Research Work Order 30: Seasonal body condition of adult female caribou from the Porcupine herd.

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INTRODUCTION

Body composition is an important factor in the survival and reproduction of barren-ground caribou (*Rangifer tarandus granti*). For the Porcupine Caribou Herd (PCH), body condition may be used to monitor herd health and to assess potential effects of industrial development. In this study, a technique is being developed to permit the assessment of herd condition using indicator bones, muscles and fat measurements from hunter-killed and recaptured caribou. This study also examines the effects of season, migration, and reproduction on body composition of the adult female from the PCH. The objectives of this research are as follows:

(1) To determine seasonal patterns of body weight and body condition of reproductive and nonreproductive females from the PCH.

(2) To develop sensitive indices for the routine assessment of body condition from a) hunter-killed animals and b) radio-collared caribou being used to monitor annual productivity.

The results of this work will be used to test the following hypotheses:

H_a: Body condition varies both interseasonally and interannually and thereby affects fecundity in adult females.

H_0: Body condition of female caribou is constant both interseasonally and interannually and does not effect female fecundity.

RESULTS AND DISCUSSION

Adult female caribou from the PCH were collected four times annually, in March/April, June, September and November, during both 1987 and 1988. In addition, development of a technique for estimating body composition of radio-collared females *in vivo* was initiated in 1989.

Annual Variation

No significant differences ($p > 0.05$) were found between 1987 and 1988 measurements of body weight or body fat levels of adult female caribou. Seasonal fat compositions of reproductively active females were remarkably similar between the two years, with mean differences of only 0.1-0.3%. Among reproductively inactive females, differences between 1987 and 1988 were larger, especially in November when the difference equalled 4 percentage points.

Body protein showed a significant year-to-year effect. Body protein was consistently higher in 1988 than in 1987. This finding for body protein led to questions concerning between-season mobilization rates to determine whether either body protein or body fat changes could have an effect on fetal growth and birth weight of calves.

Seasonal Changes

Annual minima for body weight, body fat and body protein of reproductively active females were reached in June. In contrast, annual maxima were reached at different times for body weight (September), body fat (November and April), and body protein (September and November).

Among reproductively inactive females, annual maxima in these three variables were reached concurrently in September and November. Therefore, differences between the reproductive cohorts were most pronounced in November and least pronounced in June. The results suggest that lactational demands of adult females results in a minimum ability for them to fatten by the time of peak breeding, i.e., October, and therefore we investigated the relation of body composition changes with reproductive requirements.

Reproductive females mobilized approximately 47 grams of fat and 18 grams of protein daily between November and March to sustain maintenance and fetal development in late gestation (Fig. 1). Following parturition, body tissues were replenished between June and September with body protein deposited at approximately twice the rate of body fat. This process reversed in September when body fat was preferentially deposited at the expense of body protein. Body fat deposition continued between November and March.

In contrast to pregnant females, nonpregnant females may actually be able to deposit body fat reserves between March and June (Fig. 1). In the absence of lactation, the rate of tissue deposition was 4 times greater in nonlactating than lactating females. In winter, between September and March, reproductively inactive females apparently mobilized greater amounts of tissue

