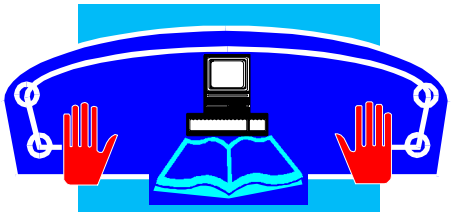

Sustainable Harvesting Of Muskoxen-a Research Proposal
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WILDLIFE

5 - 3 - 6

sustainable Harvesting of Muskoxen

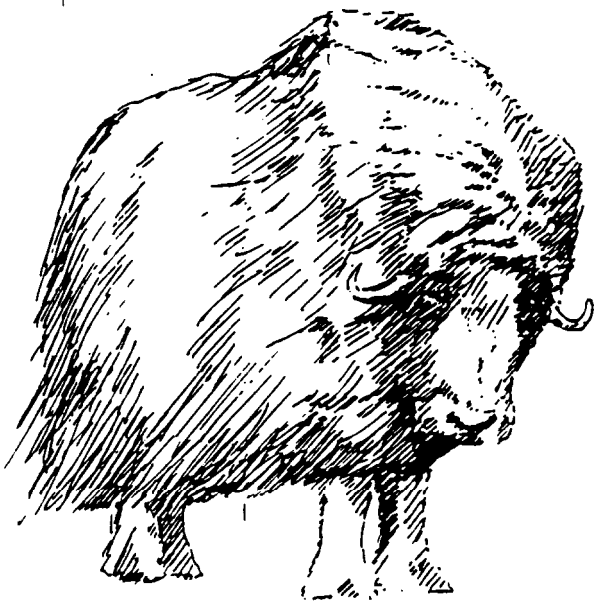
- a research proposal - KP

To **experimentally measure sustained yield**

To measure the **numerical and functional response**

of **muskoxen to their forage**

To investigate caribou-muskox relationships



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NOTE: This is a draft research proposal for review: the amount of design detail will be increased as it develops and the research hypotheses recast as statistical hypotheses with appropriate tests.

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Introduction:

The rate of increase of the muskox population on Banks Island has slowed since the mid-1980's. The changes are consistent with the muskox numbers becoming too high for the amount of forage. Alternatively, the increasing frequency of freezing rain and " increasing snowfall in the 1980s reduced forage availability which could then explain the decline in productivity, decreased survival of calves and yearlings and increased susceptibility to parasitism. Determining which cause is operating is critical in developing and justifying harvest levels on Banks and Victoria Island where the muskox populations are following the same trends as on Banks.

Accounts of muskox population dynamics have been more descriptive than analytical or experimental. Estimates of sustained yield can be derived from estimates of population size but such an approach depends on the accuracy of the surveys. The current standardised survey is designed more for precision than accuracy. An experimental determination of sustained yield is necessary to substantiate any estimates derived from logistic models based on the survey information.

Harvesting at level of the Maximum Sustained Yield (MSY) is a risky proposition in a fluctuating environment as a population can quickly be overharvested if environmental conditions reduce survival or productivity. The closer the sustained yield is to the maximum, the more frequent have to be surveys to track the trend in population size but those surveys reveal nothing of the relationship between environmental fluctuations and the changes in the population. Monitoring rates of increase or body condition gives a snapshot of current and past conditions but, sheds little light on underlying mechanisms. An alternative approach is to measure the effects of unpredictable swings in weather on the interplay between muskoxen and their forage.

The approach to measuring the effect of the environmental variation is to reduce the herbivore-forage system to three components whose interactions can be then modelled (Caughley et al. 1987) . The relationship between the amount of forage eaten and the amount available (the functional response) will be measured during "grazing down" trials. The changes in the rate of increase of muskoxen in response to changes in the amount of forage will be detected during aerial surveys to estimate population size. The effect of the environment on the amount of vegetation will be monitored by comparing plant productivity and weather such as length and mean temperature of the growing season as well as winter snow conditions.

