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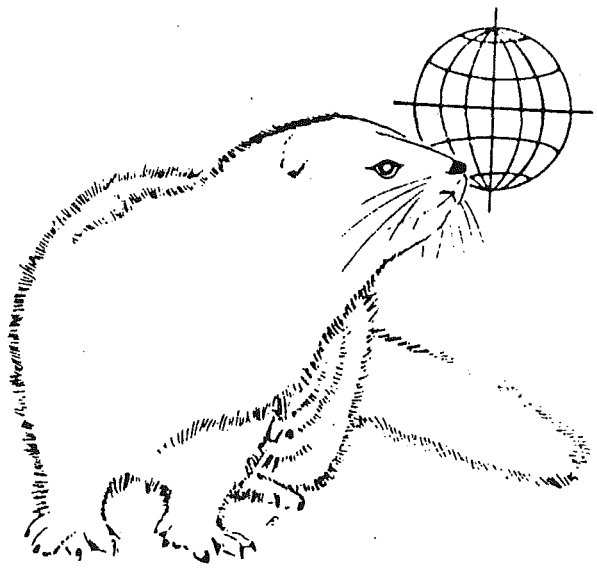

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**Titles of other publications - not abstracted**

**Book Review. Biology, ecology and management of the red fox.** *Jacek Goszczynski. Acta Theriologica 36 (3-4):292, 1991. 1-256, publication of Rome Theriological Association, Rome, 1991. ISSN 0394-1914. Code 1-14-F.*

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## 4. Genetics

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**Robertsonian translocation in Arctic fox (*Alopex lagopus*) stocks. (Review).** *Z. Szendro. Magyar Allatorvosok Lapja, 45;11:657-659, 1990. Code 4-3-F.*

## 5. Reproduction

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**Parvoviruses. Medical and biological aspects.** *John R. Pattison. Fields Virology, Volume 2 (edited by Fields, B.N; Knipe, D.M) ed. 2; 1765-1784, 1990. 136 refs. Code 9-M-O.*

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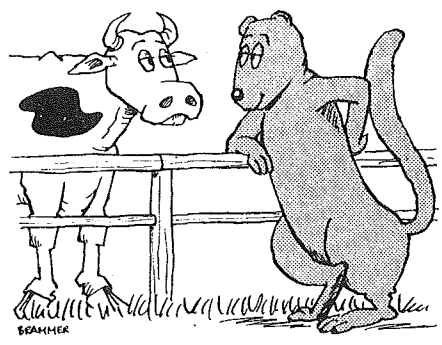
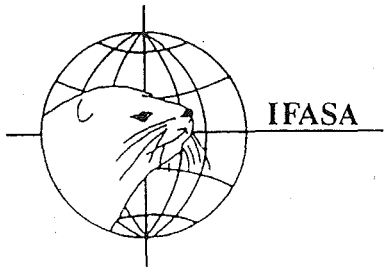
## 8. New books





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Notes

SCIENTIFUR

Vol. 16, No. 3

August 1992

The Vth International Scientific Congress in Fur Animal Production in Oslo August 13-16, 1992 is the event of the year for everybody interested in fur animal research and production.

Scientifically, the number and quality of reports confirms the increasing activity in basic and strategic research regarding fur animals. This is very promising for the future of fur animal production. The influence of the crisis in the fur industri does, however, cast a shadow, i.e. on the number of participants - which is far too low.

Many good researchers and advisers will be absent as they are no longer in the business because their positions have been eliminated in connection with the decrease in economic resources for such activities. Many are also absent because it has been impossible for them to raise the necessary funds for participation. Both reasons - WITH EXACTLY THE SAME BACKGROUND - are not very promising for the future.

It is therefore very important that this congress and the establishment of the working groups of IFASA can intensify the international cooperation and coordination regarding fur animal research.

International congresses are very valuable as "status reports" regarding the stage of research. They are also very valuable for the participants to make important contacts at all levels.

On the other hand, congresses are not real scientific working events. Such activities take place in smaller audiences in working clothes instead of evening dress. Therefore it is so important during the Vth Congress to get the IFASA working groups established and get the ball rolling.

Based on my experience of more than 30 years in the Scandinavian and the international fur animal scientific arena, my suggestion and wishes for the working groups shall be that the formal committees of the groups will ensure a really good contact between existing groups experienced in such work and arrangements.

It is extremely important that in future the active scientists in the different disciplines have the best possible opportunities to communicate and meet frequently - better between congresses than only at the congress.

THEREFORE - DEAR COLLEAGUES - LEAVE YOUR EVENING DRESS IN OSLO AND WORK HARD IN THE WORKING GROUPS TO ENSURE FURTHER IMPROVEMENT OF INTERNATIONAL FUR ANIMAL RESEARCH WITH THE REDUCED ECONOMIC RESOURCES - A SITUATION WHICH UNFORTUNATELY CANNOT BE EXPECTED TO BE OF A TEMPORARY CHARACTER.

At the Oslo Congress we will distribute the printed SCIENTIFUR INDEX II covering 1987-1991 and present the electronic version - which is not yet ready for distribution. This electronic version covers all the 15 volumes of SCIENTIFUR (1977-1991), i.e. the main part of the international scientific literature on fur animal research all the way back to 1960.

From the editorial point of view we thank all our contributors of original reports. We regret to say that our luxury problem, as mentioned in Notes, SCIENTIFUR, Vol. 16, No. 2, still exists.

We have too much important material in relation to the space available. So give us time - if it can be of any comfort, we have not yet in 1992 ordered copies of material reported through the international database search, so much more important information is on the way for our subscribers.

On page 254 we have taken the liberty to copy a letter from a dear friend - namely Bruce W. Smith - dated June 25 this year - former editor of Fur Rancher.

Thank you Bruce for many years of friendship and cooperation. We wish you all the best for the future, which we can see from your letter will still be active, and we are convinced that we shall meet again.

The address and phone number of Bruce will appear on page 254.

In conclusion, we wish all the best for the Vth Congress in Oslo and for you until we are back again after the inspiring event.

Best regards,

Your editor

Gunnar Jørgensen

*Original Report*

# Induced changes in social relationships of blue foxes

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**Summary**

Extra animals were added to original group in an attempt to induce possible changes in social status and rank orders. Hierarchical positions were most pronounced at feeding times and were employed by visual signals and fights. Among the members of the original group, males were normally dominant to females, and no marked correlation between the size of animal and dominance was observed. The hierarchical structure of original group was rather fixed. The newcomer was normally more or less of an outsider of the original group despite its social status. The changes induced in social structure by means of extra animals were independent of sex.

## Introduction

Many members of the family Canidae can form flexible social organizations when living in groups (*Scott, 1967; Fox, 1969; Kleiman and Eisenberg, 1973; Alexander, 1974; MacDonald, 1983*). Typically, such a social organization is maintained by the social behaviour of the individuals within the group, and is characterized by numerous visual status signals and contacts (*Rabb et al., 1967; Kleiman, 1967; Zimen, 1976; Wakely and Mallory, 1988*). Thus one can detect separate roles within the pack. For example, in the case of the wolf, there is a dominant male and female, subordinate males and females, the peripheral males and females, and juveniles (*Woolpy, 1968*). Often the social rank order within the pack is rather stable, despite the maturation of young and their emergence into the adult hierarchy.

The arctic fox (*Alopex lagopus L.*) is often considered to be relatively solitary when living in the wild (*Fox, 1969; Banfield, 1977*). During the denning season, on the other hand, reproducing arctic foxes can form social family groups consisting of an adult male, a female and their progeny. Social interactions between members of the family at dens, however, seem to be limited (*Garrott et al., 1984*). Sometimes also supplemental adults have been observed at rearing dens (*Eberhardt et al., 1983*), some of them acting as helpers (*Hersteinsson and MacDonald, 1982*). In captive-reared arctic foxes the social organization is formed very easily since the animals have already reached their adult stage (*Wakely and Mallory, 1988*).

In our previous paper (*Korhonen and Alasuutari, 1991*) we have studied the formation of social hierarchies in farmbred arctic blue foxes kept in captivity. The results showed that blue foxes are social animals that employ a rich repertoire of visual signals in order to denote status and intent. The present paper continues to further clarify the social relationships among foxes housed in large ground floor enclosures.

## Materials and methods

*General procedures*
The experiments were carried out at the Muddusjärvi Experimental Farm of the University of Helsinki, In Finnish Lapland. The original group (ORIG; see tables 1 and 3) consisted of four juvenile arctic blue foxes (2 males, 2 females) originally farmborn (June 10th, 1990) and all coming from the same litter ( Exps. 1-7). At the beginning of September they were transferred together into a large ground floor enclosure measuring 11 m long x 8 m wide x 2 m high. The enclosure contained three wooden nest boxes measuring 70 cm long x 40 cm wide x 40 cm high.

The animals were fed twice a day. Feed composition and ratios were mainly based on the standards recommended by the Finnish Fur Breeders' Association (*Korhonen and Harri, 1986*). The body weights of the animals were measured employing a LARIO-bowbalance (accuracy ± 50 g). During the mating season, the development of the oestrus cycle was monitored in females by the evaluation of vulval swelling as well as the change in the electrical resistance of the vaginal tract (measured with a modified ohmmeter:SiLi3 digital heat detector, LIMA AS, Sandnes, Norway).