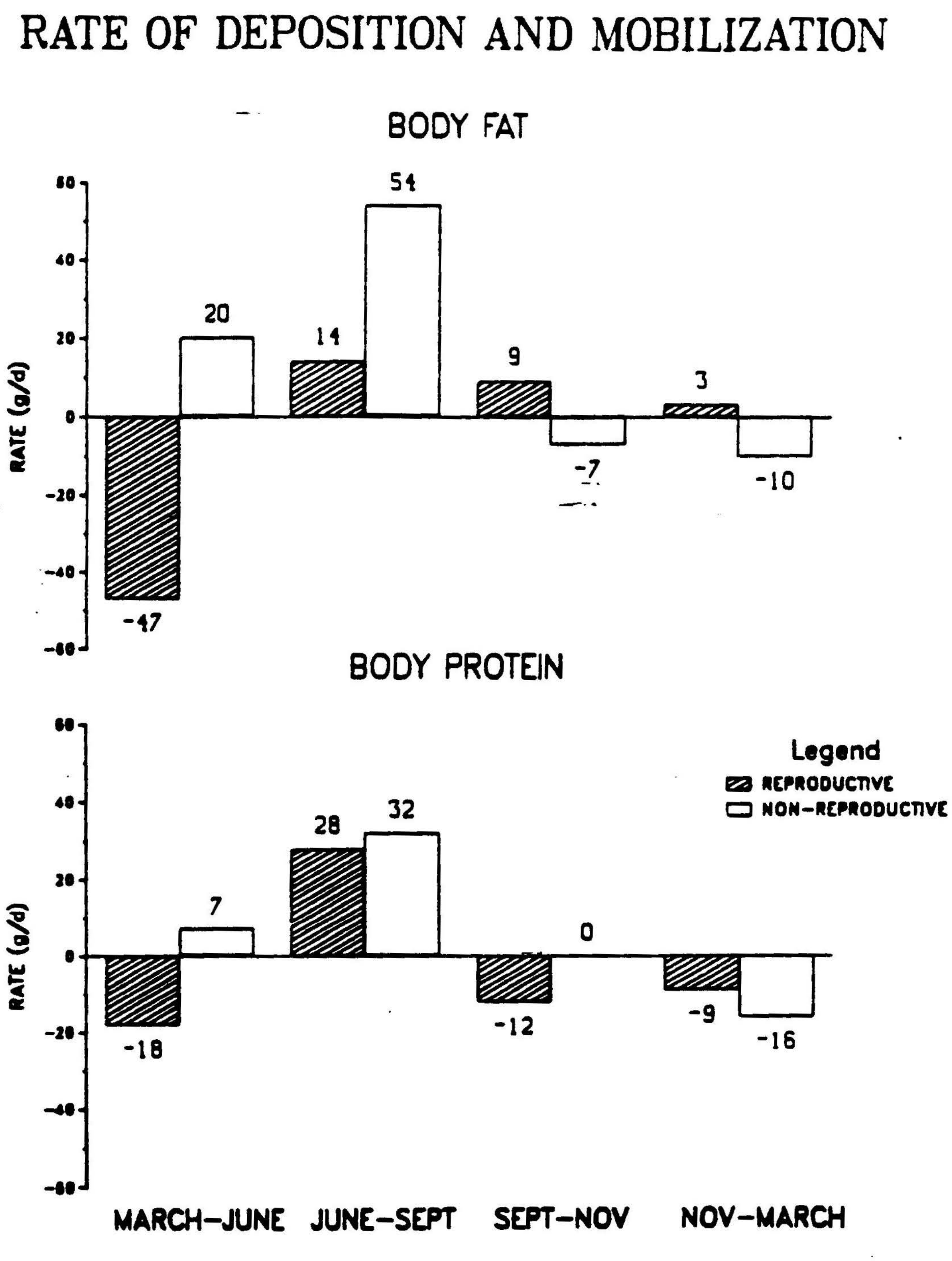

FIGURE 1. Seasonal rates of deposition and mobilization in reproductively-active and reproductively-inactive females.

