Proportion of Calves and Adult Muskoxen, *Ovibos moschatus* Killed by Gray Wolves, *Canis lupus*, in July on Ellesmere Island

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Generally Gray Wolves (*Canis lupus* L., 1758) tend to focus predation on young-of-the-year ungulates during summer, and I hypothesized that wolves preying on Muskoxen (*Ovibos moschatus* Zimmerman, 1780) in summer would follow that trend. Over 23 July periods observing wolves on Ellesmere Island, Nunavut, Canada, I found that packs of 2-12 adult wolves killed seven calves, one yearling, and five adult muskoxen at distances of 2.9 to 32 km from their current dens and pups. Given a possible bias against finding calves because of their fewer remains, these results do not necessarily refute the hypothesis, but they do make it clear that adult muskoxen form an important part of the wolves' diet in July and thus possibly at other times during summer.

Key Words: Gray Wolves, *Canis lupus*, Muskox, *Ovibos moschatus*, nutrition, predation, predator-prey relations, arctic.

Wolf (*Canis lupus* L., 1758*)* predation on ungulates during summer tends to focus on young-of-the-year. This generalization is well documented for White-tailed Deer (*Odocoileus virginianus* Zimmerman, 1780), Moose (*Alces alces* L., 1758), and Caribou (*Rangifer tarandus* L., 1758) (summarized by Peterson and Ciucci 2003), Bison (*Bison bison* L., 1758) (Carbyn et al. 1993), and Elk (*Cervus elaphus* L., 1758) (Smith and Bangs 2009). Thus it is reasonable to hypothesize that this generalization would apply to wolf predation on Muskoxen (*Ovibos moschatus* Zimmerman, 1780) during summer. One of the earliest publications on the subject supported that hypothesis, based on documenting four Muskox calf kills (Mech 1988). It also seems reasonable to hypothesize that if wolf packs did kill any adult Muskoxen in summer, it would be larger packs of wolves that did so. I tested both these hypotheses during 23 summers of observing wolf packs in Canada's High Arctic.

I studied wolves and their primary prey, Muskoxen, in the Eureka area of Ellesmere Island (80°N, 86°W), Nunavut, Canada during July each year from 1986 through 2009. The study area included primarily 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, although in 2009, I obtained some data from along the south shore of Slidre Fiord. The study area included shoreline, hills, lowlands, creek bottoms, and the west side of Blacktop Ridge. Wolves, Muskoxen, and Arctic Hares (*Lepus arcticus* Ross, 1819) 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 three to seven adult wolves that at times occupied an area of at least 2600 km^2 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 2000). After a few years of normal weather, both prey species began to recover; wolves reappeared in 2003 and then began reproducing in 2004 (Mech 2005) and continued to reproduce each year through 2009. During the latter period, packs of up to 12 adults were observed.

During two to four weeks in July of each year (except 1999), associates and I attempted to locate a pack of denning wolves in the study area by experience, tracking, and following nursing females. When possible we observed these animals from all terrain vehicles (ATVs) close-up around the den, followed them on ATVs while they hunted, and observed them from long distances through binoculars and spotting scopes (Mech 1988). The amount of time spent following the wolves on ATVs was greater from 1986 through 1998, so the sample is biased toward those years. In 2009, we radio-tagged a breeding male with a combination VHF/GPS/Argos satellite collar and radio-tracked the animal and his pack from the ground (Mech and Cluff 2010). We noted the age classes of the muskoxen they killed during these observations.

During the 23 July study periods, two wolf packs of 2 to at least 12 adults (non-pups) occupying the study area consecutively were documented killing seven

calves, one yearling, and five adult Muskoxen (Table 1). There was no relationship between pack size or hunting-pack size (traveling-pack size) and whether the kill was a calf or adult. Wolves killed Muskoxen from 2.9 to 32.0 km straight-line distance from their current dens and pups. Two of the adult kills were made on a river bed, one was along the shore of a fiord at the base of a 6.1 km-long hill, and one within 200 m of the shore at the base of the same hill. The fifth adult was attacked on a hillside (Mech and Adams 1999). The calves and yearling were killed on level tundra, except one the wolves chased up a hill, after the wolves had killed two others a few minutes earlier (Mech 1988). One calf and a yearling were killed during a single attack.

Little was known about wolf predation on muskoxen during summer except for anecdotal accounts (Mech 1988, Mech and Adams 1999), but based on knowledge of summer predation by wolves on other large ungulates, a logical hypothesis was that wolves would prey primarily on Muskox calves during summer. The present long-term assessment, however, does not support that hypothesis. My data indicate that wolves kill both calves and adults during summer, at least during July, possibly in about equal proportions. This conclusion could be biased against proportion of calves, however, because wolves would spend less time at calf kills, and their sparse remains would be harder to find. This would have been especially relevant to my 2009 observations which were made from about 7 km away through 12-45× binoculars and scope. However, at other times I observed nine of the kills (seven calves, one yearling, and one adult) while following the wolves, so there should have been no bias in proportion of each age killed in this subsample. My results seem contrary to most other studies of wolves preying on ungulates in summer. However in most other study areas it has not been possible to quantify the ratio of adults to young-of-the-year taken. In the one study that has been able to, juvenile Moose comprised 90% of the individuals taken, although that study may also have been biased against finding calves (Sand et al. 2008). Given the possible bias in my results also, I cannot consider my hypothesis supported. What is clear from my data, however, is that adult Muskoxen do contribute considerably to the wolves' diet in July, and given their much larger size might contribute at least as much biomass as do calves.

TABLE 1. Known Muskoxen killed by wolves during July in the Eureka area, Ellesmere Island, Nunavut, Canada, 1986-2009.

Year	Age	Sex	Number of adult wolves (Number involved in kill)	Km from den
1986[1]	3 calves		7 (7)	3.8–4.4
1987[1]	1 calf		7 (7)	32.0
1989	1 calf, 1 yearling		8 (6)	12.5
1989	1 calf		8 (6)	15.0
1990	1 calf		3 (?)	12.0
1992	1 adult	M	2 (2)	2.9
1994[2]	1 adult	F	4 (1–2)	2.9
1998[3]	1 adult	F	2 (2)	–[4]
2009	1 adult	–	≥12 (?)	10.6
2009	1 adult	–	≥12 (?)	10.6

[1] Mech 1988
[2] Well worn teeth; female marrow was fat
[3] Mech and Adams 1999
[4] Wolves did not den in 1998

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