*Original group*
The original group (ORIG; 2 males, 2 females of same litter) formed the basic social organization (table 1). Seven extra foxes were added to group one at a time (table 2). The testing of any extra animals was not begun before mid-October, i.e. before the animals had reached their adult size. The basic group was monitored several days weekly to determine its social hierarchies and dominances. The behavioural patterns of the animals were then registered 15 minutes before feeding, at feeding time, and 15 minutes after feeding. Feed was presented to each animal on a wooden tray measuring 30 cm long x 25 cm wide x 2 cm thick. The order in which the individuals ate, as well as the number and outcome of challenges made by the other foxes was recorded. The behaviour of both the challenger and the defender was noted. Feeding dominances were determined on the basis of aggressive encounters and visual status signals with respect to feed items (*Fox, 1969*). The behavioural patterns and activities of the animals were additionally recorded by visual observations lasting 24 consecutive hours (*Korhonen and Alasuutari, 1991*).

*Testing of extra animals*
The animals added to the groups were housed according to conventional farming procedures (individually) before the experiments. The testing periods lasted from 6 to 26 days. They started by releasing the extra animal into the enclosure. Immediately after its release, careful observations lasting 30-60 minutes were made. Special attention was paid to the following aspects: (1) how did the newcomer behave? (2) what were the reactions of the original group? (3) what was the social rank of the newcomer?

Additional observations were made daily during feeding times. Now the most important questions were: (1) did the newcomer eat or learn to eat? (2) were there any changes in the original feeding hierarchy? During the experimental weeks this was monitored further: (1) did the newcomer remain an outsider or could it become integrated into the group? (2) how did social hierarchies develop during the weeks?

## Results

*Original hierarchies*
Social hierarchies and dominances developed quickly, being evident to some extent 1-4 days after the experiments had started. However, they were not necessarily firm at this time but somewhat flexible. Normally males were dominant to females (tables 1-3). Hierarchical dominances were most pronounced at feeding times. Often, the dominant male quickly consumed its own feed. After that, it went and warded off the subordinate male or females from their feeding trays, and ate some (or all) of their feed.

The body weights of the original animals (ORIG) were measured four times (table 1). At the beginning of the experiments (in September), the dominant male (M-2) appeared to be the heaviest, but because we did not measure them accurately we cannot be quite sure. However, on January 17th, the subordinate male (M-1) was the heavi-

est, weighing about 600 g more than the dominant male. As concerns the females, the dominant individual (F-C) was slightly heavier then the subordinate one (F-3). The trend was similar throughout the experimental period. At the last weighing (April 22th), the dominant male was 400 g lighter than the subdominant individual. Because of rather excessive feed supply, each individual received a required amount of feed which partly explains why the body weight of the dominant individual could be lighter than that of the subordinate one. The social status of the animals within the group is additionally given in table 1. Within the group, the rank order remained the same throughout the study.

**Table 1.** Body weights (kg) and social status of the original group (ORIG). Social status=1; most dominant, social status=4; least dominant. ?=dominance unable to estimate. M-1=initially subordinate male, M-2=initially dominant male, F-3=initially subordinate female, F-C= initially dominant female.

| Variable | M-1 | M-2 | F-3 | F-C |
|---|---|---|---|---|
| Body weight, Kg | 9.2 | 8.6 | 6.9 | 7.2 |
| Jan 17 | 9.3 | 7.5 | 7.0 | 6.9 |
| Feb 28 | 8.2 | 6.7 | 6.1 | 6.2 |
| Mar 19 | 7.3 | 6.9 | - | - |
| Apr 22 | | | | |
| Social status | | | | |
| Oct 17 | 2 | 1 | 4 | 3 |
| Nov 1 | 2 | 1 | 4 | 3 |
| Jan 17 | 2 | 1 | 4 | 3 |
| Feb 28 | 2 | 1 | 4 | 3 |
| Mar 19 | ? | ? | ? | ? |
| Apr 22 | 2 | 1 | - | - |

*Experiment 1*

The first testing started on October 18th when an old male was put into the enclosure (table 2). Soon after, a fairly tremendous fight between the newcomer and the group was observed. The entire pack chased the old male who, however, stayed firm and repelled the attacks. After 15-20 minutes from the start of testing the situation calmed down.

**Table 2.** Summary of the animals tested and experimental arrangements. Date1=start of the experiment. Date2=end of the experiment. BW1=initial body weight (kg). BW2=final body weight (kg). M-O=1 year old male, F-O=1 year old female, M-Y=juvenile male, F-Y= juvenile female, M-OO=juvenile male, F-OO=1 year old female.

| Animal/Experiment | Date 1 | Date 2 | BW 1 | BW 2 |
|---|---|---|---|---|
| M-O/EXP 1 | Oct 18 | Oct 31 | - | 6.0 |
| F-O/EXP 2 | Nov 2 | Nov 12 | - | - |
| M-Y/EXP 3 | Nov 16 | Dec 12 | - | 6.9 |
| F-Y/EXP 4 | Jan 3 | Jan 17 | - | 6.7 |
| M-O/EXP 5 | Jan 30 | Feb 12 | 6.3 | 6.2 |
| M-OO/EXP 6 | Feb 19 | Feb 24 | - | 7.6 |
| F-OO/EXP 7 | Feb 27 | Mar 7 | 5.9 | 5.2 |

At the first feeding time the old male did not eat because the feeding pattern was so different from that which he was previously used. During the second feeding time, however, he already knew what to do and got his feed. Social rank orders formed very quickly during the first day of testing. The newcomer now dominated all of the other foxes (table 3), except for the original dominant male (M-2). This social hierachy remained fixed throughout the entire testing period. Despite the fact that the newcomer was second highest in the ranking list, he mainly stayed alone and was an outsider in relation to the original group.

**Table 3.** Social rank orders of the original group (ORIG) and animals tested (Exps. 1-7). For the abbreviations and experiments see tables 1 and 2. Highest=most dominant, lowest=least dominant.

| ORIG | EXP 1 | EXP 2 | EXP 3 | EXO 4 | EXP 5 | EXP 6 | EXP 7 |
|---|---|---|---|---|---|---|---|
| M-2 | M-2 | M-2 | M-2 | M-2 | M-2 | M-2 | M-2 |
| M-1 | M-0 | M-1 | M-1 | M-1 | M-1 | M-1 | M-1 |
| F-C | M-1 | F-0 | M-Y | F-C | M-0 | F-C | F-C |
| F-3 | F-C | F-C | F-C | F-3 | F-C | F-3 | F-3 |
| | F-3 | F-3 | F-3 | F-Y | F-3 | M-00 | F-00 |

*Experiment 2*

The second test composed of the original group include an old, barren female (table 2). The situation now was rather calm from the very beginning, and not many fights or contact-seeking attacks occured. The males were not interested in the newcomer. The females, on the other hand, went over to sniff the newcomer. In this situation, however, the dominant female (F-C) suddenly bit the tail of the newcomer who then fled. F-C chased her for a while. Both females screamed occasionally when persecuting the old female. Already 10 minutes after the start of the experiment the group and the newcomer calmed down.

At feeding time the newcomer did not understand how to eat at first. After eating their own feed, the other animals came to eat the feed of the newcomer, and warded her off. This occurred during the 1st and 2nd feeding times. At the third feeding the old female was already eating. Now F-C approached the newcomer, but she chased F-C away. Soon after that the subordinate male (M-1) came and warded off the newcomer from the feeding plate. At later feedings the old female ate and defended her own feed. However, she remained somewhat shy and as an outsider to the group throughout the experiments. On November 12th, the old female was already ruling the feeding situation; she could ward off the other females from their own feeding plates. The males, on the other hand, still ruled over the newcomer. Finally, the newcomer was ranked as the highest female in the list (table 3).

*Experiment 3*

A juvenile male was tested in this experiment (table 2). At first, the group was interested in the newcomer. The newcomer, however, ran away, and the original group started to chase it. This lasted for the first 10 minutes, after which the situation became calm. Now the newcomer stayed in one of the corners, and the original group went to the other side of the enclosure. After 15 minutes, the chasing started again but was rather playful in character. Occasionally, original males yapped at the new male.

At feeding times the newcomer stayed some distance out of the range of the feeding trays during the first three days. Thereafter, it learned to eat. However, the original males often drov him from the feed, and then ate his feed. In respect of the females the newcomer was now dominant over the feed items. Although still somewhat of an outsider, the newcomer became clearly integrated within the group after 3 days of introduction. Finally, its social rank rose to 3, i.e. subordinate to the original males, but above the females (table 3). Table 4 additionally illustrates the development of social status in this experiment. Breaking of the original hierarchy did not start until two weeks after the start of the experiment. During that time there occurred an unstable state before the hierarchies reached their final form in December 11th.

**Table 4.** A representative example of the development of social status between the animals of the original group (M-2, M-1, F-C, F-3) and the newcomer (M-Y). Testing period here lasted 26 days (Exp 3). Social status=1; most dominant, social status=5; least dominant, ?=dominance unable to estimate.

| Date | M-2 | M-1 | F-C | F-3 | M-Y |
|---|---|---|---|---|---|
| Nov 16 | 1 | 2 | 3 | 4 | 5 |
| Nov 20 | 1 | 2 | 3 | 4 | 5 |
| Nov 22 | 1 | 2 | 3 | 4 | 5 |
| Nov 29 | 1 | 2 | ? | ? | ? |
| Dec 5 | 1 | 2 | ? | 5 | ? |
| Dec 11 | 1 | 2 | 4 | 5 | 3 |
| Dec 12 | 1 | 2 | 4 | 5 | 3 |

*Experiment 4*
A juvenile female was tested here (table 2). A subordinate male noticed the newcomer at once, and came over to sniff her. Soon, the entire group approached her, resulting in chasing activity. After a few minutes, the chase was over; the newcomer then went to the other side of the enclosure, and the original group, accordingly, to the other side.