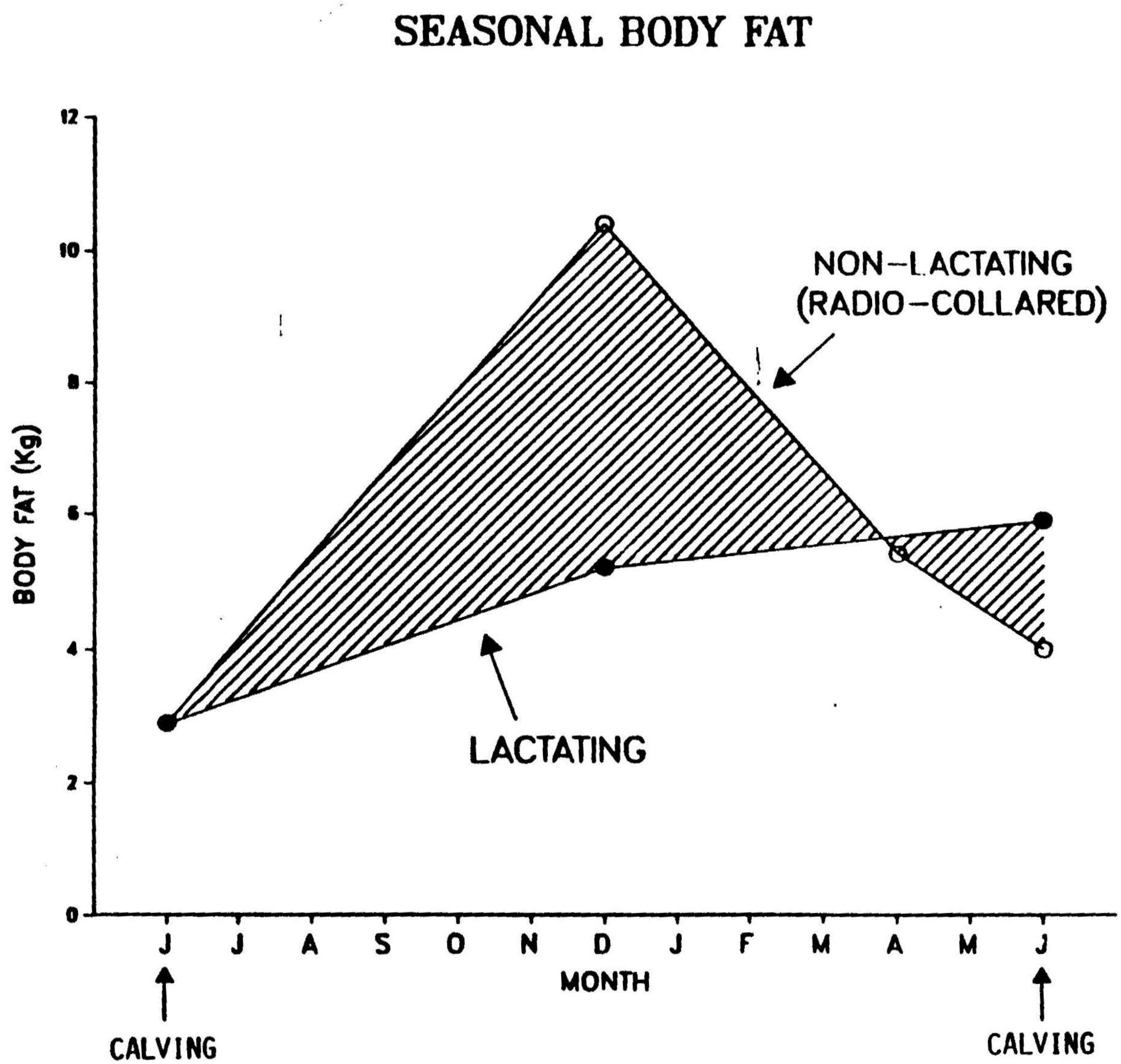

FIGURE 2. Seasonal body fat reserves in lactating and non-lactating (radio-collared) females between June 1987 and June 1988.

than reproductively active females. This pattern of winter tissue mobilization in nonpregnant females was verified using radio-collared cows which had their calves removed from them in June 1987 (Fig. 2). The finding that reproductively inactive females are unable to maintain body tissue reserves throughout winter is surprising. Two possible hypotheses include (1) competition for prime feeding areas - reproductively active females are perhaps dominant over inactive females, and inactive females are forced to feed in less productive sites; and (2) reproductively inactive females may attempt to minimize maintenance requirements throughout winter and thus avoid more energetically costly competition for food. Utilizing a small amount of body reserves may not be critical since fat reserves are not necessary for milk production.

Body Condition and Breeding Success

In November, females that had conceived successfully had twice the fat reserves and approximately 12% more protein than females that had not conceived. However, only body protein was found to significantly affect fetal weight in April (Fig. 3) and birth weight in June (Fig. 4). The relationship between body protein and fetal weight was improved when adjusted for body size, as indexed by femur weight. Together body protein and femur weight accounted for 75% of the variation in fetal weight in March-April.

