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Annual Arctic Wolf Pack Size Related to Arctic Hare Numbers

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ABSTRACT. During the summers of 2000 through 2006, I counted arctic wolf (*Canis lupus arctos*) pups and adults in a pack, arctic hares (*Lepus arcticus*) along a 9 km index route in the area, and muskoxen (*Ovibos moschatus*) in a 250 km^2 part of the area near Eureka (80˚ N, 86˚ W), Ellesmere Island, Nunavut, Canada. Adult wolf numbers did not correlate with muskox numbers, but they were positively related ($r^2 = 0.89$; $p < 0.01$) to an arctic hare index. This is the first report relating wolf numbers to non-ungulate prey.

Key words: arctic hare, *Lepus arcticus*, wolf, *Canis lupus arctos*, Ellesmere Island, muskoxen, *Ovibos moschatus*, population dynamics, predator-prey relations, predation

RÉSUMÉ. Pendant les étés 2000 à 2006, j'ai compté les jeunes loups arctiques et les adultes (*Canis lupus arctos*) d'une bande, les lièvres arctiques (*Lepus arcticus*) le long d'une route indexée de 9 km dans la région, et les bœufs musqués (*Ovibos moschatus*) dans une zone de 250 km^2 près d'Eureka (80˚ N, 86˚ O), sur l'île d'Ellesmere, au Nunavut, Canada. Le nombre de loups adultes ne corrélait pas avec le nombre de bœufs musqués, mais il était relié de manière positive ($r^2 = 0{,}89$; $p < 0{,}01$) à un index de lièvres arctiques. Il s'agit du premier rapport établissant un lien entre le nombre de loups et des proies non ongulées.

Mots clés : lièvre arctique, *Lepus arcticus*, loup, *Canis lupus arctos*, île d'Ellesmere, boeufs musqués, *Ovibos moschatus*, dynamique de la population, relations prédateur-proie, prédation

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INTRODUCTION

An important question in the field of wolf-prey relations is what factor or factors determine the trajectory of a wolf population (Fuller et al., 2003). Conceptually, biomass of vulnerable prey was proposed as the primary factor influencing year-to-year changes in wolf numbers (Packard and Mech, 1980), but in various areas that factor took several forms. On Isle Royale, it was the number of old moose (*Alces alces*) in any year that determined the number of wolves the next (Peterson et al., 1998). In the Superior National Forest from 1968 to 1978 (Mech, 1990) and in Denali Park, Alaska (Mech et al., 1998), snow depth affecting vulnerability of primary prey determined wolf numbers. Later in Minnesota, the change in wolf population was related to seroprevalence of canine parvovirus (Mech and Goyal, 1995), showing that wolf numbers are not always related to vulnerable prey biomass. Such findings are few and disparate, and no similar information is available for wolves in the Arctic. In this study, I document the relationship between the population trajectory of an arctic wolf pack and an index to arctic hare (*Lepus arcticus*) numbers.

STUDY AREA

I studied wolves and their primary prey, muskoxen (*Ovibos moschatus*) and arctic hares, in the Eureka area of Ellesmere Island (80˚ N, 86˚ W), Nunavut, Canada. The study area included the region of the Fosheim Peninsula in a 180˚ arc north of Eureka, from Eureka Sound to Remus Creek, and from Slidre Fiord to Canon Fiord. It included shoreline, hills, lowlands, creek bottoms, and the west side of Blacktop Ridge. Wolves, muskoxen, and arctic hares have long been common in the area (Tener, 1954), and wolves have denned there for decades or even centuries (Parmelee, 1964; Grace, 1976; Mech and Packard, 1990). From at least 1986 through 1997, a pack of 3–13 wolves that at times occupied an area of at least 2600 km^2 (Mech, 1987) preyed on muskoxen and arctic hares and produced pups almost annually in traditional dens in the area (Mech, 1995). In 1997 and 2000, however, after snow in mid-August abnormally covered the area for the rest of the year, muskox and hare numbers crashed, and wolves disappeared (Mech, 2004). After a few years of normal weather, both prey species began to recover, wolves reappeared, and the wolves reproduced again (Mech, 2005).

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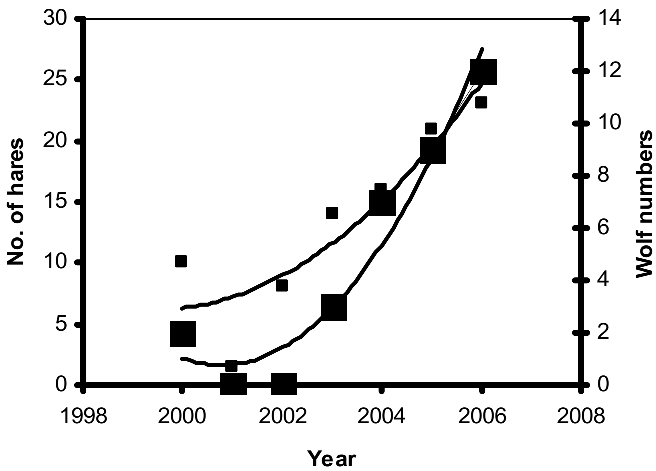

FIG. 1. Population trajectory of wolves and trajectory of arctic hare index near Eureka, Ellesmere Island, Nunavut, Canada, 2000–06. Large squares represent total wolf numbers and small squares represent the hare index.