At feeding times the newcomer was an outsider, and normally was left without much feed by the other foxes. This pattern was typical throughout the entire observation period. The social status of the newcomer was lowest as concerns both feeding hierarchies and other activities (table 3).

*Experiment 5*
The same elderly male was tested as in experiment 1 (table 2). Soon after putting this male into the enclosure, the original group began to chase him for approximately 5 minutes. After that, the newcomer retreated into his own corner and the original group moved to the other side of the enclosure. This led to a calming of the situation. After a 10-minute interval, both of the original males started to chase the new male, all the while growling and attacking aggressively. The females stayed out of this quarrel. Encounters between the males lasted for about half an hour. When feed was offered to the animals, the newcomer was able to hold his own feed to some extent. He always warded off females if they came too close to his feed. The original males, on the other hand, dominated him and often forced the new male away from its feeding tray. During the test period, many rough fights were observed between the newcomer and subordinate male. Meanwhile both original males chased the new male together. At the final ranking, the newcomer placed third after the original males (table 3).

*Experiment 6*
A juvenile male was tested in the present experiment (table 2). No marked fights were observed, although the entire group chased the newcomer. The dominant male (M-2) was found to be the most aggressive. The situation calmed down within 5-10 minutes. The newcomer now went into its own corner, at a distance from the original group.

At feeding times the newcomer was shy. Typically, he went inside the nest box when feed was offered to the animals. He did not dare come out before feeding time was over. Thus, he normally did not receive feed at all. During the entire experimental period, the new male remained as an outsider in relation to the original group. As concerns the final social ranking, the newcomer was listed at the very bottom, even below the females (table 3).

*Experiment 7*
The last animal tested outside the original group was a one-year-old female (table 2). At first, the males showed interest in the newcomer, but soon the females also became interested. Chasing by the group was evident here again. The most remarkable attacks were observed between the newcomer and the dominant female (F-C). One hour after the start of the experiment, some quarelling and chasing still occurred.

During the first 3-4 days the new female did not eat at all. On March 7th, it was noticed for the first time that the newcomer came and ate the feed that was reserved for her. However, she could not defend her feeding tray, but was easily

warded off by the other foxes. On February 28th, it was noticed that the left ear of the newcomer had been bitten and was bleeding. Blood was also seen on the nose of the dominant female (F-C). These two females were found to fight every now and then throughout the testing period. The newcomer was ranked as lowest in social hiearchy (table 3). Her position remained the same throughout the testing time.

Table 5 summarizes numerically the level of social aggressiveness between the individuals of the originally group and the newcomers. The bigger the number, the more social aggressiveness existed between the animals compared. Among the original group, aggressions towards the newcomers were most pronounced in the dominant male (M-2) and dominant female (F-C). No correlation was found between the sex of the newcomer and the aggressiveness of the original group. Juvenile newcomers tended to cause less aggressivenes than older animals. The highest level of aggressiveness was present when the 1 year old female (F-00) was tested close to the breeding season.

**Table 5.** Estimated levels of aggressiveness between original (ORIG) and tested animals. 1=high level of aggressiveness, 2=moderate level, 3=low level. For the abbreviations and experiments, see tables 1 and 2.

| | M-0 | F-0 | M-Y | F-Y | M-0 | M-00 | F-00 | TOTAL |
|---|---|---|---|---|---|---|---|---|
| M-2 | 3 | 1 | 1 | 1 | 3 | 2 | 2 | 13 |
| M-1 | 2 | 1 | 1 | 1 | 3 | 1 | 2 | 11 |
| F-C | 1 | 3 | 2 | 1 | 1 | 1 | 3 | 12 |
| F-3 | 1 | 2 | 1 | 1 | 1 | 1 | 3 | 10 |
| TOTAL | 7 | 7 | 5 | 4 | 8 | 5 | 10 | |

## Discussion

Juvenile hierarchies in captive arctic foxes have been described to be nonlinear and dominant individuals are associated with neither a particular sex nor weight class. After the animals reach their adult size (after the fall equinox), however, the hierarchies seem to become linear, and the dominant individuals are the heaviest males (*Wakely and Mallory, 1988*). In the present study, the experiments were not started before September, i.e. before the animals had a body size of the adult stage. Thus, the results do not deal with the development of juvenile hierarchies, but concern adulthood. This probably explains why the hierarchies of our original group developed so quickly, and remained surprisingly constant throughout the periods studied. Additionally, we found the males to be dominant over the females in our original group. Adult male arctic foxes have been found to be dominant over females under field conditions, too (*Hersteinsson and MacDonald, 1982; Garrott et al., 1984*). However, our findings do not confirm the previous observation that the heaviest male under captive conditions is not necessarily the most dominant (*Wakely and Mallory, 1988*); as table 1 revealed at each weighing the dominant male was markedly lighter than the subordinate one. The body weights of both original females, on the other hand, were similar. In the wolf, there are also some observations that the size of the animal does not appear to be an essential criterion of dominance, either within or between sexes (*Woolpy, 1968*).

The results revealed that the social structure of the original animals was surprisingly fixed but, nevertheless, their social hierachies can be manipulated to some extent. These changes seem to be possible to induce, at least, by putting extra animals into the group. The relationships between the newcomer and the original group, however, seem to be loose in general. In the wolf, it has been found that also temporary removal of the original alpha male promotes changes in the social order among captive packs (*Rabb et al., 1967*). Occasional escapes or removals of the females in the present work, however, did not seem to induce any hierarchical changes for the rest of the group. In some canids, natural changes have been additionally described to occur by the death of the original alpha individual, by temporary extraterritorial movements or by other factors such as injury or aging (*Scott, 1967; Rabb et al., 1967; Zimen, 1976; Messier, 1985*).

As the results showed, the newcomer was normally more or less of an outsider of the group, and did not achieve a close relationship between the original group despite its social status. Our testing periods were rather short, which of course, can influence the situation and the formation of relationships. If the new animals had remained for longer periods of time within the group, the relationships and rank orders probably could have been different. Our longest experiment (3) showed that the start of changes in the original hierarchy could require a time of up to 2-3 weeks.

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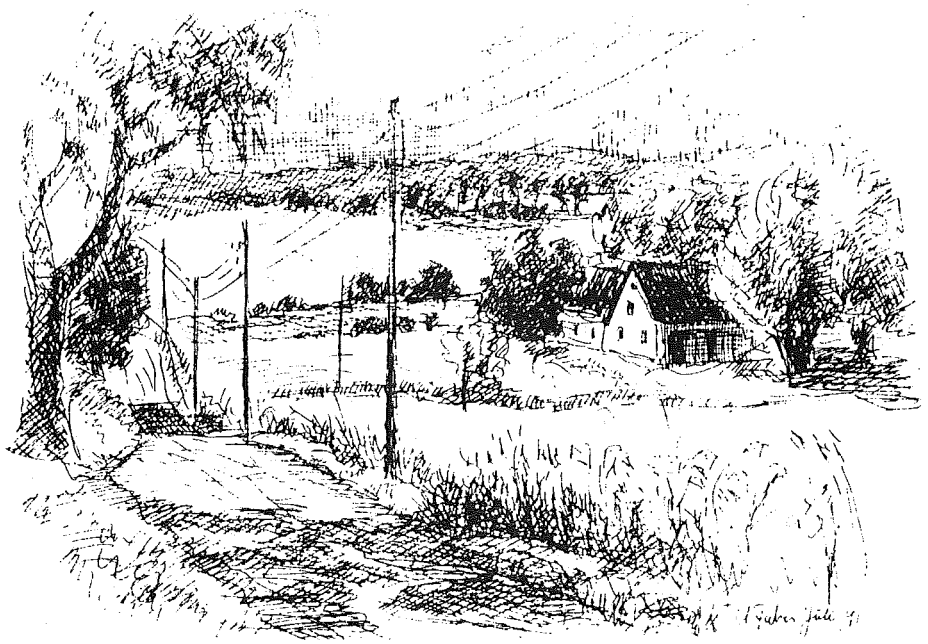


**Effect of environmental stress and immobilization on stress physiological variables in farmed mink.**

*Steffen W. Hansen, Birthe M. Damgaard.*

The effect of cage size and nest box environment on plasma cortisol, number of eosinophil leucocytes, and on frequency of leucocyte groups was measured on 132 farmed mink. The experiment included three cage sizes (0.10 $m^2$, 0.27 $m^2$, and 1.1 $m^2$) and cages with and without nest boxes. Furthermore, the effect of daily immobilization in a mink trap for 5 or 30 min. over periods of 10 days was demonstrated.
The effect of daily immobilization for 5 min. was an unchanged cortisol response to immobilization from day 1 to day 10, no effect on eosinophil leucocyte level, and a decrease of H/L-ratio from day 1 to day 10. After 30 min. daily immobilization the cortisol response decreased from day 1 to day 10, the eosinophil leucocyte level decreased, and the H/L-ratio increased from day 1 to day 10. Mink females in cages without nest boxes had a higher plasma cortisol level, a lower level of eosinophil leucocytes, and a higher H/L-ratio than mink in cages with nest boxes. No effect of cage sizes was seen on the physiologicl variables used. A pronounced seasonal variation has been shown in the physiological variables used.
The results made it possible to conclude that the duration of individual immobility sessions is of consequence to the physiological effect of immobilization. The physiological stress level increased when farmed mink were deprived of the use of nest boxes. The effect of keeping mink in ages without nest boxes was similar to daily immobilization for 30 min. with regard to both the level of eosinophil leucocytes, the relative distribution of leucocyte types, and the H/L-ratio.