A preliminary assessment based on the body fat reserves of PCH females is that they are in relatively poor condition, particularly in comparison with insular caribou populations and those undergoing rapid growth. This interpretation would imply the herd may be close to carrying capacity. Therefore the assessment warrants further evidence that could be obtained from low cost monitoring studies.

Measurement of Body Condition

Body weight and body fat can be predicted reasonably well using indicator bones, muscles, and fat measurements that can be easily obtained from hunter-killed caribou. Samples from hunter-killed caribou will be collected in Canada during the 1990 hunting season. Using multiple regression equations, body weight can be predicted with a standard error of 6 kg using the weight of one indicator muscle, kidney fat weight, and metatarsus weight. Percent body fat can be predicted with a standard error of 1.3% using the depth of back fat, fat content of the indicator muscle complex and the CONINDEX, which is calculated from femur marrow fat and the kidney fat index.

Methods for Monitoring Body Condition of Live Caribou

Experiments were begun in 1989 to evaluate the utility of using tracer dilution and multiple regression techniques (involving tissue assay, visual assay and bioelectrical impedance) for prediction of body composition in live caribou under field conditions. Wild caribou from the Central Arctic Herd (CAH) and captive caribou at the University of Alaska Large Animal Research Station (LARS) were used to evaluate two well-documented tracers of the body water pool: tritiated water and C-14 urea. Tritiated water is used to measure the entire body water pool of the animal (i.e., alimentary water plus empty body water), whereas urea equilibrates only with the empty body water pool because urea is hydrolyzed during passage into the alimentary tract. Estimation of body composition is based on the relationship between body protein and empty body water pool size, and the inverse correlation between body fat and body water.

In addition to using these two tracers, a body condition index was developed using visual appraisal of the levels of fat over the pin bones and ribs. The possibility of extracting a small amount of muscle from the back line of the animal to assess fat content and of measuring back fat depth was evaluated. A bioelectrical impedance machine has been purchased to evaluate its accuracy for measuring the body water pool size.

Initial evaluation of these techniques has been carried out at the LARS in early 1989 and will continue in 1990 using animals dietarily manipulated to provide a wide range in body condition for technique evaluation.

In October 1989, caribou from the CAH were darted from a helicopter, immobilized, and tracer injected and sampled over a 30-minute period. Half of the study animals were then killed and a complete body composition measurement made. The other half of the study group was fitted with radio-collars and released to determine their survival and for future collection to make serial estimates of body condition once the calibration curves have been developed from the slaughtered animals.

Results to date indicate that for samples collected during the first 30 minutes post-injection, estimates of total body water using tritiated dilution varied within 1.5 to 15% of the estimate based on a complete analysis of the dilution curve

