

Experiences from 40 years of muskox (*Ovibos moschatus*) farming in Norway

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Abstract: Experiences from the management of a semi-domesticated herd of muskoxen, mostly on an island outside Tromsø (~70° N; 19° E), over a period of 40 years have been collected, and data on husbandry practices, reproduction, diseases and longevity are presented and discussed.

Key words: muskoxen, *Ovibos*, reproduction, arctic, sex ratio, *Contagious ecthyma*, longevity, muskox farming.

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Background

Ten male and 15 female calves < 1 year were imported from East-Greenland in 1969 by Norsk Moskus AS to an inland location at Bardu, (68°44'N; 18°31'E), in northern Norway, where they were kept on fenced grass farmland, supplemented with hay and cattle feed pellets, until 1976. At that time the herd was, after a fatal accident, exiled to the secluded island (1 km²) of Årøya (69°53'N; 21°58'E), which is covered with open birch forest and patches of grassland, where the animals were roaming freely, while hay and cattle feed pellets were again offered as supplementary feeding. Finally, in 1979 the herd was taken over by the Department of Arctic Biology (AAB) at the University of Tromsø, and moved to the coastal island of Ryøya, near Tromsø (69°40'N; 18°58'E) in 1980. This island (1.2

km²) is covered by a mixture of heather, open birch and pine forest, and patches (5 acres) of cultivated grassland, where again the animals were roaming freely, while getting food supplements of hay and “reindeer pellets” (FK reinfor, Felleskjøpet, Trondheim, Norway) during winter.

Experiences and results

Males

A total of 43 bulls (the 10 imported calves from 1969 and 33 subsequently born and raised in Norway) aged more than one year are included.

Of these 11 were sold at variable age and time, 13 died due to *Contagious ecthyma* infection at ages from 1+ to 6 years, 7 died due to a variety of accidents, 10 died of natural causes, including old age and wounds inflicted during

rut, 2 are presently alive in Tromsø.

Average body mass of 5 mature bulls (5-11 yrs) in Sept.-Oct. was 305 ± 12 (SD) kg ($n=10$) (Range: 292-330 kg).

Reproduction

A total of 13 bulls were used over the period. 4 of the bulls did not have any competition at first rut, and successfully reproduced at 3 years of age, and although one bull which had a "come back" at 10 years was able to reproduce until the age of 14 (not confirmed by DNA, but he was certainly the alpha-male), 7 bulls that faced competition from younger bulls lost their harem at ages 8, 7, 7, 8, 7, 6 and 5 years.

Longevity

Only 5 bulls died from natural causes at "old age".

One that was the alpha-bull for a total of 10 years (with a "siesta" of 2 years starting at 8 years) died at the age of 17 years, while two inferior ones died for no obvious reason at the age of 8 and 9 years. Two bulls at the age of 10 years (at different times) were removed from the herd to a nearby zoo. There they were without competition from other males and reached the age of 14 and 18 years.

Females

A total of 52 females (14 of the 15 imported calves from 1969 and 38 subsequently born and raised in Norway) aged more than one year are included.

Of these 10 were sold at variable age and time, 13 died during abortions, 6 (of which 4 were 1+ year) died due to *Contagious ecthyma* infections, 19 died for various reasons: old age (7), emaciation, mainly caused by intraspecies social neglect (4), accidents (2), unknown reasons (6), and 4 are still alive.

Average body mass of 4 mature (5-14 yrs) females in Sept.-Oct. was 220 ± 10 (SD) kg ($n=16$). Range: 205 kg (6 yrs) - 232 kg (10 yrs).

Reproduction

All females that reached mature age ($n=33$) gave birth to at least one calf. A total of 157 calves were born during the period, in addition to 27 stillborns by abortion. Of the former 71 (45%) lived for more than a year.

Of the 157 calves, 24 were of unknown or uncertain sex, while of the 133 of known sex, 66 were females and 67 males. Twinning never occurred. Calves birth weight was 9.29 ± 1.47 kg ($n=6$; both sexes).

Of 88 calves with known birth date, median calving date was the 17 May (which incidentally is the National Day in Norway), while earliest calving occurred 23 April and the latest 30 August. However, the date when most calves were born was 1 May (9) and 7 May (7).

Calves were separated from their mothers in late Sept.-early Oct. and given special care at the animal facility at AAB in Tromsø, until re-introduced into the herd in May the next year.

