Protocol Development Summary

Protocol: Muskox (*Ovibos moschatus*)

Parks Where Protocol will be Implemented: BELA, CAKR, NOAT, GAAR

Justification/Issues being addressed:
By the middle of the 19th century muskoxen were extirpated from Alaska (review in Lent 1999). Muskoxen were re-established in Alaska in the 1930's. Currently, viable muskoxen populations occur in four locations in Alaska, two of these ranges overlay park units in ARCN. Muskoxen were re-established on the Seward Peninsula, AK and near Cape Krusenstern AK, in the 1970's. Since their establishment, muskoxen have become are an important subsistence foods for local residents and are highly prized sport hunting resources. Muskoxen tend to occupy small home ranges in comparison to migratory species so are good integrators for local environmental conditions and meta-populations of this species are found throughout the year within the boundaries of the ARCN (e.g., residents). Muskox populations may have substantial effects on plant communities and by extension wildlife communities through effects on vegetation either directly through browsing and grazing or indirectly through biogeochemical cycling. Muskoxen are rare worldwide. Within the U.S. National Park system (NPS), muskoxen only occur in the ARCN. Key reasons for monitoring muskoxen are that muskox are: (1) an important subsistence species that occur in all park units within this network; (2) may impact reindeer and caribou in the ARCN; (3) as an arctic obligate species, area a good integrator of the condition in arctic park ecosystems.

Specific Monitoring Questions and Objectives to be Addressed by the Protocol:
Some of the specific monitoring questions that will be addressed by this protocol include:

- What are the long-term trends in population numbers of muskoxen in BELA and CAKR?
- What are the long-term trends in herd sex and age composition?
- Is the distribution of muskoxen changing?
- What is the late winter physical condition of muskoxen in BELA and CAKR?
- What is the long-term trend in the incidences of disease and parasites in muskoxen?
- How do muskoxen affect plant and lichen communities and how do muskoxen respond to changes in the plant and lichen communities?
- Is there a correlation between key environmental/weather factors and the distribution, productivity, and number of muskoxen?

1. Determine population trends in muskoxen: In BELA, a census for muskoxen occurs every 2 years on a rotational basis as part of a cooperative effort with the Alaska Department of Fish and Game, the U.S. Fish and Wildlife Service and the Bureau of Land Management. In CAKR, a census is done with the Alaska Department of Fish and Game on an annual basis. Historically, census efforts have been supported by park base funds and from support from other state and federal agencies. ***Justification.*** *Muskoxen are an important subsistence species in the ARCN, particularly in BELA. The value of this species as a subsistence resource varies relative to the abundance of caribou.*
2. Investigate trends in muskoxen sex and age composition and how they potentially relate to herd productivity: This monitoring question is currently being addressed cooperatively with the Alaska Department of Fish and Game. Composition is evaluated immediately following the census in BELA and during the summer in CAKR. ***Justification.*** *Herd sex and age composition provides critical information for understanding population trends. With composition data, herd productivity can be correlated with environmental conditions, habitat conditions, predation and harvest patterns, and management*

strategies. This information can be used to identify hypotheses for evaluation of the long-term health of muskoxen herds.

3. Is the distribution of muskoxen changing? This monitoring question can be answered with data collected during the census but will require a consistent effort to map an a regular basis. ***Justification.*** *Muskoxen distribution has implications for the availability of subsistence resources in western Alaska. The potential for competitive interactions between reindeer and muskoxen exist as muskoxen distribution shifts.*
4. Investigate late winter physical condition of muskoxen. ***Justification.*** *Body condition is probably the most important correlate of survival and reproductive potential in muskoxen. A long-term data set on variation in late winter fat and protein stores in muskoxen could be correlated with environmental, weather and habitat conditions and could be used to identify hypotheses for evaluation of the long-term health of the herd.*
5. Investigate the incidence of disease and parasites in the muskoxen. ***Justification.*** *The type and frequency of disease and parasites in muskoxen has a substantial impact on the health of the herd and the value of the muskoxen as a subsistence resource. The incidences and impacts of disease may be substantially affected by changes in climatic conditions.*
6. Evaluate habitat condition by evaluating plant communities and forage availability. ***Justification.*** *Because of a relatively sedentary life history muskoxen have the potential to substantially alter plant communities, either through trampling and grazing, or though the addition of urine and feces. The impacts of muskoxen on habitat plant communities may affect the productivity of other fauna of the region.*
7. Investigate environmental/weather factors and examine correlates with the distribution, productivity, health and body condition of the muskoxen. ***Justification.*** *Changes in climate in the region may have consequences for the long-term health and productivity of muskoxen.*

Basic Approach:

Monitoring of muskoxen population size and sex and age composition of the herd will continue with annual surveys with cooperators. Currently there are two projects scheduled to radiocollar muskoxen in or near BELA and CAKR in FY 2008. ARCN will cooperative with these projects to obtain location data for muskoxen. Location data from radiocollars will be used as an aid in the census and herd composition surveys, in habitat investigations, and to document the distribution of muskoxen.

Fecal samples and urine samples will be collected annually in the late winter to assess the late winter body condition of muskoxen using stable isotopes. Fecal nitrogen is derived from undigested nitrogen and endogenous secretions (Barboza and Parker unpublished data). Stable isotopes in urea are a result of metabolic processes within the animals and can indicate the relationship between dietary nitrogen supply and body protein stores (Parker 2003; Parker et al. 2005). The isotopic signatures of urea and fecal pellets can thus be used to evaluate the late winter body condition of muskoxen. Fecal pellets will also be used to evaluate the incidence of disease and parasites in muskoxen.

Habitat condition for muskoxen will be monitored in conjunction with the Arctic Network's vital signs of "Terrestrial Vegetation and Soils", "Fire Extent and Severity", and "Weather and Climate". Fecal pellets will be used to examine diet. Remote sensing, permanent vegetation plots and fenced exclosures will be used to monitor vegetation communities and habitat use by muskoxen.

Principal Investigators and NPS Lead:

Principal investigators and the NPS lead for the muskox vital sign will be Brad Shults and Jim Lawler. Cooperator include: Jim Dau, Peter Bente, and Tony Gorn, Alaska Department of Fish

and Game; Nate Olson, U.S. Fish and Wildlife Service; Kyle Joly, Bureau of Land Management; and Joel Berger, University of Montana and The Wildlife Conservation Society.

Development Schedule, Budget, and Expected Interim Products:

The P.I.'s will produce a draft protocol ready for external peer review by by the end of FY 2009. After peer review, revision and approval, we hope to implement the protocol in Spring 20010. We have budgeted $0 for protocol development and testing in FY08.