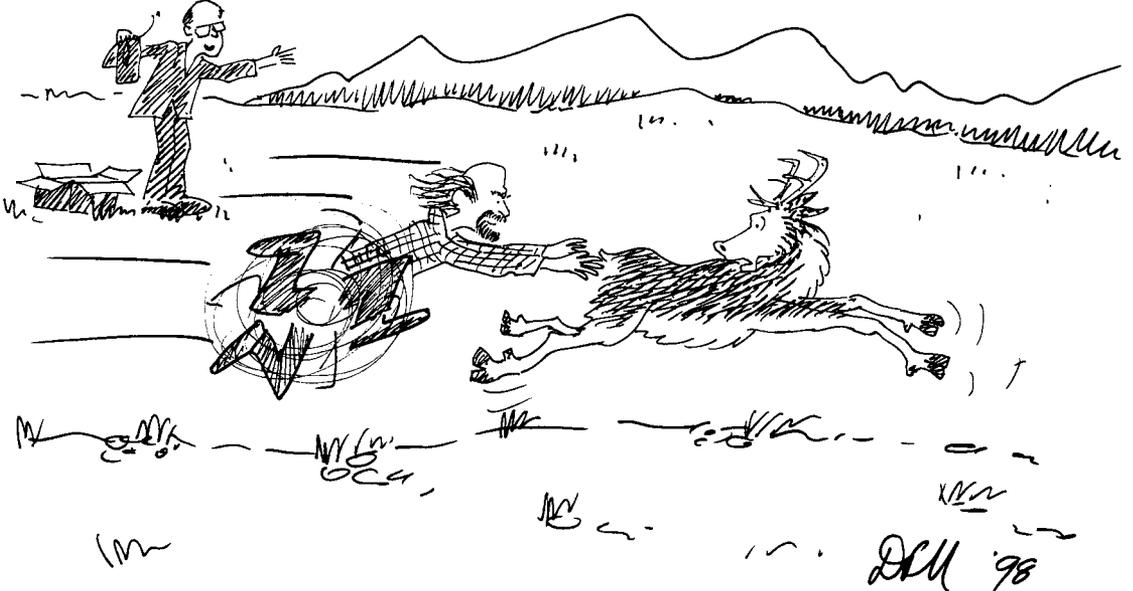


Session one

Population Dynamics

COST EFFECTIVE MEANS OF COLLARING
FORTY MILE CARIBOU

OKAY CRAIG! THAT'S
THE LAST ONE!!