The relationship between caribou and muskoxen is a longstanding community concern. Previous attempts to describe the relationships focused on diet overlap. An alternative approach is to measure whether an experimental decrease in muskox numbers increases the number of caribou using the area. Clearly the first step is to determine if such a response occurs then the cause as to whether muskoxen displace caribou or remove their forage can be investigated.

The project follows the approach applied by Caughley et al. (1987) to their study of the dynamic interactions between kangaroos and their forage. This exploration of the dynamics of muskoxen may follow some unexpected pathways from the kangaroo-annual pasture system. The productivity of grazed sedge meadows increases when grazed by muskoxen (Raillard 1992) . Conjecturally this positive feedback loop between grazing and plant productivity could jump under different grazing intensities to a negative feedback state which would change the shape of the response curves.

References

Caughley, G., N. Shepherd and J. Short. 1987. Kangaroos: their ecology and management in the sheep rangelands of Australia. Cambridge: Cambridge University Press, 253p.

Raillard, M. 1992. Influence of muskox grazing on plant communities of Sverdrup Pass (79°N) , Ellesmere Island, N.W.T., Canada. Ph.D. thesis, University of Toronto, Toronto, Ontario.

STUDY AREA and MUSKOX POPULATION

Minto Inlet runs east west some 100 km north of Holman, western Victoria Island. The landscape is rugged Precambrian Upland escarpments lining narrow steep-sided valleys and raised marine beaches. The muskox distribution is clumped in the valleys and coastal plains. In March 1992, the density was 1.0 muskoxen km-l and the estimated number was 2200 along the northside of the Inlet. The high density area is surrounded by an area of lower density (0.24 km-l) with an estimated population of 2100 muskoxen. Caribou (Rangifer tarandus) and wolves (Canis lupus arctos) both occur in Minto Inlet. We know the seasonal movements of the caribou from satellite telemetry in 1987-89.

OBJECTIVES and METHODS

Objective 1. To experimentally determine **sustained yield.** The muskox population of Minto inlet is essentially unharvested and at a steady density (K) . The experimental harvest will cause the population to decline and then stabilize at the density for which the harvest is appropriate. This experimental approach requires at least three estimates of population size to calculate the intrinsic rate of increase (r_m). Once K and r_m are known, MSY is calculated from a logistic model.

Methods Year 1

a) An aerial survey with 20% coverage will be flown in August 1992 using same methods as previous surveys. The results (population estimate and distribution) will determine level of and possible locations for the experimental removal (commercial harvests) .

b) Determine from the three population estimates (1983, 1989 and 1992) the theoretical sustained yield from a logistic model.

c) Establish experimental blocks (Best case would be three treatments - levels of removal - with two replications each but it depends on the commercial harvesting). About 60 %, 30% and 0% of the estimated muskoxen from the experimental blocks would be taken to reduce the muskoxen to low, medium and unharvested densities from one set of three blocks.

d) Monitor the sex, age, condition indices, reproductive status, parasite levels of and serum stress indices for the harvested animals.

Year 2

a) Track population density and rate of change in the blocks using a standardized aerial survey in August.

b) Harvest both sets of replicated blocks.

Year 3

a) Track population density and rate of increase in the blocks using aerial surveys and standard methodology.

b) Harvest both sets of replicated blocks.

Note: The success of the experimental approach will depend on the harvesting being carried out at about the suggested levels - to detect the differences in changes in density and rate of increase the spread of the removals has to be wide.

Objective 2. **To measure the relationship (functional** response) between the amount **of forage that muskox eat and the amount that is available.**
The expected relationship is an inverted exponential curve from plotting the forage biomass and daily forage intake. The plant biomass is measured as it is progressively grazed down by muskoxen in a enclosure. The food intake is the difference between the daily measures of plant biomass. The experiment will be in sedge-willow meadows as the characteristic summer range of **muskoxen.**

Methods **Year 1**
a) Order fencing materials for sea-lift.
b) Develop detailed design for the grazing experiment

Year 2
a) Conduct a grazing-down experiment using muskoxen corralled in temporary pens. Feeding rates (gin/day) will be estimated from consecutive biomass measurements (corrected for trampling loss).