Intervals between calving the same year was 22 ± 5 (SD) days ($n=12$).

Of 36 females, 10 conceived for the first time at age 2 years, 11 at age 3, 5 at age 4, 8 at age 5, 1 at age 6 and 1 at age 7 years.

Consecutive calving was the norm, and there are two examples of 11 years of consecutive calving.

Of 10 females that reached old age conception of calves that lived more than one year stopped at about 14 years, while two conceived at age 17 and 18 years to calves which either died soon after birth (2) or were stillborn due to abortions (2).

Longevity

Four females lived to die of old age at 21, 22, 24 and 28 years, the latter being for many years the alpha female of the herd.

General

Bottle feeding of calves

The rearing of calves independent of their

mothers has been required on various occasions for various reasons. We have found that hand rearing of calves is productive and results in very tame animals provided the calves are separated from their mothers at the age of 1-2 weeks. The calves were bottle-fed an artificial milk formula (Kalvegødt®, FK Felleskjøpet, Trondheim), based on skimmed milk and whey powder, containing 20% protein and 18% fat, fortified with 330 ml cream/2 litres, 5 times a day at the outset reduced to 3 times at age 1.5 months, at doses increasing from 100 ml to 500 ml. After one month the cream was replaced by curdled milk. Water and “reindeer pellets” were available ad lib. at all times. Weight gain during the first 3 months on this diet was about 0.5 kg/day.

Diseases

Infections from *Contagious ecthyma* have been the curse of the project, with major outbreaks of the disease occurring in winter 1974/75, followed by minor afflictions of previously affected animals in 1976, 1977, with new major outbreaks in winter 1981/82, 1985/86, then mainly calves were affected autumn 1989, 1990, 1993 and 1994, with major outbreaks again in winter 1999/2000, autumn 2005 and winter 2008.

A total of 13 males aged more than 1 year died at age 1+ (3), 2 (3), 3 (2), 4 (1) and 6 (4; first outbreak), and a total of 6 females died at ages 1+ (4), 2 (1) and 3 (1)

In addition 15 calves < 1 year, of which 7 were males, 6 females and 2 of undetermined sex also died as a direct effect of the curse, which gives a total loss of 34 animals.

The entire herd was always exposed to the infection at every outbreak, but different animals responded different: All calves were always badly affected, and always required repeated treatment, young animals (2-4 years) reacted very different, some dramatic, some hardly at all, while adult animals either did not

show signs or reacted in an un-dramatic way, without need of treatment. It appeared that males were in general more affected than females, which is also reflected by the death toll.

Parasite treatment

Calves were treated with Albendazol (*Valbazen vet.* “Pfizer”) (19 mg/ml) by oral injection of 380 mg (20 ml) at the age of 2-4 weeks, and thereafter with 5 ml/10 kg_{bw} at monthly intervals until permanent snow (usually October). All animals were treated with Fenbendazol (*Panacur vet.* “Intervet”) (liquid; 25 mg/ml) soaked up in the pelleted feed to a dose of approximately 5 mg/kg_{bw}, 3 times at intervals of 4-6 weeks during the snow-free season. All animals were also given a subcutaneous injection of 1 mg/10 kg_{bw} Ivermectin (*Ivomec vet.* “Merial”) (5 mg/ml), whenever immobilized for various purposes.

Although 2 calves were lost one year as a result of tapeworm infections caused by failure of prophylactic treatment, parasites caused no problem under this regime.

Age determination in animals of known age

Having a great many muskox skulls from animals of accurately known age we have tried to use incisor sectioning and staining to determine age, but blind testing revealed an unacceptable lack of accuracy.

Discussion

The body masses of our females are in agreement with those reported by Thing *et al.* (1987) and Adamczewski *et al.* (1997) for wild animals, and with White *et al.* (1989) and Adamczewski *et al.* (1994) for experimental animals. Moreover, Latour (1987) found that the average body mass was 188 kg (range: 143-288 kg) in mature females and 277 kg (range: 206-362 kg) in mature males on Banks Island. Tener (1965) reports a record weight of 372 kg in a bull, but

he also relays information from John J. Teal of maximal weights of *about* 650 and 300 kg for captive males and females, respectively. We find it quite outlandish that bulls should be able to reach a body mass *twice* the record body mass of all other bulls, and it is tempting to suggest that the values presented by Teal are based on estimates and not on measured values.

