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Humane management of captive muskoxen

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Abstract: Agriculture Canada has supervised muskoxen harvests in the Canadian Arctic since 1985. In early 1991 a management system was empolyed that involved penning of large herds (up to 200 head) and feeding in confinement for several days before slaughter.

A total of 409 head were slaughtered during two seperate operations. Their behavior was observed, carcasses were examined post-mortem, and specimens were collected for analysis. The purpose of the study was to determine if maintaining wild muskoxen in captivity, with the provision of feed, caused excessive stress on the muskoxen or deleteriously affected meat quality.

The good quality grass hay provided was readily accepted, the muskoxen generally did not escape the simple enclosure, there was no evidence of increased aggression due to confinement, and no apparent digestive upset.

Blood analysis (cortisol), meat quality tests (pH, shear values), and first hand observation indicated no detectable increase in stress due to confinement and no loss of meat quality.

Key words: Muskoxen, stress, meat quality, Banks Island, wildlife management, slaughter, cortisol.

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Introduction

At the time of European contact, muskoxen were widely distributed across the North American arctic. During the nineteenth century most populations were greatly reduced or extinguished. In 1917 Canada declared the species endangered, and enacted laws to protect the remaining muskoxen. In the past 20 years, populations on some of the arctic islands have grown dramatically. The 1991 survey by the Department of Renewable Resources, Government of the Northwest Territories (GNWT), estimated the muskoxen population of Banks Island at between 45,000 and 50,000.

The quota for numbers of muskoxen that can be harvested yearly in each management area of the Canadian Northwest Territories is set by Renewable Resources, GNWT. The yearly quota for Banks Island is 5000.

Commercial muskoxen harvests have been conducted on Banks Island by the Inuvialuit Renewable Resources Development Corporation (RRDC) since the early 1980s. In order to qualify the production for export, the process is supervised by Agriculture Canada. This supervision includes the responsibility for humane treatment and slaughter of animals (Governments of Canada: Meat Inspection Act, 1985 and Meat Inspection Regulations, 1990).

The purpose of this study was to attempt to evaluate the effect of short team captivity on wild muskoxen.

Materials and methods

This report details results from two harvest operations: Study I (45 muskoxen) and Study II (367 muskoxen)

Management and feeding

Study 1: Fortyfive head of muskoxen were penned at midnight, Jan 22, 1991, after a drive of about 45 km in 12 hours. (The usual response of muskoxen to danger is to come together in a group, rather than to flee. This «flocking» nature of the muskoxen makes it possible for a few competent herders on snowmobiles to gather a large group together and herd them considerable distance to a holding facility). The herd was slaughtered approximately evenly on four alternate days ending Jan 29.

Based on observations and recommendations from several sources, (Stonehouse, 1971; Gunn, 1982; Lent, 1988; Gray, 1987; Henry and Svoboda, 1989; Oakes, Harmsen and Eberl, 1989; Carpenter, Esau and Lucas, 1991; White, 1991; Flood, Adamczewski and Tedesco, 1991), 2.7 kg of good quality, low protein Timothy hay was fed daily. Drifting snow provided adequate water supply. The temperatures ranged from -20 to -40 C.

Study 2: A total of 367 head were penned in two large groups (Feb. 20 & 26, 1991). Slaughter was completed March 3. No muskoxen were held longer than 5 days prior to slaughter.

Both herds were driven about 55 km over a period of 3 days. During the herding, they were allowed to graze during the day and fed .5 to 1.0 kg hay in temporary corrals at night. Once penned at the slaughter site, salt was provided in blocks and pellets, otherwise they were husbanded as in study 1. (They ignored the salt completely.) Temperatures as in Study 1.

Observations

(A) Behavioral

The muskoxen were observed twice daily (before slaughter operations began for the day, and again after operations were complete; or morning and evening on non-slaughter days) for visible signs of stress, feed ingestion and digestive upset.