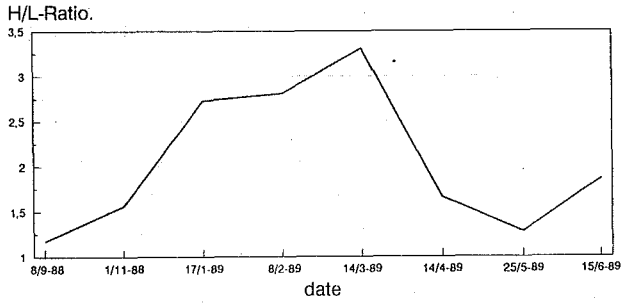



**Fig 3.** H/L-ratio (ratio between heterophil leucocytes and lymphocytes) in female mink.

*Behavioural Processes, 25, 191-204, 1991. 4 tables, 3 figs., 17 refs. Authors' abstract.*

**The effect of housing management upon the growth and haematological parameters of standard nutria.**

*V. Parkányi, J.Rafay, I. Jakubicka, M. Barta.*

20 heads of standard nutria (10 males and 10 females) at 60 to 240 days of age were tested. 10 animals (5 males and 5 females) were reared in enclosures with basins and 10 animals (5 males and 5 females) in cages with drinkers. The objective of our work was to evaluate both systems from the standpoint of growth and haematological parameters.
Growth was equal in both systems and during the investigated period did not differ in terms of rearing system. At 240 days of age, nutria live weight was 5661±537.06 g in the enclosures with basins and 5923±678.54 g in the cages with drinkers.
Acid-base balance values (pH, $pCO_2$) and haematological parameters (leucocytes, erythrocytes, hemoglobin, hematocrit) did not differ. Significant differences were recorded only in $pO_2$ values, mean erythrocyte volume and colour index. It may be stated, however, that nutrias adapted to the rearing systems and maintained their internal homeostasis in both types of housing. The above-mentioned knowledge may be used as an objective criterion of suitability of cage technology for nutria rearing.

*Scientific works of the Research Institute of Animal Production, Nitra, XXIV, 159-165, 1991. 3 tables, 13 refs. In CHEC, Su. ENGL, RUSS, CHEC. Authors' summary.*

**Growth of the ferret tracheobronchial tree.**

*Michael J. Oldham, Robert F. Phalen, Robert F. Huxtable.*

Because the ferret is being used increasingly in inhalation toxicology and lung physiology studies, it is necessary to better understand the airway structure of its tracheobronchial tree. Previously published information does not include dimenstions of bronchi and bronchioles in either adult or growing ferrets. The airway structure of interest for calculating inhaled particle deposition patterns includes airway lengths, diameters and branching angles in each generation. Measurements of these dimensions were obtained for several selected airway paths on replica casts. Casts

were made *in-situ* in four male litter mates age 14 hours, 9.5 days, 16.5 days and 56 days. These data demonstrate, that as with human lung growth, body length at a given age is a good predictor of airway lengths and diameters. Airway branch angles do not appear to change significantly during growth. Sufficient measurements were made to provide dimenstions of a typical tracheobronchial pathway for this species. This pathway begins with the trachea and ends at the terminal bronchiole. The morphometric data were not sufficient to determine whether or not the number of tracheobronchial generations increase or decrease postnatally.

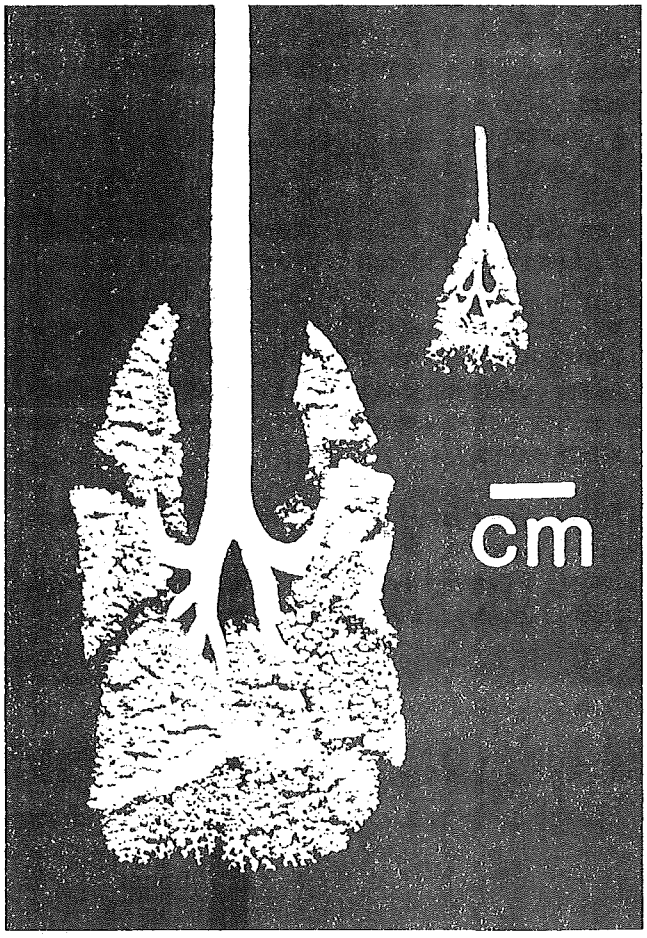



Fig 2. The young adult and newborn ferret tracheobronchial casts (Fe #4 and Fe #1). The silicone rubber casts were prepared in the thorax to maintain anatomical accuracy.

*Laboratory Animal Science, v. 40(2), p. 186-191, 1990. 4 tables, 3 figs., 30 refs. Authors' summary.*

**The anatomical and histological structure of the colon in the coypu (*Myocastor coypus* Mol.).**

*Marian Langenfeld, Ewa Kochan.*

A morphological description of the colon of the coypu, its form and measurements in length and diameter was presented. The structure of the colon walls with particular attention of the mucosa and the lymphatic tissue was shown.

*Acta Agraria et Silvestria. Series Zootechnica, vol. 28, p. 81-19, 1989. 2 tables, 8 figs., 16 refs. In ENGL, Su. POLH, RUSS. CAB-abstract.*

**Influence of aeroionization on the organism and productivity of mink.**

*N.M. Khrenov, A.V. Kokhan, I.N. Koykova.*

The authors was studied the influence of air ionized with light negative aeroions on the organism and productivity of minks. It is stated that the artificial aeroionization renders a positive influence on the physiological status of mink organism and assist in the improvement of the microclimate indices.

*Veterinariya, No. 2, 23-25, 1991. 1 table. In RUSS, Su. ENGL. Authors' summary.*

**Derivation of gnotobiotic ferrets: perinatal diet and hand-rearing requirements.**

*Dean D. Manning, Judith A. Bell.*

A procedure is described which has resulted in successful gnotobiotic derivation of the domestic ferret. The most critical element of this hand-rearing procedure was found to be diet, with ferret milk being required for at least the first 7 days. Puppy milk replacer was phased in during the next 10 days, and enriched cow's milk sufficed thereafter. Around-the-clock sip-feeding with fire-polished Pasteur pipettes was necessary at intervals gradually increasing from 1 to 1.5 hours at birth to 3 hours by day 21. Temperature regulation was accomplished with an electric heating pad placed eccentrically under towel bedding to provide a 30°-40°C gradient, along which the kits positioned themselves to their own comfort. Techniques are described for minimizing fatalities due to dehydration, milk-aspiration pneumonia,

underfeeding, overfeeding, gut stasis and obstipation. Internal hemorrhage, the greatest single cause of mortality in this study, manifested at day 13 and involved all kits by day 17. Despite immediate vitamin K1 dietary supplementation, five of the seven remaining kits died of hemorrhage by day 19. Around day 50, the two surviving kits were weaned from milk to dry commercial cat and ferret diets supplemented with vitamins K, C, A, D, E and B-complex and were reared to adulthood on this diet.

*Laboratory Animal Science, Vol. 40, No. 1, 1990. 1 table, 2 figs., 10 refs. Authors' summary.*

**The C120 magnum with pan trigger: A humane trap for mink (*Mustela vison*).**

*Gilbert Proulx, Morley W. Barrett, Stephen R. Cook.*

The C120 Magnum trap, equipped with a 66 x 69 mm pan trigger, which favored double strikes in the neck and thorax regions, successfully killed nine of nine wild mink (*Mustela vison*) in simulated natural conditions. Average times to loss of consciousness and heartbeat were estimated at <72 (±24) sec and 158 (±48) sec, respectively, after firing of the trap. This study confirmed that the C120 Magnum trap can be expected to render >79% of all captured mink unconscious in ≤3 min ($p < 0.05$). This is the first mink kill trap to meet the requisites of the Canadian General Standards Board regarding killing traps.