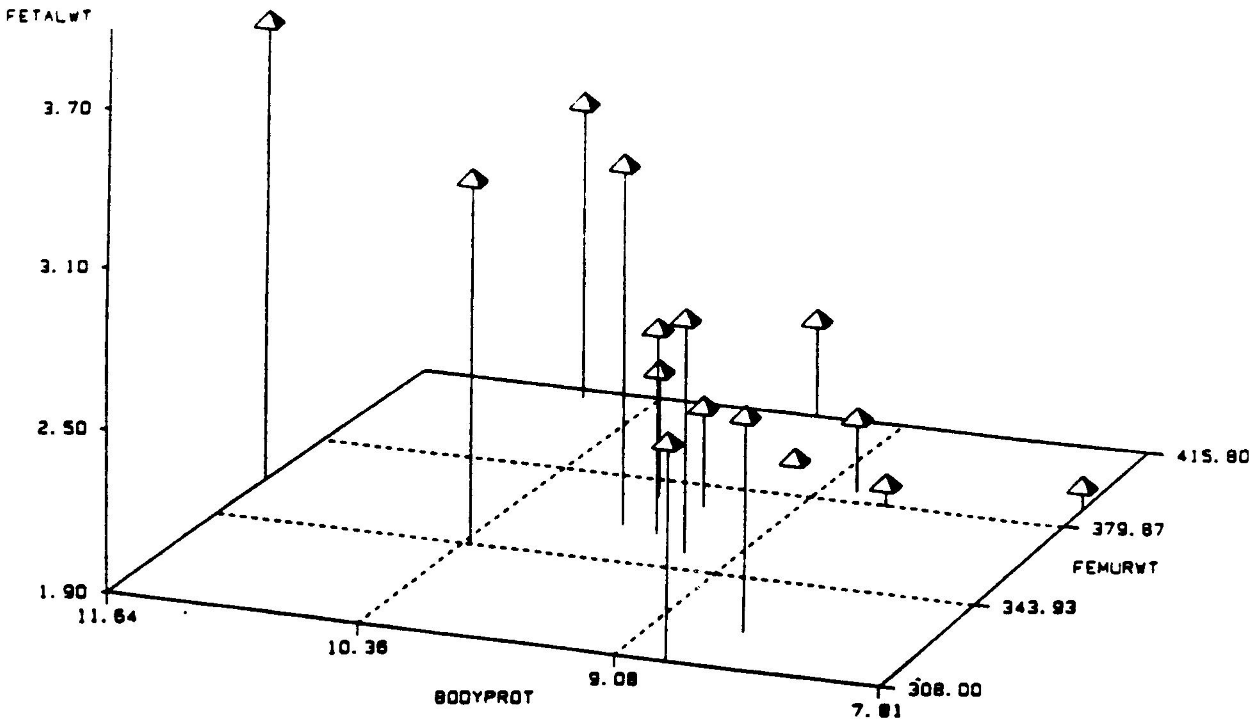

FIGURE 3. Effects of body protein (Kg) and femur weight (g) on fetal weight (Kg) in March/April.

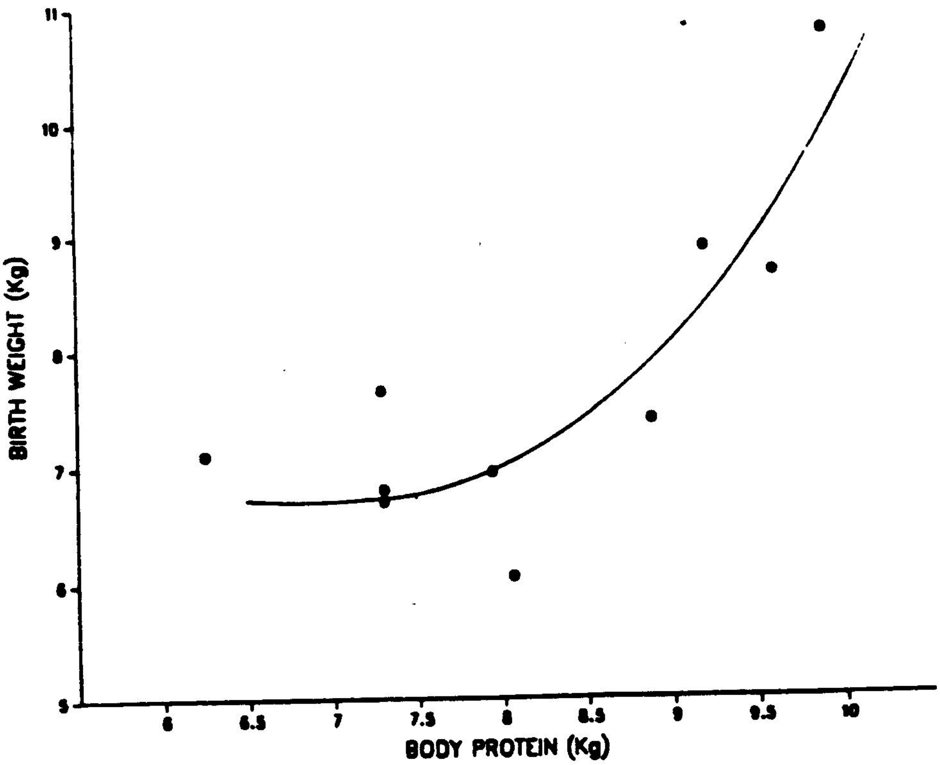

FIGURE 4. Effect of body protein (Kg) on birth weight (Kg) in June.

