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Decline and Recovery of a High Arctic Wolf-Prey System

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ABSTRACT. A long-existing system of wolves (*Canis lupus*), muskoxen (*Ovibos moschatus*), and arctic hares (*Lepus arcticus*) in a 2600 km^2 area of Canada's High Arctic (80° N latitude) began collapsing in 1997 because of unusual adverse summer weather but recovered to a level at which all three species were reproducing by 2004. Recovery of wolf presence and reproduction appeared to be more dependent on muskox increase than on hare increase.

Key words: arctic hares, *Canis lupus*, climate change, Ellesmere Island, High Arctic, *Lepus arcticus*, muskoxen, *Ovibos moschatus*, wolves

RÉSUMÉ. Un vieux système biologique composé de loups (*Canis lupus*), de bœufs musqués (*Ovibos moschatus*) et de lièvres arctiques (*Lepus arcticus*), occupant 2600 km^2 de l'Extrême-Arctique canadien (80° de latit. N.), a commencé à s'effondrer en 1997 en raison d'intempéries estivales anormales, mais il s'est rétabli à un niveau qui permettait aux trois espèces de se reproduire en 2004. Le rétablissement de la présence et de la reproduction du loup semble plus dépendre de l'augmentation du bœuf musqué que de celle du lièvre.

Mots clés: lièvres arctiques, *Canis lupus,* changement climatique, île d'Ellesmere, Extrême-Arctique, *Lepus arcticus,* bœuf musqué, *Ovibos moschatus,* loups

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INTRODUCTION

Canada's High Arctic, north of 75° N latitude, is characterized by extensive, sterile ice fields interspersed with disjunct areas of soil, flora, and fauna. Extremely low temperatures, short growing seasons, and sterile soil potentially minimize the resilience of biological systems in the area. Therefore it is of interest to document perturbations in such systems and the details of the systems' recovery. This article describes a High Arctic wolf (*Canis lupus*)–prey system and the details of its decline and recovery.

STUDY AREA

The study area includes about 2600 km^2 of the Fosheim Peninsula east, north, and west of Eureka on Ellesmere Island (80° N, 86° W), Nunavut, Canada. It includes shoreline, hills, lowlands, creek bottoms and the area around Blacktop Ridge. Unlike much of the surrounding region, this area is generally free of snow and ice in summer, and contains rock, gravel, bare soil, and scattered tundra and northern wetland vegetation. Wolves, muskoxen (*Ovibos moschatus*), and arctic hares (*Lepus arcticus*) have long been common in the area (Tener, 1954), and wolves have denned there over decades or possibly centuries (Parmelee, 1964; Grace, 1976; Mech, 1987, Mech and Packard, 1990). The main foods of the wolves, aside from the findings from intermittent scavenging around a weather station and military base, are muskoxen and arctic hares (Tener, 1954), although seals (*Phoca* spp.) are occasionally taken.

METHODS

During each June and July from 1986 through 2004 (except 1999), an assistant and I spent one to six weeks in the study area on foot and all-terrain vehicles (Mech, 1994) searching for and observing wolves, muskoxen, and arctic hares (Mech, 1995, 1997). In 2004, we spent 8–16 July in the study area. We surveyed the area with binoculars and spotting scope from high points in much the same manner each summer. Muskoxen, which are very dark, and arctic hares and wolves, which are white, were easily seen from many kilometers away. From one vantage point on the west side of Blacktop Mountain, we could survey an area of some 250 km^2 through a spotting scope. This annual survey served as a gross index of local muskox numbers. Additionally, we surveyed for arctic hares each year, using all-terrain vehicles (ATVs), along a 9 km route through an area where the greatest number of hares have traditionally been observed. This survey served as a gross index of local hare numbers.

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TABLE 1. Numbers and reproductive status of wolves, muskoxen, and arctic hares observed during summer, and carcass remains from previous winter, in Eureka area of Ellesmere Island, Nunavut, Canada. Modified and updated from Mech (2004).

Summers	Muskoxen			Arctic Hares			Resident Wolves	
	No.[1]	Young Seen?	Carcass Remains	Total[2]	Index Route	Young Seen?	No.	Young Seen?
1986–97[3]	≤ 151	≥ 10/12 years	≤ 2	(≤ 200)	-	≥ 10/12 years	6.8 (3–13)[4]	10/12 years
1998	30	No	9	56	26	No	2	No
2000[5]	48	Yes	0	39	10	?	2	No
2001	16	No	18	8	0	No	0	No
2002	41	Yes	0	14	8	Yes	0	No
2003	59	Yes	0	25	14	?	3	No
2004	101	Yes	0	28	15	Yes	7	Yes

[1] Number seen through spotting scope from mountainside overlooking about 250 km^2.
[2] Total seen during summer.
[3] See Mech (2000).
[4] Mean and range.
[5] No data for 1999.

