relative influence of genetics and nutrition on both population and animal indicators, captive studies should continue. A high nutrition diet should be fed for an additional year before nutritionally stressing the animals. This will provide improved baseline data and allow biologists to better estimate gestation length and seasonal patterns of weight gain.

LITERATURE CITED

Allaye-Chan, A. C. 1991. Physiological and ecological determinants of nutrient partitioning in caribou and reindeer. Ph. D. thesis, University of Alaska, Fairbanks, Alaska.

Bergerud, A. T., and W. B. Ballard. 1989. Wolf predation on the Nelchina caribou herd: a reply. J. Wildl. Manage. 53:251-259.

Bos, G. N. 1975. A partial analysis of the current population status of the Nelchina caribou herd. Proc. Int. Reindeer and Caribou Symp. 1:170-180.

Cameron, R. D., W. T. Smith, S. G. Fancy, K. L. Gerhart, and R. G. White. 1992. Calving success of female caribou in relation to body weight. Can. J. Zool. (Submitted April 1992).

Dauphine, T. C., Jr. 1976. Biology of the Kaminuriak population of barren-ground caribou. Part 4. Growth, reproduction, and energy reserves. Can. Wildl. Serv. Rep. Ser. No. 38.

Doerr, J. 1979. Population analysis and modeling of the western Arctic caribou herd with comparisons to other Alaskan *Rangifer* populations. M.S. Thesis, Univ. Alaska Fairbanks. 340pp.

Franzmann, A. W. 1985. Assessment of nutritional status. Pages 239-258 *in* R. J. Hudson and R. G. White, eds. Bioenergetics of wild herbivores. CRC Press, Boca Raton, Florida.

Gerhart, K. L., R. G. White, and R. D. Cameron. 1992. Estimating body composition of caribou and reindeer using bioelectrical impedance analysis and body condition scores. Rangifer. In Press.

Hall, C. B., H. C. Lukaskai, and M. J. Marchello. 1989. Estimation of rat body composition using tetrapolar bioelectrical impedance analysis. Nutrition Reports Int. 39:627-634.

Hundertmark, K. J. 1992. Evaluation and testing of techniques for moose management. Alaska Dep. of Fish and Game Res. Fed. Aid in Wildl. Rest. Res. Prog. Rep. Proj. W-23-4. Study 1.39. Juneau. 31pp.

Lukaski, H. C., P. E. Johnson, W. W. Bolonchuk, and G. I. Lykken. 1985. Assessment of fat-free mass using bioelectrical impedance measurements of the human body. Am. J. Clin. Nutr. 41:810-817.

McCarthy, T. M. 1992. Nutritional Status of the Southern Alaska Peninsula, Nelchina, and other Southcentral caribou herds. Alaska Dep. of Fish and Game. Fed. Aid in Wildl. Rest. Res. Prog. Rep. Proj. W-23-5. Study 3.36. Juneau. 13pp.

Pitcher, K. W. 1991. Nutritional Status of the Southern Alaska Peninsula, Nelchina, and other Southcentral caribou herds. Alaska Dep. of Fish and Game. Fed. Aid in Wildl. Rest. Res. Prog. Rep. Proj. W-23-4. Study 3.36. Juneau. 42pp.

Reimers, E., D. R. Klein, and R. Sorumgaard. 1983. Calving time, growth rate, and body size of Norwegian reindeer on different ranges. Arctic and Alpine Research 15:107-118.

Skogland, T. 1984. The effects of food and maternal conditions on fetal growth and size in wild reindeer. Rangifer 4:39-46.

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

Thomas, D. C. 1982. The relationship between fertility and fat reserves of Peary caribou. Can. J. Zool. 60:597-602.

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

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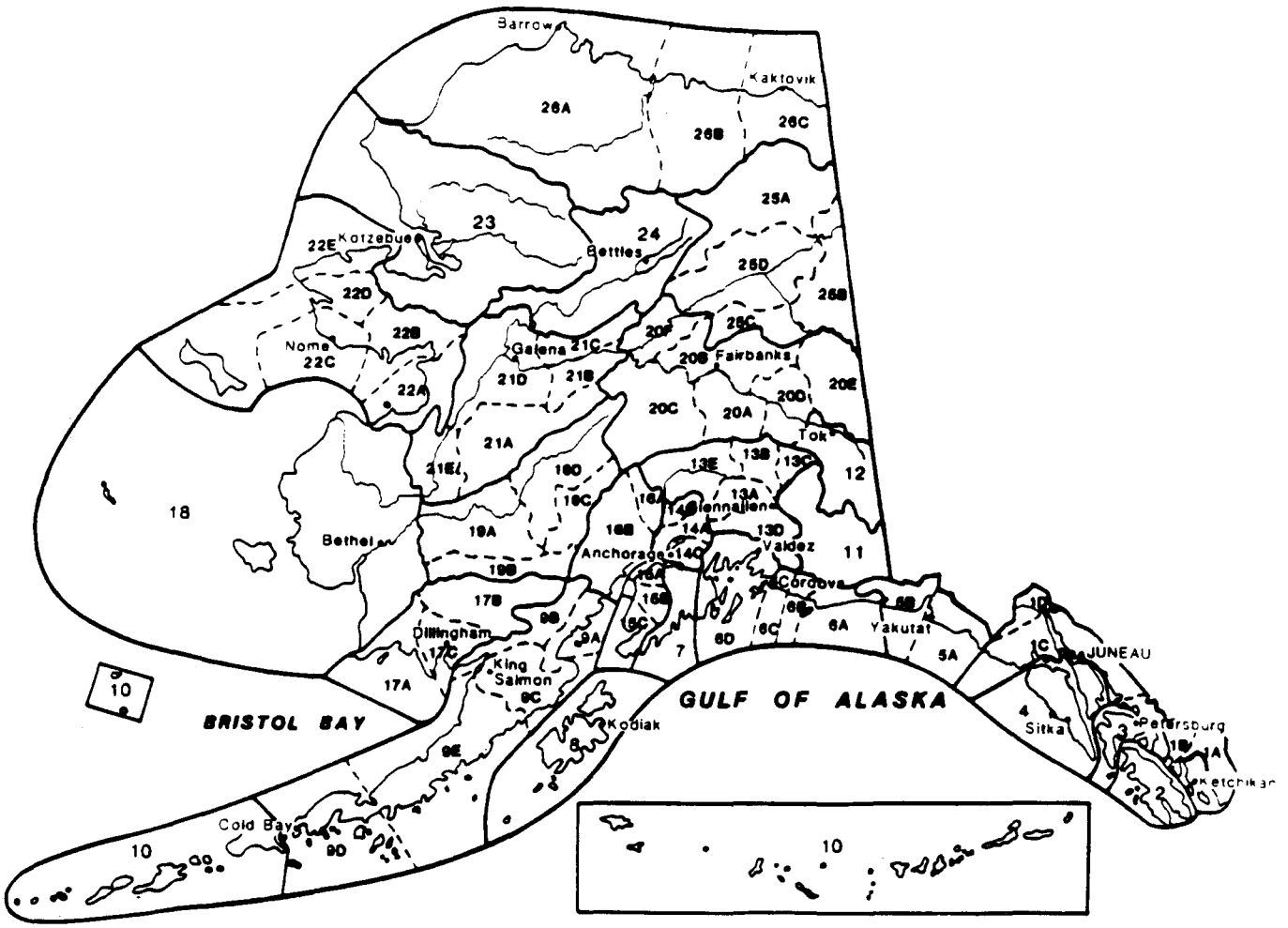

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