Note: the experiment will be labour intensive and as well as local assistance, the support of Earthwatch volunteers may be a useful adjunct to the project.

Objective 3. **To measure the numerical response of muskoxen (rate of increase) to their food supply.**

Changes in rates of mortality, reproduction and dispersion are summarised in the exponential rate of increase. When the rate of increase is plotted against forage biomass, an inverted exponential curve is to be expected.

Methods **Year 1.**
a) Measure forage biomass on the treatment blocks and their replicates.

Year 2.
a) Measure forage biomass on the treatment blocks and their replicates.
b) Measure the rate of change of the muskoxen from surveys of numbers on the experimental blocks.

Year 3.
a) Measure forage biomass on the treatment blocks and their replicates.
b) Measure the rate of change of the muskoxen from surveys of numbers on the experimental blocks.

Objective 3. To experimentally determine if reduction in muskox density increases the winter or summer occupancy by caribou.

The research hypothesis is that caribou occupancy will increase during a 2-year period in the two treatment blocks and their 2 replicate areas where muskox density was reduced 60 and 30%, respectively compared to the two areas where muskoxen were not experimentally reduced. Occupancy will be measured as immediate by aerial surveys and longer-term by permanent pellet plots.

Methods **Year 1.**

a) Establish permanent plots and determine current and past levels of caribou summer and winter occupancy from numbers and type of fecal pellets.
b) Determine caribou abundance and distribution during aerial surveys in late winter.

Year 2.
a) Determine current caribou occupancy from fecal pellet counts on the permanent plots.
b) Determine caribou abundance and distribution during aerial surveys in late winter.

Year 3.
a) Determine current caribou occupancy from fecal pellet counts on the permanent plots.
b) Determine caribou abundance and distribution during aerial surveys in late winter.

Supplementary objectives:

A project of this experimental scale offers potential to test . other hypotheses such as the effect of reduced densities on social structure (intra-group competition) ; plant responses to muskox grazing and their measurement by remote sensing etc and technical questions on survey techniques, calibration of indices etc. However, at this time (and budget) , to keep the project manageable additional questions will not be developed except as independently funded and staffed projects. An obvious candidate for this separate approach is movements between the treatment blocks and CC Shank and myself are drafting a proposal for that.

Budget:

	Inuvialuit Implementation Funds		Kitikmeot
			DRR
	Research	Victoria 1s1. monitoring	
Year 1			
Muskox survey	**45,000**		
Caribou survey		**20,000'**	
Forage biomass[2]	**10,000**		
Muskox **removal**[3]	**20,000**	29,000[3]	
Fuel caches & Sea-lift	**35,000**		
Year 1 TOTAL	**110,000**	**66,000**	
Year 2			
Muskox survey	**30,000**		
Caribou survey	**15,000**		
Forage biomass	10,000		
Muskox foraging	25,000		
Muskox removal	**20,000**	**43,0005**	[4]
Year 2 TOTAL	**100,000**	**43,000**	
Year 3			
Muskox survey			**40,000**
Caribou survey			**20,000**[6]
Forage biomass			**5,00**
Analysis and write-up			**5,000**
Year 3 TOTAL			65,000
TOTAL **O&M**	**210,000**	**99,000**	**65,000**
Salaries			**110,000**

[1] Amount reduced from $34,000 in 1991 budget as coverage will be confined to experimental area and not attempt to estimate the trend in overall numbers.
[2] This includes the cost of **consultancies** with G. Henry (**UBC**) and R. G. White (Alaska).
[3] Muskox removal will be a commercial harvest: the contribution to the costs is to offset the effects of harvesting in particular areas and the costs of monitoring the condition and health.
[3] The funds are reallocated from the **muskox** and caribou collections originally forecast for the same area.
[4] DRR contributes equipment and personnel (Biologist + 2 **RROs**) .
[5] The funds are reallocated from the collections and **muskox** composition survey originally forecast for the same area.
[6] Funding may be required to supplement the regional budget.