(B) Post-mortem

The carcasses were checked for rumen fill, visible digestive upset, and meat quality. Regular meat inspection procedures were also done. The following specimens were collected for laboratory analysis:

1) Blood: for cortisol assay.
   The cortisol assays were carried out by Reproductive Endocrine Assay Systems, Reproductive Endocrine Laboratory, WCVM, University of Saskatchevan, Saskatoon).
2) Muscle samples for determination of:
   a: pH
   b: Shear values (tenderness).
   The meat samples were analyzed by Meat Research Laboratory, Agriculture Canada, Alta, Canada).

In study 1, carcasses were hung in a heated building at approximately 0°C for 24 hours prior to collection of muscle samples; in study 2, samples were collected and frozen immediately after slaughter. Muscle samples were an approximately 5 cm section from the middle of the triceps muscle of the forearm.

Results

Behavioral observations:

Study 1: Darkness when the herd was penned made observations difficult but there were no stragglers or obviously stressed animals noted. When observed the next morning, no stiffness, weakness, lameness, obvious signs of capture myopathy or other stress was noticeable.

The muskoxen became progressively quieter and easier to approach each day, with the exception of day 6, when they seemed more skittish. Fresh wolf or dog trakcs were found around the enclosure on this day.

On day 5 strong winds blew down large segments of the fence, but the muskoxen remained inside the enclosure. A few animals did cross the fence on two other occasions, but remained near the pen and were re-penned.

For the duration of captivity, there was no evidence of increased aggression, no sign of bloat or diarrhea. The character of the feces did not appear to change. Som muskoxen ate feed on the first day; by day 3 all appeared to be eating during the observation period.

Study 2: When corralled, there was no evidence of exhaustion, and no signs of capture myopathy. There was no evidence of increased aggression from mixing of herds. Muskoxen ate the hay readily, and there was no visible sign of digestive upset. They seemed easier to approach and less skittish, the longer they were held.

Post mortem observations:

Study 1: All carcasses were approved. No evidence of capture myopathy was noted, although the heavy muscles were not deeply incised except for sectioning of wholesale cuts.

On day 2 (the first day of slaughter), all rumens appeared full. On day 4, rumens from 2 of 3, twenty month old animals appeared to be only partially full and had watery content; the rest appeared normal. On subsequent slaughter days, all rumens were full and hay was visible in the stomach contents. There was no visible evidence of gastritis, enteritis or diarrhea. Carcass condition was good, and no change in meat quality was apparent for the duration of the test. «Marbling» of all carcasses was measured by the «Japanese Beef Grading Standards» (Jones and McIsaac, 1988). Marbling measured from 1 to 6 on this scale, and was considered by the slaughter operators to be very acceptable.

Carcass weight averaged 75 kg. (Range 37 kg to 148 kg).

Study 2: Carcasses were in generally good condition. From the operators' marketing standpoint, all but two carcasses were considered excellent. (The two carcasses were thinner than would have been desired.) Carcasses were not weighed.

Most (362 out of 367) rumens were full, and hay was visible in the rumen content; there was no indication of digestive upset. There was little evidence of capture myopathy - two hind quarters were condemned due to hemorrhage in the gastrocnemius muscle (probably capture myopathy). Very few other abnormalities were detected. One carcass was condemned.

Laboratory results:

(a) *Serum cortisol* (Figure 1):

Study 1: 20 samples assayed. Values ranged from 5 to 138 nmol/l.
Day 2: 5 samples averaged 90.8 nmol/l.
Day 4: 5 samples averaged 36.8 nmol/l.
Day 7: 6 samples averaged 38.2 nmol/l.
Day 8: 4 samples averaged 29.0 nmol/l.