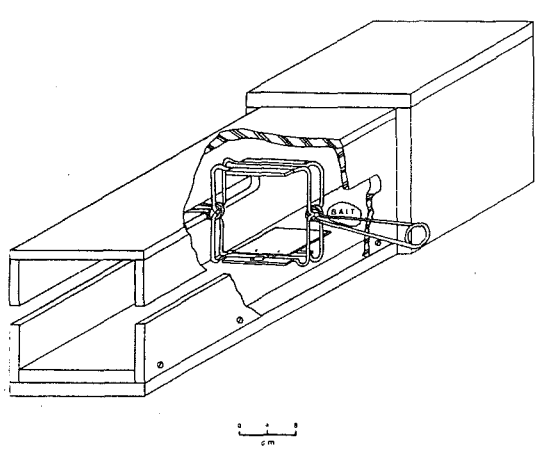


Fig. C120 Magnum with 66 x 69 mm pan trigger in cubby set.

*Journal of Wildlife Diseases, 26 (4), 511-517, 1990. 2 tables, 3 figs., 18 refs. Authors' summary.*

**Fluctuations and behaviour of foxes determined by nightlighting. Preliminary results.**

*Jean-Marc Weber, Stéphane Aubry, Nicole Lachat, Jean-Steve Meia, Claude Mermod, Alain Paratte.*

Nightlighting was used to determine the fluctuations of a red fox *Vulpes vulpes* Linnaeus, 1758 population in the Weiss Jura Mountains between July 1987 and April 1990. The number of foxes seen fluctuated according to month and year. It decreased in winter. Fewer foxes were seen in 1988, likely because of the high human hunting pressure. The behaviour of every fox seen was recorded. Their main activity was hunting and foraging (45%).

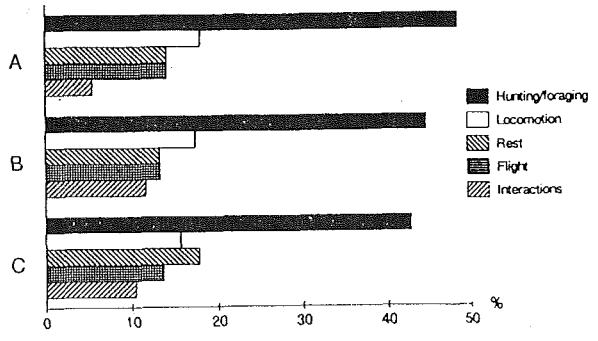



Fig. 2. Frequency of occurrence (%) of different activity types during the 3 sampling periods (A: 9.00 – 12.00 p.m.; B: 0.00 – 3.00 a.m.; C: 3.00 – 6.00 a.m.).

*Acta Theriologica 36 (3-4), 285-291, 1991. 2 tables, 2 figs., 17 refs. Authors' summary.*

**Activity pattern of the red fox *Vulpes vulpes* in Doñana, SW Spain.**

*Jorge Servin, Jaime R. Rau, Miquel Delibes.*

Radio tracking data from six red foxes *Vulpes vulpes* (Linnaeus, 1758) in Coto Doñana (SW Spain) were used to obtain the activity pattern throughout the day and night. Results suggested that females travelled longer distances during the night than during the day ($p < 0.001$). Males travelled distances similar during both day and night ($p < 0.15$) but they travelled farther than females throughout 24 h periods ($p < 0.05$).

*Acta Theriologica 36 (3-4), 369-373, 1991. 2 tables, 1 fig., 21 refs. Authors' summary.*

**Conspecific recognition and mating in stone marten *Martes foina*.**

*Thierry Lodé.*

The study of the mating of the stone marten *Martes foina* (Erxleben, 1777) revealed the importance of behavioural modifications which favour the intraspecific tolerance. The precopulatory activities affected the whole mode of communication. The frequencies of the male's olfactory investigation of the female's anogenital region and the male's abdominal scent marking increased at this time. Other signals like a particular muted vocalization, the cluck, or those which interested the general sensitivity like body contact facilitated the female's receptivity and the synchronization of behaviours. The male kept on the female with a neck bite which was similar to the newborn transport behaviour of the female. The male's obstinacy to obtain a positive response from the female seemed to determine successful mating.

*Acta Theriologica 36 (3-4), 275-283, 1991. 4 tables, 3 figs., 41 refs. Author's summary.*

**Different levels of energy for mink in the nursing period and the frequency of greasy kits.**

*Georg Hillemann.*

In the nursing period of 1991 experiments were carried out at the Research Farm North with different levels of carbohydrates. The experiments were performed with the standard, pastel and wild mink types. Metabolizable energy from carbohydrates in the feed mixtures varied between 5 and 15%. No significant differences in breeding results etc. were found as a direct result of the experimental treatment. The results regarding kit weight indicated a somewhat better kit weight with 15% of the energy from carbohydrates. Statistics performed on the entire material showed as previously that the highest frequency of greasy kits was seen in young females, in large litters, in kits born relatively late, and in pastel and wild mink. Indications were also found that an increasing content of fat increases the frequency of greasy kits.

*Danish Fur Breeders' Association. Technical Year Book 1991. 93-102. In DANH. 11 tables.*

**Blood values of silver fox kits in the growth period.**

*Bente Lyngs, Grethe Møller, Niels Therkildsen.*

The objective of examining the blood of the kits was to describe the development of certain blood values (normal values) in the growth period, to describe possible differences between males and females, and to describe possible differences between farms. Thus, it would be possible to evaluate analytical results from problem populations in practice. The experiment was carried out at the Research Farm South and at the Research Farm North.

Based on this examination, the following can be concluded:

- there was a certain variation between farms as regards the blood parameters included here. It must be expected that this variation also existed in silver fox populations in general. Some blood values had shown significant differences between the two farms, especially the haematocrit values in all periods and the mean corpuscular volume in 5 out of 7 periods,

- the number of red blood corpuscules increased evenly during the growth season and had possibly not yet reached its peak when the kits were 6 months old,

- the haemoglobin and haematocrit values showed the same development as the red blood corpuscules,

- the number of white blood corpuscules seemed to culminate when the kits were 8 weeks old,

- apparently the red blood corpuscules had the highest mean corpuscular volume at the beginning of the examination period (4 week old kits),

- no significant correlation between the blood values of the female and her kits was found.

*Danish Fur Breeders' Association. Technical Year Book 1991. 161-168. In DANH. 2 tables, 1 reference.*

**Experiment with freezing of fox skins**

*Bente Lyngs.*

In 1990 an experiment with freezing of fox skins at various stages of the pelting process was carried out at the Research Farm North. The skins were frozen for approx. 2 months, when they were sorted according to the general guidelines of the research farm.

The conclusion was:

- apparently blue fox skins were not affected by freezing at different times in the pelting process. Neither quality, size nor clarity of the experiment groups differed from those of the control group,

- in silver foxes, skins frozen immediately before stretching were significantly smaller than the control group,

- the degree of clarity in silver foxes frozen immediately before stretching was significantly better than that of the control group,

- other properties did not differ from the control group.

It therefore seems that blue fox skins can be frozen at any time during the pelting process without risking a deterioration of quality, size and clarity.

Apparently silver fox skins lose some of their elasticity when frozen immediately before stretching. There is no doubt, however, that the conditions under which the skins are unfrozen are very important to the result. The skins should be thawed in such a way that they absorb the condensed water again.

*Danish Fur Breeders' Association. Technical Year Book 1991. 169-173. In DANH. 3 tables.*

**Examination of fat content in the liver macroscopically, chemically, by floating test and correlation to the ALAT content of the blood plasma.**

*Tove N. Clausen.*

The purpose of the examination was to evaluate the correlation in mink between a macroscopical evaluation of the colour of the liver, a "floating test" for determination of the fat content of the liver, a chemical fat determination of the liver and the ALAT enzyme in blood plasma. A further objective of the investigation was to clarify whether the ALAT content of the blood and the fat content of the liver change after 18 hours without feed. The "floating test" shows a fairly good correlation to the chemical fat determination and can therefore be used for an evaluation of the approximate fat content in the liver. Between the "floating test" and an evaluation of liver colour the correlation is, however, not quite so good. This was as expected, however, as it is very difficult to evaluate the colour of the liver in connection with killing. Animals anaesthetized with pentobarbital-Na develop blood stasis in the liver, and it is therefore necessary to remove excess blood. In females deprived of feed for an increasing period of time and to a smaller extent in animals fed differently, an increase of the content of ALAT in the blood and at the same time an increased content of fat in the liver was seen. In animals starved for 18 hours, there was one animal with 13-25% fat, the rest had below 13% fat corresponding to animals which have had access to feed all the time. The procedure of the Research Farm to remove the feed from the cages at 16:00 and take blood samples/kill the animals the next morning must be regarded as satisfactory to avoid hunger-induced fat infiltration in the liver and a "false", too high content of ALAT in the blood.

*Danish Fur Breeders' Association. Technical Year Book 1991. 261-265. In DANH. 4 tables.*

**The importance of stretching to skin length and quality in mink.**

*Niels Therkildsen.*

At the same stretching pressure male and female skins will expand equally expressed in mm, whereas the percent increase was approx. 25% higher in female than in male skins. At the stretching pressures used (4, 5.5 and 7 bar in male skins and 4, 5 and 6 bar in female skins) there are no statistically significant correlations between the absolute or relative skin enlargement at stretching and skin quality. In male skins there was no statistically significant difference in skin length at the stretching pressures used. There was, however, a difference in skin length before stretching which may be the reason why no correla

tion was found in males between stretching pressure and skin length. In the female skins there was a statistically significant increase of skin length between 4 and 5 bar and 4 and 6 bar stretching pressure. It is certain that the skin quality of male skins improves when the stretching pressure is increased from 4 to 5.5 bar. A further increase of the stretching pressure to 7 bar does not with certainty change skin quality or length. The skin quality of female skins is not with certainty influenced in the interval from 4 to 6 bar stretching pressure. The general practice, where male skins are stretched with a pressure of 1-2 bar higher than female skins are in accordance with the experimental results. The use of a high stretching pressure (in this experiment 7 and 6 bar in male and female skins, respectively) increases skin length and does not with certainty deteriorate skin quality, but the risk of overstretched skins increases.