Reproductive performance of female Alaskan caribou

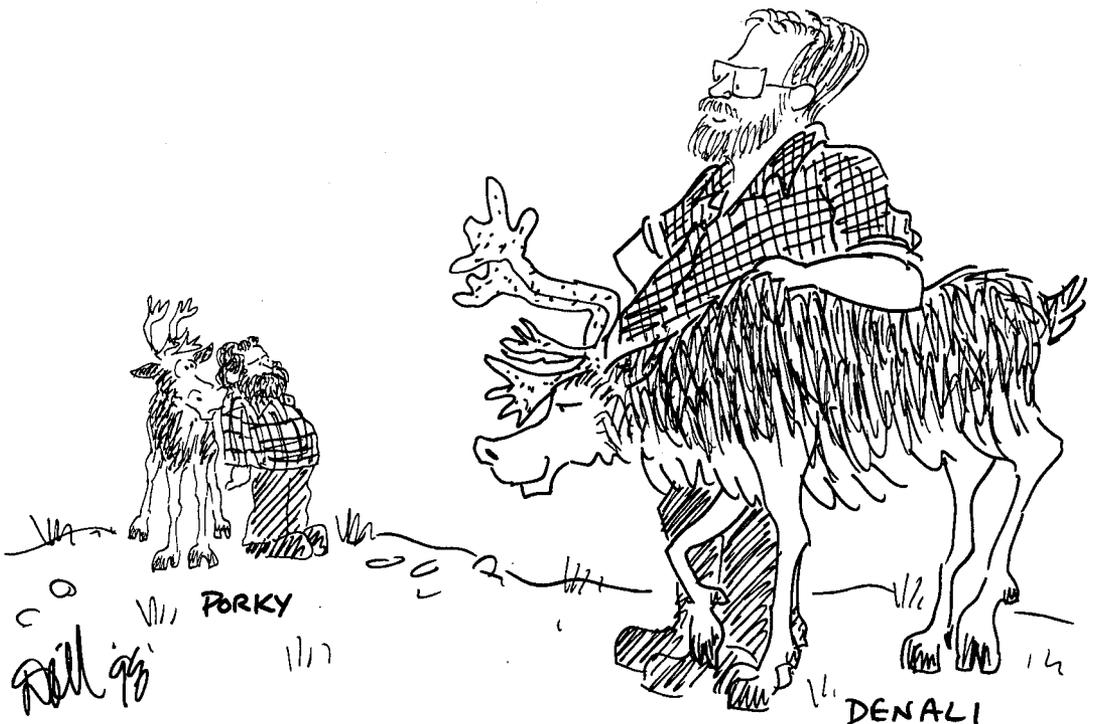
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Abstract: We examined the reproductive performance of female barren-ground caribou (*Rangifer tarandus*), in relation to age, physical condition and reproductive experience for 9 consecutive years (1987-95) at Denali National Park, Alaska, during a period of wide variation in winter snowfall. Caribou in Denali differed from other populations where reproductive performance has been investigated in that they occur at low densities ($\leq 0.3/\text{km}^2$) and experience high losses of young to predation. Average annual natality rates increased from 27% for 2-year-olds to 100% for 7 year-olds, remained high for 7-13-year-olds (98%), then declined for females ≥ 14 . Females ≥ 2 years old that failed to reproduce were primarily sexually immature (76%). Reproductive pauses of sexually mature females were rare (6%) and occurred predominantly to young (3-6 years old) and old (≥ 14 years old) females. Natality increased significantly ($P < 0.05$) with body mass of 10-month-old females weighed 6 months prior to the autumn breeding season, and of females > 1 year old weighed during autumn (late September-early November). Natality for 2-, 3-, 4-, and 6-year-olds declined significantly with increasing late winter snowfall (February-May) during the winter prior to breeding. Because influences of weather on productivity were limited to young age-classes and adverse weather also decreased recruitment, population productivity was affected more by changes in population age-structure, than by age-specific productivity.

SIZE CORRELATION BETWEEN BIOLOGISTS AND THEIR STUDY HERDS N=2



Sex, age, and condition of wolf-killed caribou

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Abstract: We compare the sex, age, and condition of caribou killed by wolves with caribou killed by hunters, and estimates of herd composition. These comparisons provide insight into selectivity and predation characteristics of wolves on barren-ground caribou. We investigated 205 kills after wolves had left the kill site and examined 65 hunter killed caribou. Of 124 known-sex kills, males comprised 45% of caribou killed by wolves. Ageclass could be determined for 171 caribou kills, of which calves comprised 17% of wolf-killed caribou. Herd composition surveys indicated available proportions of 57% cows, 14% calves, and 29% bulls. Although confidence intervals were wide, selection by wolves for calves and adult males was suggested. Sex of wolf-kills did not vary by season (March *vs.* November) in this study, although the test was weak due to small sample sizes. Hunters killed primarily adult females and the hunter kill may therefore reasonably approximate the availability of full-grown (>3) adult females. Wolves killed proportionally more old (ages ≥ 8) caribou than in the hunter-killed sample (2X2 Chi-square=6.58, $P=0.010$). While the old *vs.* young categorization is arbitrary, chi-square analyses were still significant if the cut off age was moved one year in either direction. This pattern of selectivity is consistent with that reported for other species. The comparison of physical characteristics by cause of death was limited to adult females because sample sizes for bulls and calves were insufficient. Sample sizes for wolf-killed adult females ranged from 10-12 resulting in low power of statistical comparisons. Only mean diastema length varied significantly by cause of death ($P=0.031$). However, means for all parameters were consistently lower for wolf-killed caribou suggesting increased vulnerability of small individuals to wolves. Trends were identical for full-grown females (>3 years of age). Wolf-killed adult female caribou had significantly lower marrow fat ($\bar{x}=67\%$, $s=0.319$, $n=12$) than hunter-killed adult females ($\bar{x}=90\%$, $s=0.048$, $n=52$). Three of the wolf-kills had very low marrow fat (<25%) that likely had a strong influence on means. None of the 52 hunter-killed adult females had less than 30% marrow fat. Sample sizes are small and controls only roughly reflect availability. Nonetheless, this analysis suggests that selectivity by wolves among caribou sex and age classes is similar to that shown for other ungulates.