We determined resident wolf numbers each year by checking known dens, travel routes, and a weather station and military base that local wolves traditionally visit. Traveling wolves were followed by ATVs and binoculars (Mech, 1994). When we saw a wolf that appeared to be nursing pups, we persisted in following the animal until we found her pups.

Long-term data on temperatures, precipitation, and snow cover were obtained from Environment Canada at a weather station in Eureka in the study area. The weather station is located on the shore of the Arctic Ocean, so most of the study area is higher than the weather station and the actual temperature in most places is often colder than the weather station records indicated.

RESULTS AND DISCUSSION

The Fosheim wolf-prey system persisted over at least five decades (Tener, 1954; Parmelee, 1964; Grace, 1976; Mech, 2004). Continuous occupation by resident territorial wolves in summer was documented from summer 1986 through summer 2000 (Mech, 1987, 1995, 1997, 2004). A pack of wolves varying in size from the basic breeding pair to seven adults and yearlings plus pups persisted for that period (Table 1). However, two unusually snowy summers (1997 and 2000) resulted in a precipitous decline in muskoxen and arctic hares, with the nadir in numbers during 2001 (Mech, 2000, 2004). Since 2001, both muskox and hare numbers have increased, although hare numbers may have leveled off at a low density between 2003 and 2004 (Table 1).

The last pair of resident wolves capable of breeding was seen in 2000, and they produced no pups that year. In summer 2001 and 2002, an inspection of the known dens of the wolf pack and the main travel routes used from 1986 to 2000 showed no fresh tracks, scats, or scratching except for the track of a single wolf, which passed through the area in summer 2001. (This animal did not stop at any of several muskox carcasses even though it passed within 500 m of at least two of them. Several summers of experience with local wolves showed that resident wolves would have known of such carcasses and visited them.)

In 2003, however, a pack of one adult male and two females occupied the area. The male raised-leg urinated (RLU), and one of the females squat-urinated (SQU) in the same spot. This behavior, called double-marking, is typical of a mated pair (Rothman and Mech, 1979). The fact that we did not see the female flexed-leg urinating (FLU) and that she did not seem to be nursing indicated that she was young and had not yet bred. The other female did not double-mark with either of these two wolves, but she traveled with them. The trio traveled through the center of what had been the previous pack's territory (Mech, 1995).

In 2004, what seemed (from general appearance and behavior toward us) to be the same mated pair was still present, and the mated female showed signs of nursing. She also made SQUs and FLUs both alone and in tandem with the male. An individual that behaved like the other female seen in 2003 was also observed, but she was not seen with either pair member.

The pair had produced a litter of four pups, about four to five weeks old when we found them on 10 July 2004. Urination posture indicated the litter included at least one male and one female. These pups appeared robust and survived at least until late September 2004, according to weather station observers. This finding—a territorial pair of wolves reproducing for the first time since 1997—documented the recovery of this wolf-prey system six years after its decline began.

The system decline appears to have been precipitated and prolonged by an unusual combination of two snowy summers in four years that cut the herbivores' nutritional replenishment period in half each year (Mech, 2000, 2004). The unusual weather resulted in declines in both muskoxen and hares and retarded their reproduction. After summer weather returned to normal, both species began recovering, but wolves lagged a few years. However, our data

indicate that system recovery was influenced more by muskox response than by hare response. After the nadir in both populations in 2001, muskoxen increased markedly each year, whereas hares increased more slowly (Table 1). This unexpected response, given the hare's higher reproductive potential, may well be attributed to the greater predation pressure sustained by hares. The only major mortality source for muskoxen is wolves, whereas hares are sought by wolves, foxes (*Alopex lagopus*), weasels (*Mustela erminea*) and various raptors, ravens (*Corvus corax*), jaegers (*Stercorarius longicaudus*), and other birds. In any case, although wolves in our study area use both hares and muskoxen, it appears that their quick response to increasing prey was more related to the muskox increase than to the weaker hare increase. This study also indicates that even under the extreme conditions of the High Arctic, a substantial perturbation in this terrestrial ecosystem can be overcome in a relatively short time.

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