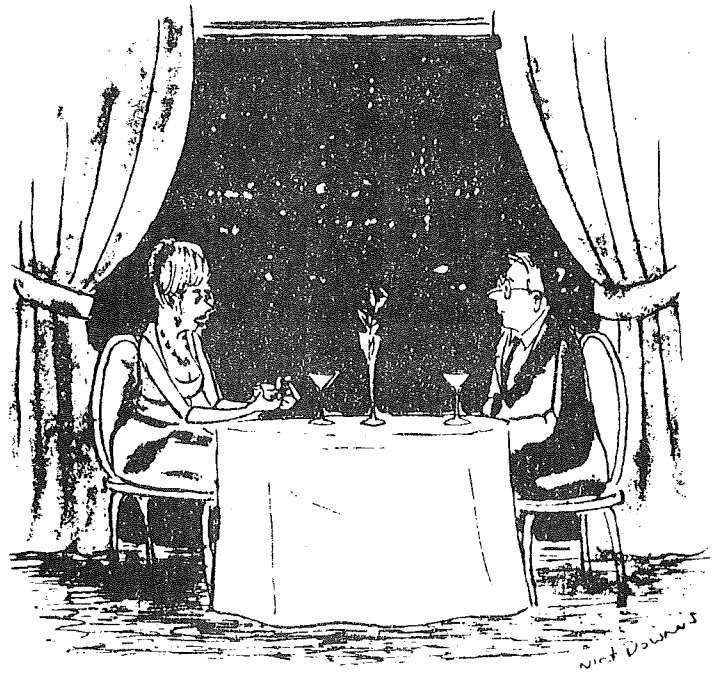
*Danish Fur Breeders' Association. Technical Year Book 1991. 272-277. In DANH. 3 tables, 2 references.*

**Skin length and skin quality**

*Ejner Børsting and Niels Therkildsen.*

A number of investigations show concurrently that weighing and subjective evaluation of the quality on live mink kits give a significant correlation to skin length and quality. Comparisons of weight and length measurements of live kits equally clearly show that the weight is the best measure of skin length. The negative correlation between skin length and quality is mainly biological. Therefore, the measurements on live animals used for selection of breeders must be able to find this correlation. The methods of measurement should therefore aim at giving a real picture of the negative correlation and not "overlook" the real correlation. Generally speaking, this is fulfilled by weighing and the objective quality evaluation of potential breeders.

*Danish Fur Breeders' Association. Technical Year Book 1991. 278-285. In DAHN. 7 tables, 11 references.*



"It may be indistinguishable from a diamond chemically, Harry, but to me, charcoal is charcoal."

*Original Report*

# The microchromosomes in silver foxes, red foxes and their hybrids

*Vladimir Parkányi, Dusan Mertin, Ján Rafay*
*Research Institute of Animal Production,*
*Hlohovská 2, 949 92 Nitra, Czechoslovakia*

**Summary**

In this study were used the lymphocyte cultures obtained from 35 foxes (11 silver and 3 red foxes and their hybrids - 5 gold, 11 golden cross, 5 blended cross foxes). Besides 2 foxes (1 female silver fox and 1 male golden cross fox) are presented the microchromosomes in c-metaphases of all investigated foxes. ß-chromosomes varied in number from zero to five resulting in variation in diploid numbers from 34 to 39. The most frequent numbers of microchromosomes numbers were found. 51.4% of analysed foxes had the mosaic karyotypes. Authors detected 11 variants of mosaic c-metaphases. The red foxes (52.63%) and golden cross foxes (34.34%) had the highest frequency of c-metaphases with 1 microchromosome. The silver foxes (36.59%) and gold foxes (34.04%) had the highest frequency of c-metaphases with 2 microchromosomes. Blended cross foxes were typical with the highest frequency of lymphocytes without microchromosomes (37.50%). The highest statistically significant value of diploid number chromosomes was found in gold foxes (x = 36.98 ± 1.21).

**Introduction**

The red foxes (*Vulpes vulpes L.*) and their melanotic mutations silver foxes (*Vulpes fulvus Desm.*) have the lowest number of chromosomes of all the species hitherto investigated in the family Canidae (*Wurster & Benirschke, 1968*). The karyotype consists of 34 metacentric and submetacentric chromosomes plus a variable number (from 0 to 8) of microchromosomes/ß chromosomes as well.

A diploid chromosome number of 2n=38, which included two pairs of microchromosomes, was first reported by Makino (1947). This same number was later also found by Lande (1958), Gustavsson (1964) and Moore & Elder (1965). The number of microchromosomes has been found to vary from 0 to 8 (*Gustavsson & Sundt, 1965, 1967; Sasaki et al., 1968; Wurster & Benirschke, 1968; Buckton & Cunningham, 1971; Voght & Arakaki, 1971; Lin et al., 1972; Low & Benirschke, 1972; Belyaev et al., 1974; Ellenton & Basrur, 1980; Graphodatsky & Radjabli, 1981; Mäkinen & Gustavsson, 1982; Yoshida et al., 1983; Switonski, 1984; Switonski et al., 1987*).

The microchromosome are centric fragments from a chromosome evolution process of centric fusion (*Gustavsson & Sundt, 1967*). Kuokkanen et al. (1985) found that the most frequent numbers of microchromosomes in the silver foxes were 1, 2 and 3. A mosaic karyotype was common, being present in 84% of the animals. Belyaev et al. (1974) found this in 45% of cases, Ellenton & Basrur (1981) in 75% and Switonski (1984) in 29%.

An interesting observation was made by Radjabli et al. (1978). They found a higher number of microchromosomes in germinal cells than in somatic cells.

Switonski et al. (1987) observed the mitotic and meiotic chromosomes of four silver foxes. 1-4 ß-chromosomes in addition to standard karyotype were investigated with special attention given to pachytene chromosome behaviour as revealed by electron and light microscopy. On the basis of pairing behaviour and morphology it is assumed that the ß chromosomes of silver fox are homologous.

**Material and methods**

The study was carried out with 35 foxes from an experimental fur animal farm of the Research Institute of Animal Production in Nitra. Samples of peripheral blood were obtained from vena saphaena of 11 silver and 3 red foxes and their hybrids - 5 gold, 11 golden cross, 5 blended cross foxes. The hybrids copulate and are completely fertile.

Cultures of lymphocytes were set up, cultivated and harvested according to modified standard procedures (*Mäkinen & Gustavsson, 1980*). We used 2 ml culture medium RPMI 1640 (USOL, Prague) plus 0.2 ml whole blood with 1 drop PHA (USOL, Prague). The cells were treated with colchicine (0.02% solution) 1.5 h. before harvesting. Chromosome preparations were made by the conventional air-drying technique. The average number of analyzed c-metaphases, obtaining after cultivation of lymphocytes peripheral blood, was 10 from 1 fox.

At the present time there is no information about microchromosomes in gold, golden cross and blended cross foxes. Therefore it is utmost topical to the classification of individual genotypes of the genus Vulpes.

**Results and discussion**

Our results give information about the karyotypes of silver, red and mutation foxes that have 32 autosomes and 2 genosomes. Besides 2 foxes (1 female silver fox and 1 male golden cross fox) are presented the microchromosomes in c-metaphases of all investigated foxes. ß-chromosomes varied in number from zero to five resulting in a variation in the diploid numbers (from 34 to 39; table 2). The morfology and greatness of microchromosomes are similar to γ-chromosome, that is acrocentric with the smallest of relative length in c-metaphase. The most frequent findings were with 1-2 microchromosomes in the somatic cells irrespective of genotypes. These results are typical for mosaic and non-mosaic c-metaphases. 51.4% of the analysed foxes had the mosaic karyotypes.

Table 1 gives the frequency distribution of microchromosomes in males and females and classifies mosaic karyotypes with 11 variants. The mosaic c-metaphases are characterised with interindividual differencies among genotypes and intraindividual differencies among cells within individuals.