measured over several days. Estimation of empty body water using C-14 urea sampled over 30 minutes were within 1.8 to 5.1% of the estimate using a total curve analysis technique, i.e., measured over several hours. These results indicate the great potential for using both tracers under field conditions. The bioelectrical impedance equipment has not been field tested.

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TERRESTRIAL RESEARCH

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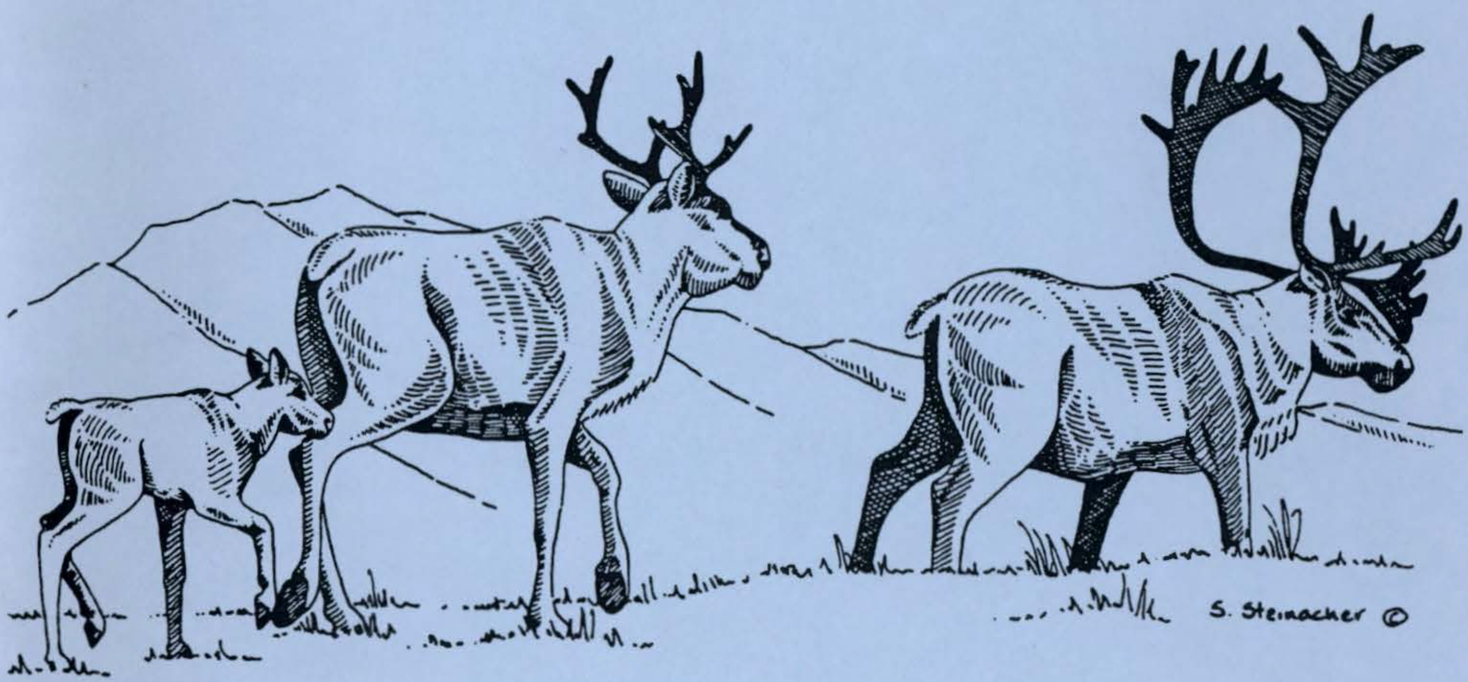

Annual Progress Report

Field Season - 1989

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