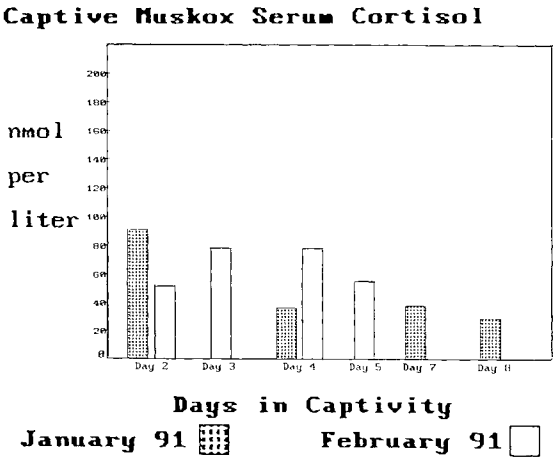

Fig. 1. Average serum cortisol in muskoxen held for slaughter January/91 and February/92.

Study 2: 13 samples assayed. Values ranged from 9 nmol/l to 106 nmol/l.
Day 2: 4 samples averaged 51.5 nmol/l.
Day 3: 2 samples averaged 78.5 nmol/l.
Day 4: 4 samples averaged 77.75 nmol/l.
Day 5: 3 samples averaged 55.0 nmol/l.
The assays indicate that at the January harvest, cortisol levels were highest the day after herding, then fell to a lower level and stayed relatively constant for the duration of the test. At the February kill, the levels started at a lower level, but did not drop as at the previous harvest.

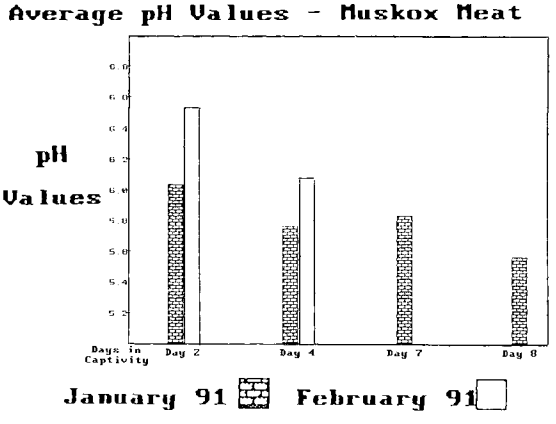

Fig. 2. Average pH values of meat from muskoxen slaughtered in January/91 and February/91.

(b) *pH of muscle.* (Figure 2):

Study 1: 11 samples assayed. Values ranged from 5.53 to 6.72, and generally declined from day 2 to day 8.
Study 2: 6 samples assayed. Values ranged from 5.76 to 6.71.

(c) *Tenderness of muscle.* (Figure 3)

Study 1: 11 samples.
Study 2: 6 samples.

Shear values showed considerable variation, but did not seem to follow any pattern that would relate to the length of time in captivity.

In general, the meat samples from the February harvest were slightly higher in pH and slightly tougher than those from the January kill. No trend to deterioration in quality was apparent with increasing days of captivity.

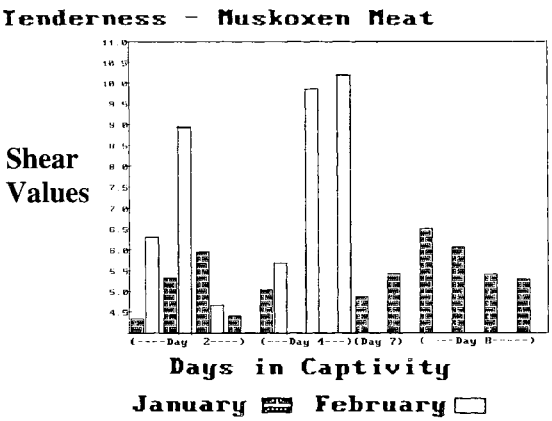

Fig. 3. Shear values (toughness) of meat from muskoxen slaughtered in January/91 and February/91.

Discussion

The study is handicapped by the dearth of previous data and the difficulty of interpreting observed behavior in animal subjects.