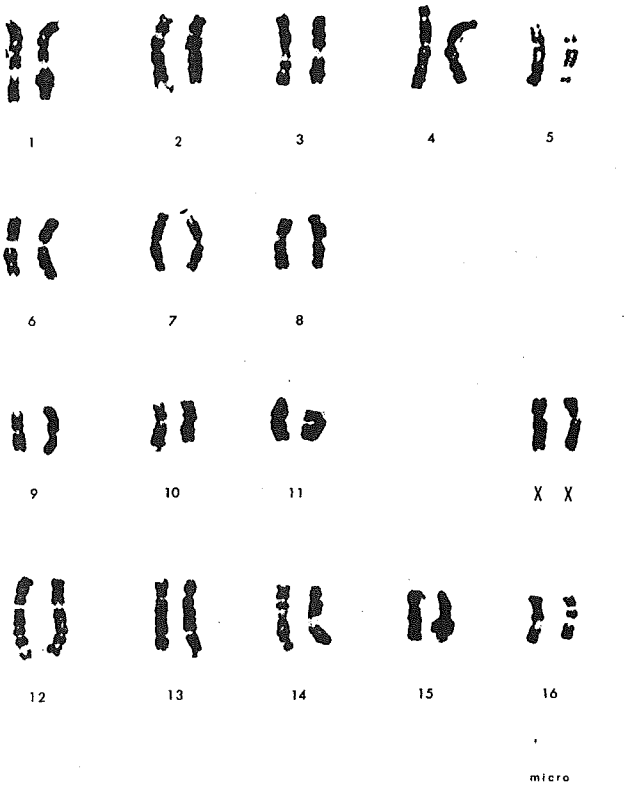


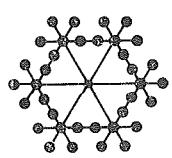

Fig. 1. G - banded karyotype of the Gold fox. 2n = 34.xx + 2ß

Table 1. Variability of microchromosomes in investigated fox genotypes (S-silver, R-red, GF-gold, GNF-golden cross, B-blended).

| Genotypes ß-chrom. | S n=11 | R n=3 | GF n=5 | GNF n=11 | B n=5 |
|---|---|---|---|---|---|
| 0 | ♀78 | | | ♂205 | |
| 1 | ♂47 | ♂9 | | ♀228, ♂229 | ♀218 |
| 2 | ♀72, ♂59, ♂57 | | ♀216 | ♂225, ♂230 | |
| 3 | ♂39, ♂43 | | | | ♂201 |
| 4 | | | | | ♂227 |
| 5 | | | | | |
| 0-1 | | | | ♂231 | ♀224 |
| 0-1-2-3 | | ♂3 | | | |
| 1-2 | ♂55 | | | ♂207, ♂223 | ♀232 |
| 1-2-3 | ♀80 | ♀22 | | | |
| 1-2-3-4 | | | ♂217 | | |
| 1-3 | | | ♂211 | | |
| 2-3 | ♀60 | | | ♀214 | |
| 2-3-5 | | | | ♂215 | |
| 2-4-5 | | | | ♀208 | |
| 3-4 | ♀52 | | | | |
| 3-5 | | | ♂219, ♂213 | | |

In table 2 are presented ß-chromosomes of all fox genotypes. The highest frequency of 2 microchromosomes is typical for silver foxes (36.59%) and for gold foxes (34.04%). The red foxes and golden cross foxes had the highest frequency of c-metaphases with 1 microchromosome (RF-52.63%, GNF-34.34%). The blended cross foxes were typical with the highest frequency of lymphocytes without microchromosomes (37.50%), i.e. the fundamental diploid number of chromosomes was 2n=34.

The gold foxes had intraindividual mosaic metaphases with 3-5 microchromosomes (23.40%) and the golden cross foxes had metaphases with 2-3-4-5 microchromosomes in frequency 2.02% only.



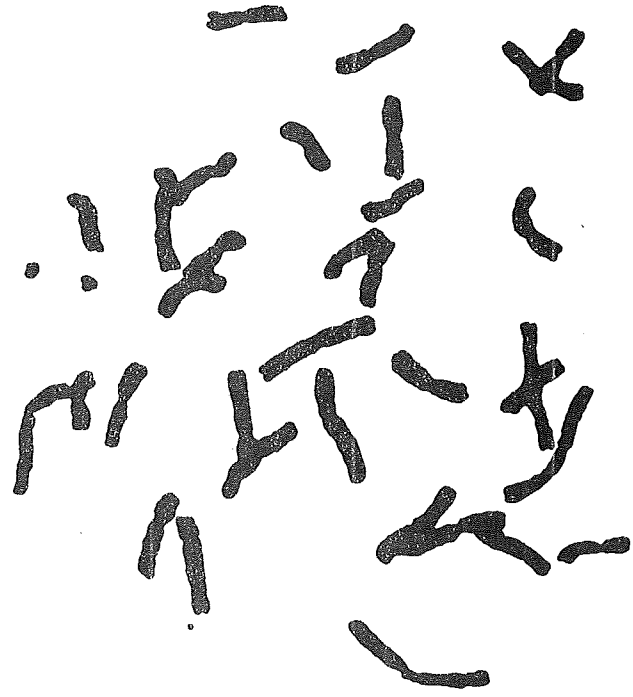


Fig. 2. C - metaphase of the Red fox. 2n = 34.xx + 1ß.

Table 2. Frequency of diploid number of chromosomes (2n=34 + ß).

| Genotypes | S n=11 | R N=3 | GF n=5 | GNF n=11 | ß n=5 |
|---|---|---|---|---|---|
| 2n | % | % | % | % | % |
| 34 + 0 ß | 10.57 | 5.26 | 0 | 8.08 | 37.50 |
| 34 + 1 ß | 26.83 | 52.63 | 8.51 | 34.34 | 20.00 |
| 34 + 2 ß | 36.59 | 34.21 | 34.04 | 31.31 | 0 |
| 34 + 3 ß | 20.33 | 7.89 | 31.91 | 12.12 | 20.00 |
| 34 + 4 ß | 5.69 | 0 | 2.13 | 12.12 | 22.50 |
| 34 + 5 ß | 0 | 0 | 23.40 | 2.02 | 0 |

Table 3. Average values of diploid number chromosomes.

| Genotypes | S n=11 | R n=3 | GF n=5 | GNF n=11 | ß n=5 |
|---|---|---|---|---|---|
| c-metaphas. | 124 | 38 | 47 | 99 | 40 |
| x | 35.85 | 35.45 | 36.98 | 35.92 | 35.70 |
| s | 1.05 | 0.72 | 1.29 | 1.21 | 1.67 |
| $s_x$ | 0.09 | 0.11 | 0.19 | 0.12 | 0.26 |
| v % | 2.94 | 2.04 | 3.50 | 3.37 | 4.47 |
| F-test | GF : S, R, GNF, B** | | | | |

$F_{0,05}(4,318) = 2,372^{+}$ $F_{0,01}(4,318) = 3,319^{++}$

Table 3 gives the average number of chromosomes in observed genotypes foxes (2n=34 + 0-5). Significant differences were among gold foxes and the other genotypes foxes (GF: S, R, GNF, $B^{++}$). In gold foxes was the highest value of diploid number chromosomes 36.98 ± 1.21.
The variation in the number of microchromosomes in the different metaphases of the hybrids (GF, GNF, B) was high and in the present study, the number of microchromosomes in silver foxes and red foxes. This can be due to either that the frequency of microchromosomes is higher in the germ line cells than in the somatic cells or that the gametes with more microchromosomes are favoured.

Most of foxes in the present study had 1 or 2 microchromosomes. The frequency can be a consequence of selection of breeding animals on the farm. Selection is mainly based on fur quality, fertility and behaviour. It would be interesting to study whether these characteristic have any connection with the number of microchromosomes with the consequence that animals with 1 or 2 microchromosomes tend to be selected.

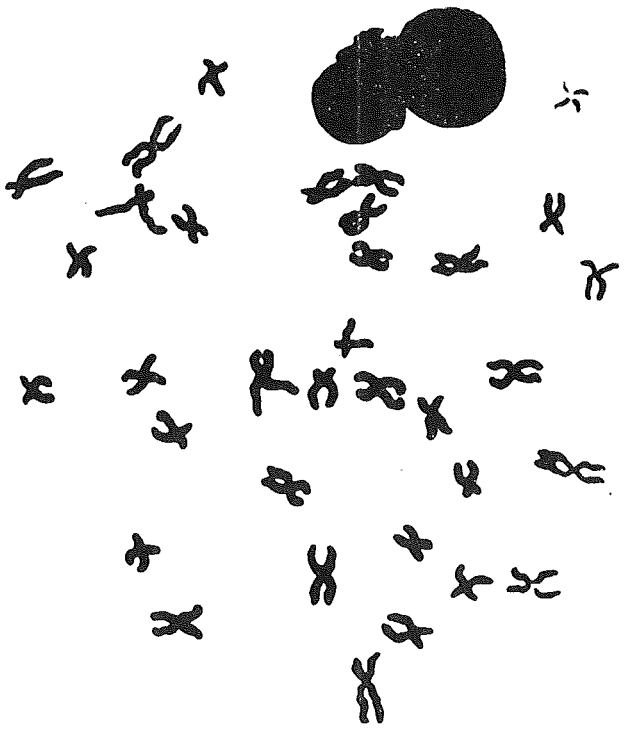


Fig. 3. C - metaphase of the Silver fox. 2n = 34.xx + 0ß.

