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Expanded abstract

The role of seasonal migration in the near-total loss of caribou on south-central Canadian Arctic Islands

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In 1980 the caribou (*Rangifer tarandus*) on Prince of Wales, Russell, and Somerset islands represented a healthy geographic population of an Arctic-island caribou ecotype on the southern tier of Canadian Arctic Islands. Those caribou exhibited complex patterns of seasonal range occupancy, involving annual seasonal migrations between and among the three islands and Boothia Peninsula (Miller *et al.*, 1982, 2005; Miller, 1990). A large segment of the population migrated annually from the islands to Boothia Peninsula in early winter, wintered there, and then returned to the islands in the following late winter and spring. There is no evidence for large-scale emigration of caribou anywhere in the study area (Gunn *et al.*, 2006).

Caribou on Boothia Peninsula occur as two distinct ecotypes that are genetically different from the Arctic-island ecotype that occurred on Prince of Wales, Russell, and Somerset islands (e.g., Zittlau, 2004). Both the Boothia Peninsula ecotype and the Mainland ecotype calve mostly on northern Boothia Peninsula, northwest and northeast sections respectively (Gunn *et al.*, 2000). After summering on the peninsula, most individuals of both ecotypes migrate south of the Boothia Isthmus onto adjacent mainland areas (Gunn *et al.*, 2000). As a result, there were about the same number of caribou wintering on Boothia Peninsula when migrant caribou from Prince of Wales, Russell, and Somerset islands wintered there, as in summer when the migrant Arctic-island caribou had returned to Prince of Wales, Russell, and Somerset islands and the migrant Boothia Peninsula and Mainland caribou ecotypes had returned from their winter ranges farther south on the mainland to their calving areas and summer ranges on Boothia Peninsula. We treat both caribou ecotypes on Boothia Peninsula as just one geographic population for our assessment.

The Arctic-island caribou ecotype on Prince of Wales, Russell, and Somerset islands declined about 98% from the estimated 5097 1+ yr-old caribou in 1980 to fewer than 100 1+ yr-old caribou in 1995 (Gunn & Decker, 1984; Miller, 1997; Gunn & Dragon, 1998; Gunn *et al.*, 2006). This loss of caribou on those islands amounts to a near-total loss of a genetically distinctive group of Arctic-island caribou (e.g., Zittlau, 2004). In contrast, the estimated number of caribou in the geographic population on Boothia Peninsula appeared to increase by 1.4-fold from 4831 to 6658 1+ yr-old caribou between 1985 and 1995, although annual harvesting pressure was heavy. It was biologically impossible for the Boothia Peninsula geographic population at its 1985 estimated size to have persisted until 1995, let alone to have increased, under the estimated average annual harvest regime of 1100 1+ yr-old caribou • yr⁻¹. There is no evidence that the Boothia Peninsula population was underestimated in 1985. It would have required a population in 1985 at least twice as great as the calculated estimate to sustain the estimated annual harvest between 1985 and 1995. An underestimate of such magnitude is too great to be probable.

In our examination of the survey results, we could find no reason to question that the calculated population estimates were not reasonable approximations. The fixed-wing aerial surveys in 1980 (Gunn & Decker, 1984), 1985 (Gunn & Ashevak, 1990), and 1995 (Gunn & Dragon, 1998) were highly comparable, well designed and executed, using standard procedures for a fixed-width, strip-transect, systematic aerial survey of caribou. One of the two observers was the same experienced survey biologist in all 3 years, the second observer in 1980 was an experienced survey biologist and in 1985 and 1995 was an experienced Inuit hunter familiar with the area, and the pilot was the same on all surveys and had flown many systematic surveys of caribou on the Canadian Arctic Archipelago and mainland Canada.

Helicopter searches of known caribou ranges on Prince of Wales, Russell, and Somerset islands that were carried out in late winter 1996 under ideal viewing conditions yielded only two caribou on Somerset Island and none on Prince of Wales Island or Russell Island (Miller, 1997). In 2004, a combination aerial and ground survey of caribou by the Nunavut Wildlife Service, using a helicopter and snowmobile-mounted Inuit observers, failed to find even one caribou or any recent sign of caribou on Prince of Wales and Somerset islands (Gunn *et al.*, 2006).

Gunn *et al.* (2006) found no evidence that an absolute shortage of forage, relative unavailability of forage due to extreme snow and ice conditions, intraspecific competition with muskoxen (*Ovibos moschatus*), large-scale emigration,

widespread disease, or heavy parasite burdens played a major role in the near-total loss of caribou on Prince of Wales, Russell, and Somerset islands. They did, however, conclude that both wolf (*Canis lupus*) predation and hunting on Prince of Wales, Russell, and Somerset islands most likely contributed to and deepened the final stage of the decline. The role of annual seasonal migration between the islands and Boothia Peninsula was not considered by Gunn *et al.* (2006). Therefore, we investigated how annual seasonal migration of the Arctic-island caribou ecotype from Prince of Wales, Russell, and Somerset islands to Boothia Peninsula could have played the major role by providing a yearly ongoing supply of caribou “recruits” on Boothia Peninsula to buffer the heavy annual harvest of caribou there.