Any human contact by a wild species will probably be stressful. It is acknowledged that captive wild muskoxen likely suffer some degree of stress, both physical and psychological. Even in domestic species accustomed to human proximity, transportation and the handling process leading up to slaughter are recognized as stressors (Jephcott *et al.*, 1986; Schaefer *et al.*, 1987; Jones *et al.*, 1988; Jones and Tong, 1989; Jones *et al.*, 1990; Schaefer *et al.*, 1990; Blood, Radostits and Henderson, 1990; Birchall, 1990). The serum assays of muskoxen sampled during three different harvests (Nagy *et al.*, 1991) suggests that muskoxen are similarly stressed.

There is considerable disagreement about the value of serum cortisol levels, or any other criteria, for assessing stress in animals. (Kaneko, 1980; Rushen, 1986; Rushen, 1987; Yousef, 1988; Rushen, 1991). However, high serum cortisol levels have traditionally been considered to be an indication of stress, and there is evidence that severe, acute stress caused by chasing muskoxen in summer with an all-terrain vehicle greatly increases their serum cortisol concentrations (Figure 4). This suggests that under these circumstances at least, stress and serum cortisol concentrations are related in this species.

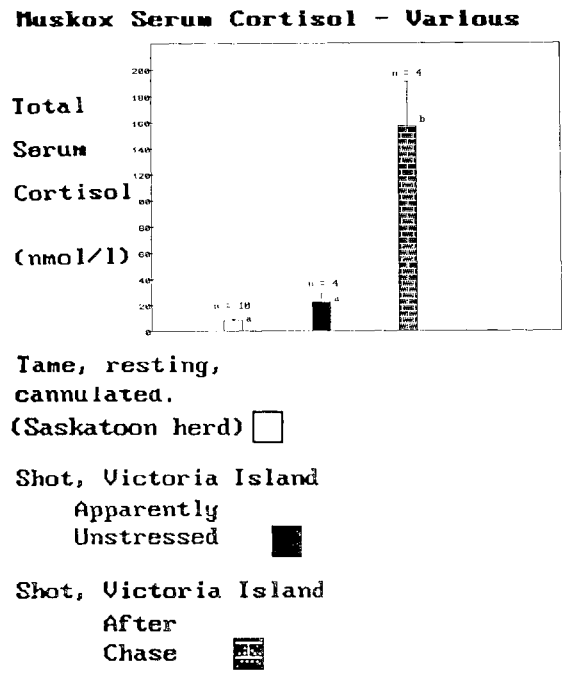

Fig. 4. Average serum cortisol in muskoxen from various sources.

Mean total serum cortisol soncentrations (+/- standard errors) in resting tame muskoxen with jugular cannulae (5 animals sampled on 2 occasions) and in muskox shot in summer on Victoria Island. Four of the shot muskoxen were stalked carefully and were apparently unaware of the hunter; the remaining four were chased by all-terrain vehicle before being killed. The lowest concentratio of cortisol that could be reliably assayed by the methos used was 5 nmol/l and all sera with nominally lower concentrations were arbitarily assigned 5 nmol/l. Bars with different

letters are significantly different (p 0.01). (Data supplied by J. Adamczewski, S. Tedesco and P. F. Flood, Department of Veterinary Anatomy, University of Saskatchewan.)

The relationship between cortisol values obtained at the January harvest, the February harvest, and those from other sources can be visualized by comparing figures 1 and 4. Most of the values from the harvests fall between those obtained from the apparently «stressed» animals and the apparently «non-stressed» animals. This result is what we would expect to see.

