Growth rates and morphological measurements of Porcupine caribou calves

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Abstract: Body weights, leg lengths, and surface area were monitored for bottle-raised barren-ground caribou calves (*Rangifer tarandus granti)* from the Porcupine herd up to 1 year of age. Body weights were compared with maternally-raised calves from the same cohort in the wild and from the Delta herd. A successful feeding regime for bottle-raising caribou calves is presented.

Key words: surface area, growth rate, leg length, *Rangifer tarandus.*

Rangifer, 9 (1): 9—13

Parker, K. L. 1989. Veksthastigheter og morfologiske mål hos Porcupine karibu-kalver.

Sammendrag: Kroppsvekter, visse knokkel-lengder og kropps-overflate areal ble målt hos flaske-oppfødde kalver av barren-ground karibu *(Rangifer tarandus granti)* fra Porcupine-stammen opp til 1 års alder. Kroppsvekter ble sammelignet med normalt oppfødde kalver av samme type i det fri og fra Delta-stammen. Det presenteres et vellykket system for flaske-oppforing av karibu-kalver.

Rangifer, 9 (1): 9—13

Parker, K. L. 1989. Porcupine -lauman karibuvasojen kasvunopeus`ja morfologiset mitat.

Yhteenveto: Porcupine -lauman pulloruokinnalla olleiden tundrakaribuvasojen ruumiinpainot, jalanpituudet ja ruumiin pinta-alat mitattiin 1 vuoden ikäään saakka. Ruumiinpainoja verrattiin vastaaviin luonnonoloissa kasvaneisiin saman lauman ja Delta -lauman vasoihin. Tutkimus kuvaa toimivan vasojen pulloruokintamenetelmän.

Rangifer, 9 (1): 9—13

Introduction

The survival of young ungulates in the Arctic often depends on the interplay between animal vigor and the influence of energetic constraints such as decreased forage resources or increased energy expenditures. Body dimensions and their rates of change are a function of the requirements for energy conservation. Whereas the efficiency of locomotion in young animals increases with body weight and leg length (Parker et al. 1984, Luick and White 1986, Fancy and White 1987), the corresponding increase in body surface area results in an increase in heat loss (Moen 1973:263). The young neonate's level of nutrient intake (e.g., milk composition and volume) plays an important role in the adaptive balance of these cost-benefit functions (White and Luick 1984).

The objective of this study was to measure the changes in body measurements in barren-ground caribou *(Rangifer tarandus granti)* raised under controlled conditions to gain an understanding of the post-natal adaptability of this northern species.

Methods

Fourteen barren-ground caribou calves were obtained between 3 and 4 June 1987 from the Porcupine herd on calving grounds near Beaufort Lagoon, Arctic National Wildlife Refuge, Alaska. The animals, which were 1–2 days of age, were flown to the Large Animal Research Station (LARS), Institute of Arctic Biology, University of Alaska Fairbanks. Calves were initially raised in groups of 4 or 5 in small disinfected wooden stalls inside an unheated barn; concrete floors were covered with wood shavings. At 1.5 months of age, animals were placed in outdoor fenced pens (4.8 x 4.9 m) seeded with brome grass, containing a sheltered feeding and bedding area of wood shavings. The calves were allowed to run as a group several times daily in a larger paddock (5.0 x 29.3 m) adjacent to the smaller pens.

A milk formula was prepared similar to that used by Parker and Wong (1987) of homogenized whole cow's milk and lamb milk replacer (Land O' Lakes, Minneapolis, MN). The amount of air-dry replacer added to cow's milk was 10% of the milk weight. Powdered casein (3% of the milk weight; Erie Casein Co., Erie, IL) was also added to the formula. Estimates of dry matter, fat, and protein for this formula were 20.4%, 6.1%, and 5.1%, respectively; these estimates are all less than average values determined for *Rangifer* species (White and Luick 1984). A child's vitamin with iron supplement was crushed and added to the milk once daily.