SEX, AGE (AND HEAD) OF CARIBOU KILLED BY WOLVES



The Western Arctic caribou herd: current status and management issues

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Abstract: As of July 1996, the Western Arctic herd numbered approximately 463 000 caribou (*Rangifer tarandus*). This herd last peaked at 243 000 caribou in 1970, then declined to about 75 000 by 1976. From 1976 to 1990, this herd grew approximately 13% annually. Since 1990, growth has been about 2% annually. Annual indices of recruitment and adult cow mortality collected since the early 1980s appear consistent with this population trend. Since 1990, annual subsistence and sport harvests have been roughly 20 000 and 1000-3000 caribou, respectively. Biological issues currently facing the Western Arctic herd include: 1) body condition and its relationship to instances of severe, localized fall and winter mortality; 2) potential effects of disease and environmental contamination on caribou and people who subsist on them; and 3) potential range deterioration. Social issues include: 1) mutual trust and exchange of information between managers and users; 2) diverse, complex and sometimes competing demands among subsistence users, sport hunters, commercial operators and nonconsumptive users of Western Arctic caribou; 3) expansion of caribou into reindeer ranges; 4) conflicts with muskoxen management; and 5) antler sales and a proposed commercial harvest of caribou for meat. Technical issues center on monitoring a population this large over its expansive range. The political issue of dual state-federal management of wildlife in Alaska overlays all biological and social considerations. Comanagement is currently being explored to meld biological, social and political aspects of managing the Western Arctic herd.

Effects of recent climate warming on caribou habitat and calf survival

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Abstract: Recent investigations of global climate change have focused on temperature, gas and nutrient flux, and vegetation, microbial, and invertebrate response. Potential effects of climate change on terrestrial vertebrates have been the subject of much speculation, but quantitative assessment has been limited by the lack of long term habitat and population data. As the dominant large herbivore in arctic regions, migratory barren-ground caribou (*Rangifer tarandus granti*) are likely to respond to global climatic changes that affect temporal and spatial variability of their forage resources. The Normalized Difference Vegetation Index (NDVI) derived from the Advanced Very High Resolution Radiometer (AVHRR) on board National Oceanic and Atmospheric Administration (NOAA) polar orbiting satellites offers the opportunity to assess large scale habitat conditions for caribou and other vertebrates during the growing season. Here we present a predictive equation relating early survival of caribou calves and NDVI at calving and the post-calving rate of increase in NDVI during 1985-1996. Because small changes (~5%) in survival of caribou calves can determine whether a population grows or declines, the relationship between calf survival and vegetation biomass and rate of vegetation growth may be used to predict effects of habitat restriction on caribou populations.

Responses of the Aishihik caribou herd to reduced wolf predation and harvest restrictions: an adaptive management experiment in the Yukon

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Abstract: Since 1992, we have studied population responses of woodland caribou (*Rangifer tarandus caribou*) moose (*Alces alces*) and Dall sheep (*Ovis dalli*) to a reduction of wolf (*Canis lupis*) numbers and harvest restrictions in the Aishihik area of southwest Yukon. We annually reduced wolf numbers in a 20 000 km² area to about 20% of the original population. Caribou hunting was closed from 1991 to present. Four caribou population parameters are being studied in both treated and untreated herds: calf recruitment, adult sex composition, population size and adult survival. Calf recruitment and adult sex composition are being compared in the treated Aishihik herd against three untreated woodland caribou herds of similar size in the southern Yukon and along the Alaska border. Population rates of change and adult survival are being compared between the Aishihik herd and the Wolf Lake herd, an intensively studied untreated herd. We are testing for differences in the rate of increase between these two herd sizes during the past five years using stratified random quadrat survey techniques. We are also testing for differences in adult survival rates using samples of 82 radio-tagged caribou in the Aishihik herd and 72 in the Wolf Lake herd. We believe that wildlife biologists can learn from manipulations of wolf-prey systems by testing hypotheses using an experimental design approach. Large scale wolf-ungulate experiments are inherently confounded by problems with treatment interspersion, pseudoreplication error and other spatial constraints. We are attempting to solve these problems using a deductive statistical approach that best explains the nature of woodland caribou responses to wolf predation and harvest treatments.