Buckley *et al.* (1954) suggest max life of females to be 24 years, while we have shown that females may live to become 28 years, while our oldest male died at the age of 18 years.

Lent & Davis (1993) found that cows conceived for the first time at the age of 2 yrs, but that there was a propensity for stillbirths and abortions among cows bred at that age, while the 3 years old performed particularly well. They also found that the reproductive life span of their cows was 17 years, while the performance after 14 years was poor. This is almost identical results with those obtained by us.

Assuming a gestation time of 235 days; range: 230-242 days (Pharr & Rowell, 1993; Rowell *et al.*, 1993) our median calving date of 17 May implies a median conception time of 25 October, which does not agree with the observed peak of rutting activities at Tromsø, which is in mid-September. Alendal (1971), on the other hand, suggests a gestation period of 244-252 days based on 4 observed cases in wild muskoxen in Norway, and Wilkinson (1971b) states that gestation lasts eight month (not revealing what months), which indicates 240 days in Alaska. Based on our observations a gestation period of approximately 245 days at 69°N in Northern Norway seems indicated, and that is not too far off the latitude relationship suggested by Flood & Tedesco (1997).

Our finding of an oestrous cycle of 22 ± 5 (SD) days ($n=12$ years) is in agreement with the 20 days reported by Rowell & Flood (1988).

Wilkinson (1971b) report a sex ratio of calves to be $45 \text{♀} / 29 \text{♂}$, and Lent & Davis (1993) a

ratio of $180 \text{♀} / 219 \text{♂}$, while Dinneford & Anderson (1984) found a ratio of $34 \text{♀} / 36 \text{♂}$, Latour (1987) $50 \text{♂} / 46 \text{♀}$ and Reindell *et al.* (1993) $23 \text{♀} / 22 \text{♂}$, which is very close to equality and agrees with our data ($66 \text{♀} / 67 \text{♂}$) to suggest that the sex ratio of muskoxen is very close to unity.

There has been several suggestions of twinning in muskoxen based on field observations (e.g. Alendal, 1979; Elsner, 1994), but Wilkinson (1971a) reported the first verified occurrence of (stillborn) twin calves in a captive herd in Fairbanks, Alaska, while Dinneford & Anderson (1984) found 4 twin foetuses in 102 pregnancies. Reindell *et al.* (1993) reported the first confirmed (live) twin birth out of 39 and one set of stillborn twins out of 5 in a captive herd in Minnesota. We have no record of twins in 157 pregnancies in the present study, and all data combined indicate that twinning in muskoxen is extremely rare.

Lent & Davis (1993) found an average birth weight of calves to be 9.77 kg ($n=84$) in males and 9.72 kg ($n=69$) in females, which was not significantly different. Our own value, 9.29 ± 1.47 kg ($n=6$) for both sexes is in agreement with this, and suggests that average birth weight for muskoxen is about 9.5 kg, at which time their rectal temperature is 39.5 ± 0.4 (SD) °C (Blix *et al.*, 1984).

Our failed attempt to determine age from incisor sectioning and staining is in agreement with Latour (1987) and Gronquist & Dinneford (1984) and suggest that there are presently no reliable method for age determination in muskoxen.

We did not observe any peculiar behaviour in our muskoxen that seemed to behave pretty much as described for wild muskoxen, but we did observe that the animals were eating seaweed (*Fucus serratus*) in spring, which might suggest mineral deficiency during winter. The island habitat of our animals also allowed them to wade in shallow water during hot summer

days, something they seemed to enjoy.

The treatment of *Contagiosa ecthyma* infections and description of the virus are given in Mathiesen *et al.* (1985). Initially, a vaccine was developed, but it soon became clear that the virus differed in different years, either as a result of rapid mutations, or as a result of new sources of infection (Moens *et al.*, 1990). Vaccination was therefore not pursued and treatment was limited to repeated surgical removal of the lesions, which in the eighties and nineties were mainly located around the eyes, on the lips and nostrils, while they in recent years have occurred to an increasing extent at the rims of the hooves. In animals which are walking in crusted snow, the latter results in constant bleeding which has obviously contributed to a lethal outcome.

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Erfaringer med 40 års moskusfehold i Norge

Abstract in Norwegian / Sammendrag: Førti års erfaring med oppdrett og røkt av moskusfe, hovedsaklig på Ryøya utenfor Tromsø (~70° N; 19° E), er presentert, og data om driftspraksis, reproduksjon, sykdommer og livsforløp er diskutert.