# Effects of Recent Climate Warming on Caribou Habitat and Calf Survival

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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 development of substantive predictive models 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 in 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 is positively related to green plant biomass in arctic regions. This relationship allowed us to assess a decade-long temporal trend in large-scale habitat conditions for caribou during the growing season.

We observed a 2° C increase in June temperatures at four stations on the Alaska arctic coastal plain during 1950-1994. In addition, there has been a linear increase in the estimated NDVI on 21 June on the calving ground of the Porcupine caribou herd ($r^2 = 0.70$) during 1985-96. We used this information, and estimates of June calf survival for the Porcupine caribou herd, to derive an empirically based predictive equation relating early survival of caribou calves to NDVI and the postcalving rate of increase in NDVI during 1985-1996. Calf survival during June was not related to previous winter severity ($P = 0.38$) or current exposure to predation ($P = 0.40$). However, 85% of the variation in June calf survival was explained by NDVI at calving and the subsequent rate of increase in NDVI (Survival = 0.33 + 2.11*NDVI + 21.16*NDVIrate; $P = 0.006$, $r^2 = 0.85$). Most (50%) of the variance in calf survival was explained by NDVI at calving.

During the recent warming trend that began in the late 1970s in arctic regions, all four herds of caribou that calve on the Alaska arctic coastal plain have increased. We conclude that there is a positive climate warming signature in summer arctic temperatures, forage available for lactating caribou and June calf survival for the Porcupine caribou herd, and in

20-year population trends for four Alaska arctic caribou herds. Because small changes (~7%) 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.

# Program and Abstracts

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