The caribou calves were initially bottle-fed 5 times daily at a volumetric rate similar to that prescribed for black-tailed deer (Parker and Wong 1987). Immediate dietary-induced diarrhea occurred, however, and feeding times were increased to 7 daily (between 05.30 and 01.00) to accommodate the lactational strategy of a follower species (Carl and Robbins 1988). Volumes fed were reduced for each individual to levels that could be tolerated without gastrointestinal disturbance. Within 1–2 weeks, all animals were habituated to the dietary formula. Total daily amounts offered were increased until the first week of July, from which time onwards milk volumes and the number of feedings were reduced gradually. Animals received only 150 ml once daily by 5 September. This volume was slowly replaced with water and fed until 6 December to maintain and reinforce the social interaction with handlers. A summary of the successful feeding regime for all caribou calves is presented in Figure 1. Initial volumes fed were less than those measured in maternally-raised caribou calves, but volumes fed after 3 weeks of age were similar (K. L. Parker & R. G. White, unpub.).

Animals were given a commercial calf starter ration (Purina Calf Starter, Ralston Purina Mills, St. Louis, MO), iodized salt, fresh soil, and water *ad libitum.* At 4 months of age, the calves were also provided a livestock pellet mixture (Qual-Tex-16, Fors Farms, Puyallup, WA) and chopped brome hay, with daily ac-

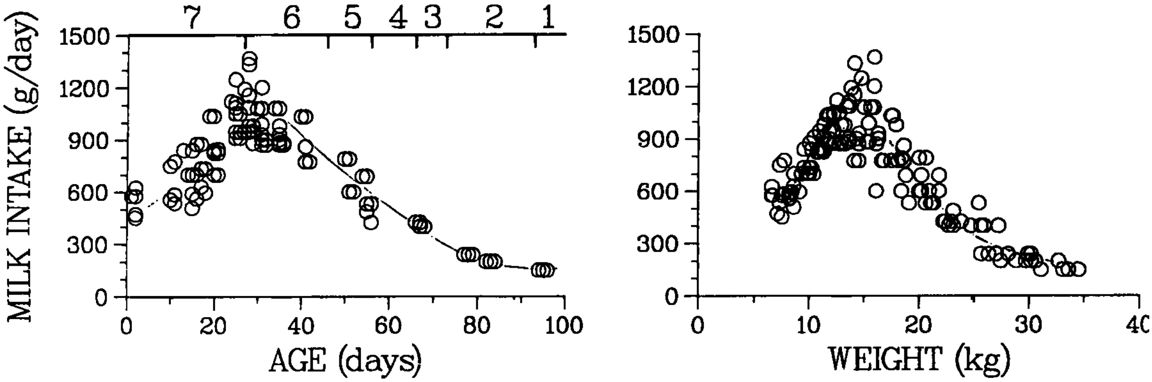

Figure 1. Milk volumes fed to Porcupine caribou calves in relation to age and body weight. Numbers at the top of the figure indicate number of feedings per day.

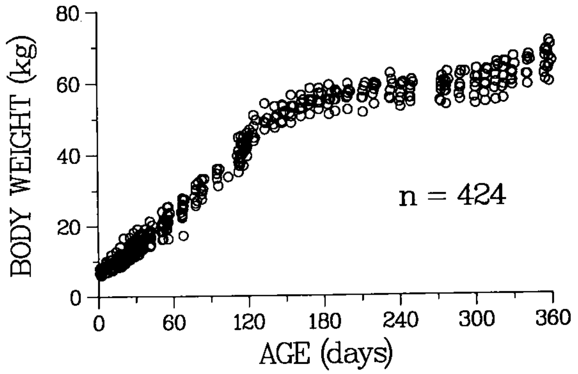

Figure 2. Body weight in relation to age of bottle-raised Porcupine caribou calves. Data are individual weights of 14 calves.

cess to brome pasture. Ground-growing lichens collected from nearby tundra areas were used as reward incentives.

Animals were weighed at 4 to 7-day intervals. Twenty-two body-surface measurements were taken to the nearest cm on standing, full-fed animals once or twice per month to calculate surface area (Moen 1973:263, 436). These values included circumferences and lengths of the nose, face, neck, ears, front and rear legs, and body. Brisket height, carpus or front knee height, and tarsus or hock height were also measured from the ground to the nearest cm and correlated with body weight. Four male calves were included in all measurements up to 2.5 months of age. Data gathered after this date (15 August 1987) were for female calves only.