The conclusions arrived at are based on a small number of samples and observations, there is very little previous data to relate to, and there are reservations about the reliability of cortisol as a stress indicator. (Rushen, 1986; Rushen, 1987; Yousef, 1988; Rushen 1991). However, the serum cortisol assays do seem to support the conclusion arrived at from the observations. That conclusion is that holding muskoxen in captivity after herding to a central location, and feeding them for extended periods does not seem to cause additional stress. Another important consideration is that the herding and penning of large groups at one time appears to be less hectic and therefore less stressful than the daily herding of smaller groups to keep the slaughter facility supplied. (The herding seems to be the most stressing part of the operation).

Meat quality was not compromised by this methos of handling, and there is some indication that a longer rest period after herding may actually improve meat quality (The declining pH values usually indicate increased resistance to bacterial growth).

Observation of muskoxen for signs of stress is obviously an inexact procedure. Muskoxen under these conditions have not been widely studied – the observations cited here may be of value in developing norms for future studies.

It is possible that the apparent phlegmatic nature of muskoxen masks any signs of stress. It is also possible that this same trait makes them less disturbed by human proximity than some of the other wild species. Some of the traditional signs of fear, anxiety, and «stress», such as aggression, frequent urination and defecation, flight, inappettance, and collapse, were not observed. Regular and problem-free feed consumption is normally considered a successful adaption.

The stress incurred by herding was not studied, and needs to be considered.

Conclusions

Holding wild muskoxen in captivity and feeding them for extended periods does not appear to deleteriously affect meat quality or increase stress levels above that caused by the herding procedure.

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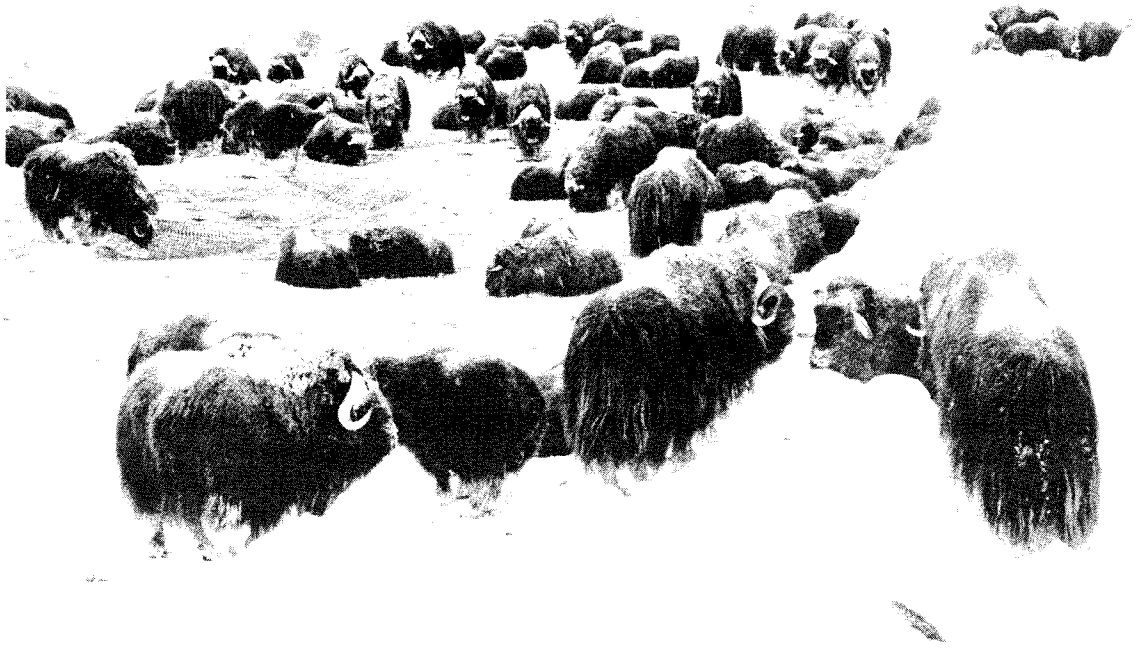
Muskoxen herding. (Photo: D. C. Lund).



Muskoxen in holding pen. (Photo: D. C. Lund).

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