Estrous synchronization and early pregnancy

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Abstract: Previously, in a subsample of wild Porcupine caribou, blood samples collected at approximately 20-41 days post breeding, were positive for Pregnancy Specific Protein B (PSPB) but had baseline progesterone levels. This same group of females were also in very poor body condition leading to the interpretation that the cows conceived but underwent early embryonic loss (Russell *et al.*, 1998. *J. Wildl. Manage.*, in press.). The objective of this study was to validate the use of combined progesterone and PSPB as an indicator of early embryonic loss and to characterize the behavior of PSPB protein in caribou/reindeer plasma. We report here the preliminary progesterone results. At the Large Animal Research Station, UAF, 7 caribou and 7 reindeer were administered prostaglandin 5 days after antler cleaning, to synchronize estrus, and again 7 weeks later to abort the embryo. After the first injection the cows were penned with bulls for 5 days. Blood samples were collected twice weekly for 11 weeks from these cows and from 5 non-bred, non-injected control cows (3 reindeer, 2 caribou). All blood was assayed for progesterone. Two of 7 reindeer and 5 of 7 caribou became pregnant. The remaining 7 animals failed to come into first estrus prior to harem formation. The non-bred reindeer underwent a small short cycle followed by 2-3 regular 21 day estrous cycles. In all pregnant animals, progesterone remained elevated, declining immediately to baseline (0.5 ng/ml) upon prostaglandin injection. All these cows returned to estrus. Prostaglandin is an effective luteolysin in *Rangifer* when a corpus luteum is present. The failure to synchronize estrus in 7 females appears to be a consequence of late onset of estrus activity. We know that rising estradiol is responsible for antler cleaning in female *Rangifer*. However, the association of antler cleaning with onset of estrus was variable in this study. The late onset of estrus may be a consequence of keeping the females separated from bulls.

Surviving in the north – a conceptual model of reproductive strategies in arctic caribou

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Abstract: Arctic and sub-arctic *Rangifer* populations have evolved in an environment characterized by long, cold winters and short growing seasons. Available resources, such as digestible nitrogen, are limited in time and space. Post parturient females must balance the requirement to replenish protein and fat reserves depleted during the winter with producing sufficient high quality milk to ensure over winter survival of her calf. This trade-off manifests itself in the allocation of energy above maintenance and activity, the partitioning of protein and fat deposition and the timing of weaning. From sequential captures of over 200 individual caribou between 1992 and 1994, the authors developed a conceptual model to evaluate implications of resource allocation to population dynamics in *Rangifer*. *Post-natal weaning* occurs when plant biomass during the first week in June, and rate of plant growth over the next three weeks, are insufficient to maintain growth rates in the calf (see Griffith *et al.*, this meeting). Upon weaning the calf dies. The cow increases in body weight and potential pregnancy (Gerhart *et al.*, 1997. *J. Zool.* 242: 17-30) and birth rate (Cameron & Ver Hoef, 1994. *J. Wildl. Manage.* 58: 674-679). *Summer weaning*, from our observations, occurs when cow protein reserves fail to be replenished. The most likely cause is accidental injury or disease in the cow as we consider nitrogen availability not limiting in the summer range of the Porcupine caribou herd (PCH). Upon weaning the calf dies. An increase in pregnancy rate is likely for the cow. *Early-autumn weaning* occurs when the fat reserves of the cow are below a specified threshold primarily due to a combination of the factors listed above and a particularly bad insect year. The survival rate of the calf declines and the age of first reproduction of the calf is likely advanced. For the cow this strategy increases her chance of pregnancy and enhances her survival through winter. *Extended lactation* is common in the PCH (Gerhart *et al.*, 1997. *Ibid*) and is associated with low fat reserves in the calf at or about early winter. As a consequence, the cow suffers reduced probability of pregnancy due to "lactational infertility" but increases the survival of her calf. Weaning is assumed for the following spring-summer. *Normal weaning*, which is initiated during the rut, results in high pregnancy rates for the cow. In this latter case both cow and calf have healthy levels of fat and protein reserves. The implication of these strategies is discussed in relation to industrial development and climate change, a potential challenge to *Rangifer* herds throughout the circumpolar north.