Predictive curves for all variables were determined by nonlinear regression techniques (Dixon 1981). Differences in body weights of these Porcupine calves were compared graphically with Beverly Lake calves and with Delta calves using analyses of covariance. Tests of significance were at $P \leq 0.05$.

Results and discussion

Growth rates

Body weight increased rapidly until approximately 170 days of age (Fig. 2). Growth rates plateaued in mid-November and then increased again in late April.

Very limited data exist on the growth rates of free-ranging caribou calves. A few values presented by McEwan (1968) suggest that growth rates of very young wild barren-ground caribou calves *(Rangifer tarandus groenlandicus)* from Beverly Lake, Northwest Territories, Canada did not differ from those of maternally-raised calves from the same herd kept in captivity. After 5 months of age, however, the captive calves continued to gain weight while wild calves lost weight and were restricted in growth throughout the following summer. Growth rates of the hand-reared Porcupines calves of this study up to 3 months of age were similar to those noted above. After 5 months of age, they were all larger than both wild and captive barren-ground caribou calves from Beverly Lake.

Eight weights of maternally-raised calves from the same Porcupine herd cohort (K. R. Whitten, unpub.) showed that at approximately 93 days of age, 2 field-caught calves (Old Crow, Yukon Territory) were of very similar weights (34.0, 36.7 kg) and 2 (45.4, 47.9 kg) were 10 to 15 kg heavier than the hand-reared animals. At approximately 176 days of age, all field-caught calves (52.3, 53.2, 53.2, and 54.6 kg; Eagle Plains, Yukon Territory) were within the weight range of the bottle-raised calves. This comparison should be qualified in that the age of the free-ranging animals was not known but was based on the average calving date for this herd (3 June). Nonetheless, the feeding and rearing conditions of the caribou calves in this study appear equivalent with respect to weight development to those raised naturally. Furthermore, adverse environmental constraints do not appear to have influenced the growth rates of free-ranging calves before 6 months of age.

Another comparison can be made between calves of the Porcupine herd and those of the Delta caribou herd. The growth rates of 4 maternally-raised Delta calves born in captivity at the LARS (R. G. White & K. L. Parker, unpub.) were significantly greater than those of the hand-reared Porcupine calves; body weights attained during the weightstable months in winter were approximately 9 kg heavier. Delta herd caribou calved 3 weeks before those of the Porcupine herd. A feasibly higher-quality nutrition provided by maternal milk and a 3-week earlier access to spring forage at a time of maximum calf growth rate may have contributed to the differences between the 2 herds. The winter plateau in calf body weight, however, occurred at approximately 170 days of age in all calves from both herds (e.g., Fig. 1), regardless of birth date. This suggests a physiological time limit to weight gain. Klein et al. (1987) documented a latitudinal cline in body size, noting that members of the Delta herd tend to be larger than those of the Porcupine herd. The extent to which genetic influences may affect