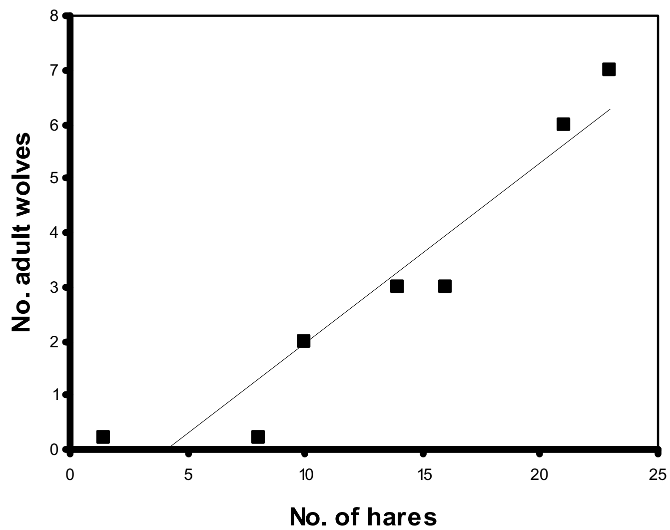

FIG. 2. Relationship between adult wolf numbers and arctic hare index near Eureka, Ellesmere Island, Nunavut, Canada, 2000–06 (y = 2.6818x + 4.8117; $r = 0.89$; $p < 0.01$).

TABLE 1. Numbers of wolves and indices to numbers of muskoxen and arctic hares in the Eureka area of Ellesmere Island, Nunavut, Canada.

Summer	Wolves Adults	Wolves Pups	Wolves Total	Hare Index	Muskox Index
2000	2	0	2	10	48
2001	0	0	0	0	16
2002	0	0	0	8	41
2003	3	0	3	14	59
2004	3	4	7	15	101
2005	6	3	9	20	15
2006	7	5	12	23	23

METHODS

From 2000 through 2006, I visited the study area each summer in early July, checked the known wolf dens, searched the usual wolf travel routes for tracks and scats, and interviewed personnel at a weather station and military base in the area about wolf sightings. If I found wolves, I followed them on an all-terrain vehicle (ATV) until I could determine if one was a nursing female. I followed any such females, searched until I found pups, and then counted the pups and the adults that attended the den (Mech, 1988, 1995).

I also established routines for determining indices to arctic hare and muskox numbers. For arctic hares, I surveyed once each summer, riding on an ATV during evening, along a 9 km route through the area where I had traditionally observed the most hares. The route follows Slidre Fiord, some 5–100 m from shore, to Skull Point along Eureka Sound. From there it continues inland for about 2 km, up some of the highest elevations in the area, to the Polar Environment Atmospheric Research Laboratory. All hares seen were counted as an index to hare numbers. Subjectively, the index seemed to fit well with the general annual hare numbers I observed over the entire study area. For my muskox index, I surveyed an area of some 250 km^2 through a spotting scope from a vantage point on the west side of Blacktop Mountain once each summer. This annual survey served as a gross index of local muskox numbers.

I predicted that wolf numbers each year would be related to the number of muskoxen or hares counted. I used simple linear regression to test numerical trends and to determine the relationship between prey numbers and wolf numbers. Similarly, I tested numbers of adult wolves and pups separately against the prey numbers to explore the strength of these relationships.

RESULTS

Total wolf numbers each summer varied from 0 to 12. Adults varied from 0 to 7, and pups, from 0 to 5. The annual hare count varied from 0 to 23, and the muskox count from 15 to 101 (Table 1). Both wolves and hares decreased from 2000 to 2001 and then increased (r^2 for hares = 0.95, and for wolves, 0.79; Fig. 1). Muskoxen increased and then decreased (Table 1). The relationships (r^2) between hare numbers and wolf numbers were 0.62 ($p = 0.04$) for wolf pups, 0.89 ($p < 0.01$) for adult wolves, and 0.84 ($p < 0.01$) for total wolves (Fig. 2). There was no significant relationship between muskox numbers and numbers of adult wolves, wolf pups, or total wolves ($p = 0.72–0.93$).

DISCUSSION

It has long been known that wolves in this study area depend primarily on muskoxen and arctic hares for their diet (Tener, 1954; Mech, 1987). However, the extent to which the wolves depend on either species is unknown, and the relative proportions of the two species in the wolf diet probably vary by year and season. During 1986–97, when hares were much more plentiful (Mech, 2000), wolves commonly fed them to their pups during summer, although the wolves fed on muskoxen during that time as well.

My findings for 2000–06 suggest that the wolves still depend on both hares and muskoxen, but that hare numbers more reliably determine wolf numbers. It appears, then, that although both hares and muskoxen supported the wolves, there were enough hares to support wolves and still increase their own population. With muskoxen, the figures are unclear. Muskoxen seem to be decreasing. If so, it does not seem that this specific hare-wolf-muskox relationship can persist for long. Either wolves must start relying less on muskoxen and more on hares, or wolf numbers must decline because of dwindling prey. The most common way wolf numbers can quickly adjust to food shortages is for offspring to disperse (Mech et al., 1998). The 2006 wolf population consisted of a breeding pair, five one- or two-year-olds, and five pups. Thus 5–10 pack members (42–83% of the population) could disperse before summer 2007, greatly reducing predation pressure on both muskoxen and hares. Future monitoring will help determine whether this reduction occurs or, if not, how the hare-muskox-wolf system shifts.

Besides establishing a new factor that can determine the trajectory of wolf pack size, this study also is the first to document the importance of a non-ungulate in determining wolf numbers over a large area.

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