We carried out a series of multiple analyses of required population structure, required proportion of females producing calves, required proportion of calves surviving to yearlings, allowable annual harvest, and resultant annual harvest shortfall (the number of caribou lost annually at the estimated level of annual harvest or the number of additional caribou required annually from beyond Boothia Peninsula to sustain the annual harvest) in relation to the required size of the 1985 caribou population on Boothia Peninsula. We derived the annual harvest estimates from data presented in Gunn *et al.* (1986) and Jingfors (1986), which yielded a per capita mean annual harvest of 3.1 caribou • person⁻¹ • yr⁻¹ throughout the Kitikmeot region and at Taloyoak. We believe the extrapolated annual harvest estimates are conservative, as we did not inflate them to account for the 1.6-fold increase in the human population at Taloyoak between 1980 and 1995 and the Inuit hunters did not report any lack of caribou or hardships in obtaining them during that time.

Inuit hunters prefer the meat of Arctic-island caribou to that of either the Boothia Peninsula ecotype or the Mainland ecotype. Thus, individuals of the Arctic-island caribou ecotype were shot each winter while they wintered on Boothia Peninsula in preference to both the Boothia Peninsula and the Mainland caribou ecotypes. Although caribou are killed year-round and there is no restriction on how many can be killed, most caribou hunting takes place during winter, when hunters can travel longer distances and haul carcasses back to the settlements more easily by snow machines.

Our analyses and assessment of the changes over time in the sizes of the two caribou populations under consideration led us to three primary conclusions. 1) It was biologically impossible for the 4831 1+ yr-old caribou estimated on Boothia Peninsula in 1985 to have sustained the estimated average annual harvest of 1100 1+ yr-old animals for 10 years: the caribou population on the Boothia Peninsula would have been in a steady state of decline and, with the population performing at expected levels, would have been reduced to a remnant or even extirpated as early as 1992. 2) Although the estimated harvest level was unsustainable by the Boothia Peninsula population, the decline was masked by an annual winter infusion of the migrant Arctic-island caribou ecotype from Prince of Wales, Somerset and Russell islands onto Boothia Peninsula during the peak annual hunting period: without the infusion of caribou from the islands, the Inuit of Taloyoak could only have realized, on average, about two-fifths of the estimated annual harvests between 1985 and 1995 without the Boothia Peninsula population entering into a steady state of decline. 3) Migrant Arctic-island caribou from Prince of Wales, Russell, and Somerset islands wintered each year on Boothia Peninsula and this resulted in the persistence of caribou on the Boothia Peninsula, but led to the simultaneous near-demise of the caribou in the Prince of Wales, Russell, and Somerset islands geographic population.

The caribou resource within the entire Prince of Wales-Russell-Somerset islands-Boothia Peninsula complex must be managed as a single unit. Effective management is not possible without ongoing assessment of the annual harvest combined with periodic monitoring of population size being carried out on all of those three islands and on Boothia Peninsula at the same times. To date this has not happened.

A serious effort should be made to obtain annual harvest statistics yearly and population estimates every 3 years. The interval between population surveys could be stretched to 5 years if the budget demands it, but 6-10 years or more between surveys should be viewed as totally unacceptable. All population surveys should be carried out in July, to obtain population estimate and sex and age composition of the population at the same time during each year and long enough after June calving to get a good measure of the early survival of calves. If any evidence is obtained for large-scale ingress or egress, the population should be surveyed the following July and the magnitude and direction of population change determined and evaluated in relation to current annual harvest estimates. The population should be surveyed the following July after every exceptionally severe winter when a major die-off is probable due to extremely unfavorable snow and ice conditions.

All responsible parties (renewable resource agencies and Inuit users) must have the will to act on the findings obtained from the monitoring efforts. Most importantly, they must take the necessary actions in a timely manner, if the findings indicate that the Boothia Peninsula caribou population is in a state of decline. Setting hunting regulations and enforcing harvest limits that are not agreed to by the Inuit users is not practical; therefore, only self-restraint by Inuit hunters will safeguard this valuable renewable caribou resource. The conservation of this hunted caribou population is complicated because preserving only a relatively few caribou is not a satisfactory goal. There must be enough caribou in the population to sustain the desired level of annual harvest or the annual harvest must be quickly adjusted downward to the sustainable level. Otherwise, with a steadily growing human population at Taloyoak, the future of the geographic population of caribou on Boothia Peninsula is not promising and most likely its continual use as a valuable renewable resource is in jeopardy. For further details on this subject see Miller *et al.* (2007).

Key words: Canadian Arctic, caribou harvest, population decline, *Rangifer*, seasonal migrations.

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