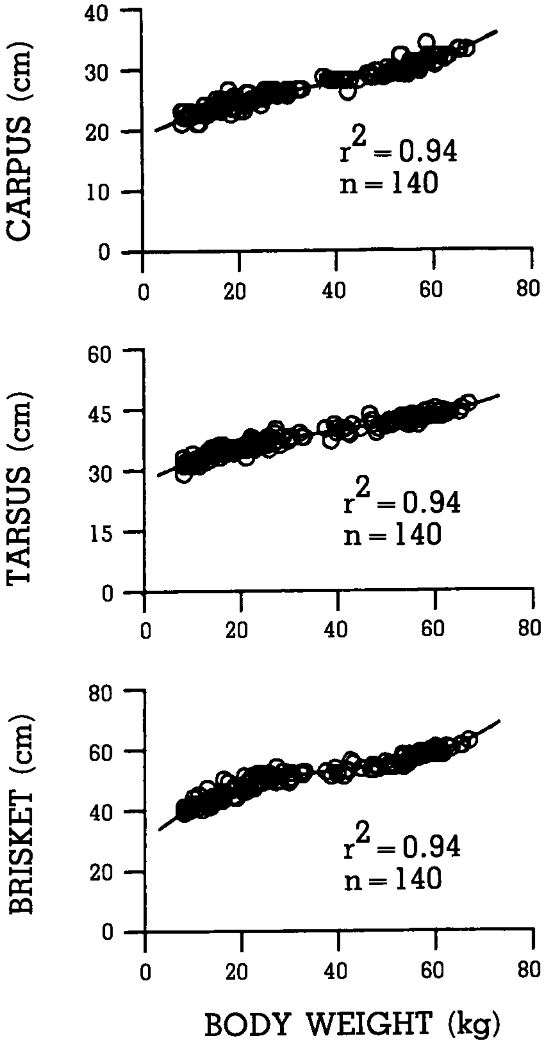

Figure 3. Leg lengths (Y) of Porcupine caribou calves in relation to body weight (X) in the range of 5 to 70 kg, described by the following regressions:
Carpus height (Y) = 18.816 + 0.409X − $0.00753X^2$ + $0.0000698X^3$
Tarsus height (Y) = 27.178 + 0.590X − $0.0104X^2$ + $0.0000845X^3$
Brisket height (Y) = 29.818 + 1.405X − $0.0313X^2$ + $0.000264X^3$

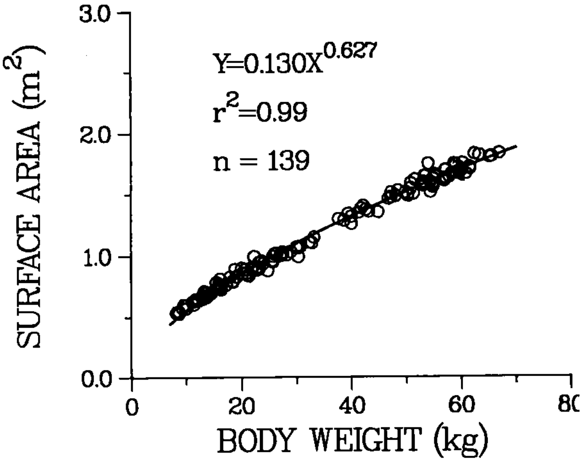

Figure 4. Surface area in relation to body weight of Porcupine caribou calves.

absolute body size in caribou from these 2 herds is unknown. With subject animals held in captivity on similar nutritional regimes and under the same environmental constraints, genetic influences on calf growth rate and absolute body size are now being addressed in long-term studies at the LARS.

Morphological measurements

Brisket, tarsus, and carpus heights increased asymptotically as a function of body weight (Fig. 3). All 3 parameters increased by approximately 30% in the first 4 months of life and continued increasing throughout the first year. At 12 months of age, average brisket height ($\bar{x} \pm SD$ = 59.9 ± 1.8 cm) was approximately 96% of that measured on adult Delta animals (1.5 - 4.5 years; 83–124 kg; $\bar{x}$ = 62.7 ± 2.4 cm; Fancy and White 1987). Major advantages to the young caribou in attaining a maximum leg length as quickly as possible include decreased net energy costs of locomotion over the long distance of spring and fall migrations (Luick and White 1986), reduced energy expenditures travelling through snow (Fancy and White 1987), increased efficiency of foraging through snow of various depths (Fancy and White 1985), and fleetness related to predator avoidance. These energetic advantages are particularly important to the young calf with its relatively higher energetic costs for maintenance and locomotion compared with older animals in the herd.

Surface area increased with body weight (Fig. 4). Although smaller animals have a greater potential than larger ones to lose heat to cold environments due to a greater surface area to volume ratio, caribou calves have minimized this heat loss compared with that of cervid counterparts in more temperate regions such as mule deer (*Odocoileus hemionus hemionus;* Parker 1987) and white-tailed deer (*O. virginianus;* Moen 1973:263). For example, at the same body weight in early winter (e.g., 30 kg), caribou (1.097 m^2) have 10% less surface area available for heat exchange with the environment than do deer fawns (1.209 m^2). A reduced surface area and a greater pelage insulation provide energetic benefits to cervid neonates in arctic climates.

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