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**Cloning and nucleotide sequence of a cDNA encoding the mink growth hormone.**

*Kazuaki Shoji, Eiji Ohara, Masanori Watahiki, Yuko Yoneda.*

We report the nucleotide sequence of a cDNA clone encoding a complete amino acid sequence of mink growth hormone (mGH). The cDNA clone was isolated from a pUC19 cDNA library derived from mink pituitary poly(A)$^+$ RNA using a porcine GH cDNA as a probe. The 783 base pairs (bp) cDNA clone has an open reading frame of 648 bp and the deduced amino acid sequence is 216 residues with a 24,469 daltons. Four cysteine residues (boxed) which may participate in the construction of structural features present in mGH at the same positions as those for other vertebrate GHs (1). The mGH shares 96%, 90%, 88%, 87% and 66% amino acid homology with the known mammalian sequences from porcine (2), mouse (3) or rat (4), bovine (5), goat (6) and human (7), respectively. The putative signal sequence is underlined and the polyadenylation signal is double underlined.

```
                                                CTCAGGGTCCTGTGGACAGCTCACCTGGCTGCA   -1

ATGGCTGCTGGTCCTCGGAACTCCATGCTCCTGGTGTTCGCCCTGCTCAGCCTGCCCTGGCCTCAGGAGGTG    72
 M  A  A  G  P  R  N  S  H  L  L  V  F  A  L  L  S  L  P  W  P  Q  E  V     24

GGCGCCTTCCCGGCCATGCCCTTGTCCAGCCTGTTTGCCAACGCCGTGCTCCGGGCCCAGCACCTGCACCAG   144
 G  A  F  P  A  M  P  L  S  S  L  F  A  N  A  V  L  R  A  Q  H  L  H  Q     48

CTGGCTGCCGACACCTACAAAGACTTTGAGCGGGCGTACATCCCCGAGGGCCAGAGGTACTCCATCCAGAAC   216
 L  A  A  D  T  Y  K  D  F  E  R  A  Y  I  P  E  G  Q  R  Y  S  I  Q  N     72

GCGCAGGCTGCCTTCTGCTTCTCGGAGACCATCCCGGCGCCCACCGGCAAGGACGAGGCCCAGCAGAGATCC   288
 A  Q  A  A  F  C  F  S  E  T  I  P  A  P  T  G  K  D  E  A  Q  Q  R  S     96

GACATGGAGCTGCTCCGCTTCTCGCTGCTGCTCATCCAGTCGTGGCTGGGGCCCGTGCAGTTCCTCAGCAGG   360
 D  M  E  L  L  R  F  S  L  L  L  I  Q  S  W  L  G  P  V  Q  F  L  S  R    120

GTCTTCACCAACAGCCTGGTGTTCGGCACCTCGGACCGAGTCTACGAGAAGCTGAAGGACCTGGAGGAAGGC   432
 V  F  T  N  S  L  V  F  G  T  S  D  R  V  Y  E  K  L  K  D  L  E  E  G    144

ATCCAAGCGCTGATGCGGGAGCTGGAAGACGGCAGCCCCCGGGCCGGGCCGATCCTGAAGCAAACCTACGAC   504
 I  Q  A  L  M  R  E  L  E  D  G  S  P  R  A  G  P  I  L  K  Q  T  Y  D    168

AAGTTTGACACAAACCTGCGCAGCGACGACGCGCTGCTCAAGAACTATGGGCTGCTCTCCTGCTTCAAGAAG   576
 K  F  D  T  N  L  R  S  D  D  A  L  L  K  N  Y  G  L  L  S  C  F  K  K    192

GACCTGCACAAGGCCGAGACGTATCTGCGGGTCATGAAGTGTCGCCGCTTCGTGGAAAGCAGCTGTGCCTTC   648
 D  L  H  K  A  E  T  Y  L  R  V  M  K  C  R  R  F  V  E  S  S  C  A  F    216

TAGTTCGCGGGCTTTCCTTTCAGCCCGGCCCCACAGCCTCCCCTGACCCTGGAAAGGGCCTCTCCCGGTGTC   720
*

CTCTGTGCTTTCCTAATAAAATGAAATTGC                                              750
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*Nucleic Acids Research 18; 21, 6424, 1990. 1 fig., 7 refs. Authors' summary.*

**Genetic polymorphism of adenosine deaminase and mannose phosphate isomerase in blood of arctic foxes *Alopex lagopus*.**

*V. Simonsen, B. Larsen, O. Lohi.*

Blood samples of 70 foxes, including 10 families, have been investigated by horizontal starch gel electrophoresis for the enzymes adenosine deaminase (ADA) and mannose phosphate isomerase (MPI). The observed variation of the enzymes could be explained as a result of one locus with two codominant alleles and one with three respectively. The segregation in the families of the alleles assumed for the two loci is in accordance with this genetic model. The frequency of the two alleles at the *Ada* locus is about the same and the slowest anodic migrating allele at the Mpi locus is the most frequent.

*Animal Genetics, 22, 87-90, 1991. 2 tables, 1 fig., 8 refs. Authors' summary.*

**Isolation of IgM and s-IgA of American mink by using of protein A-sepharose.**

*D.K. Tsertsvadze, E.S. Belousov, N.A. Popova, A.V. Taranin.*

Single and efficient methods for the preparation of mink IgM and s-IgA are described. IgM was obtained from blood serum and IgA from intestinal contents (succus entericus). Mink IgM was shown to be bound to the A-protein of *Staphylococcus aureus* quantitatively, and the s-IgA partially.
Such data offer an opportunity for applying affinity chromatography on protein A-sepharose in order to facilitate procedures of isolation of mink IgM and s-IgA and, thus, to do without multistage schemes commonly used in protein purification.

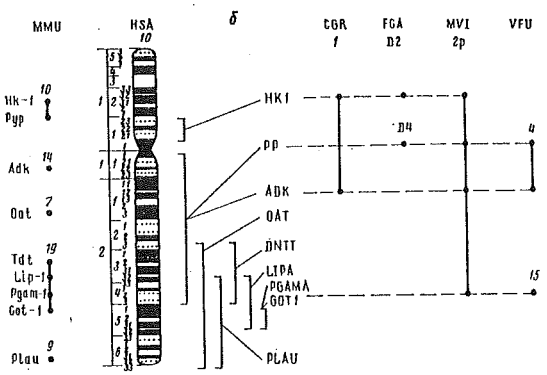
*Isvestiya Sibirskogo Otdeleniya Akademii Nauk SSSR Seriya Biologischeskikh Nauk, No. 2, 112-115, 1989. 3 figs., 10 refs. In RUSS, Su. ENGL. Authors' summary.*

**Silver fox gene mapping. Syntenic genes in carnivora.**

*N.B. Rubstov, T.B. Nesterova, S.M. Zakian, V.G. Matveeva, A.S. Graphodatsky.*

Hamster x fox somatic cell hybrids segregating individual fox chromosomes in different combinations were used to assign seven structural loci to fox chromosomes. The gene for ME1 was mapped on the VFU1 chromosome, the genes for ADK and PP being located on the VFU4 chromosome. The gene for GSR was assigned to the VFU7 chromosome and the genes for MP1 and COT1 were assigned to the VFU15 chromosome. Locali-

zation of these genes enhances the established fox genetic map and extends the known syntenic homologies between the fox and other mammalian. The comparison of data on gene mapping has provided basis for suggestion that there are significant differences in rates of karyotypic evolution in many mammalian taxa.




*Genetika, 25;12, 2199-2208, 1989. 2 tables, 2 figs., 24 refs. In RUSS, Su. ENGH. Authors' summary.*

**Feed consumption and efficiency in paternal progeny groups in mink.**

*Peer Berg, Outi Lohi.*

A total of 730 dark mink, half of each sex, representing 94 paternal progeny groups originating from 16 farms were housed on a test station from about 10 weeks of age until pelting. Average daily feed consumption in paternal progeny groups was registered daily. Individual body weights were recorded five times. Feed consumption, feed efficiency and weight gain in paternal progeny groups were calculated in four subperiods corresponding to the times of weighing. These traits, body weights and length of pelts were analysed for differences between paternal progeny groups and farms of origin. A considerable difference between farms of origin and paternal progeny groups was found for most traits, indicating genetic variation. Correlations between averages of paternal progeny groups were calculated, and interpreted as approximations to genetic correlations. Feed consumption was highly correlated across periods. Feed efficiency showed low to medium correlations between periods. A favourable correlation was found between efficiency of weight gain and efficiency of longitudinal growth.

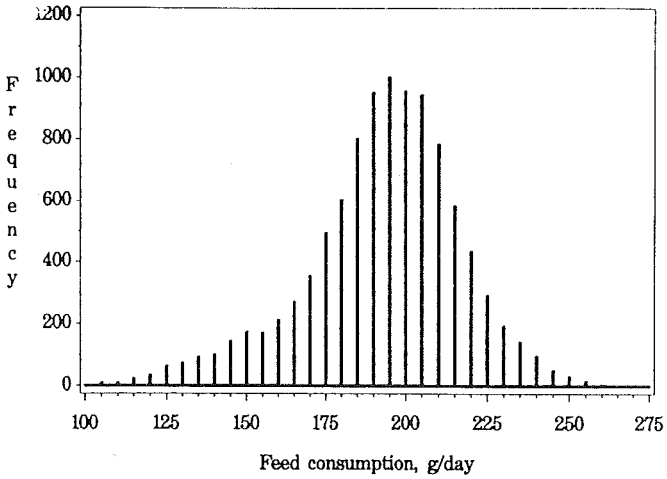



**Fig. 1.** Distribution of average daily feed consumption in paternal progeny groups.

*Acta Agric. Scand., Sect.A, Animal Sci. 42: 27-33, 1992. 7 tables, 1 fig., 16 refs. Authors' summary.*

**The pnenogenetic analysis of some fur colour changes arising during silver foxes domestication.**

*L.A. Prasolova, L.N. Trut, E.B. Vsevolodov, I.F. Latipov.*

Quantitative and qualitative analysis of pigmentation in "singne"-type fur colour mutation arising in silver foxes during domestication, was made. It was shown that the decrease in quantity of eumelanine in hair and uneven distribution of pigment granules lengthwise in the hair were the reason for the formation of "singnes".

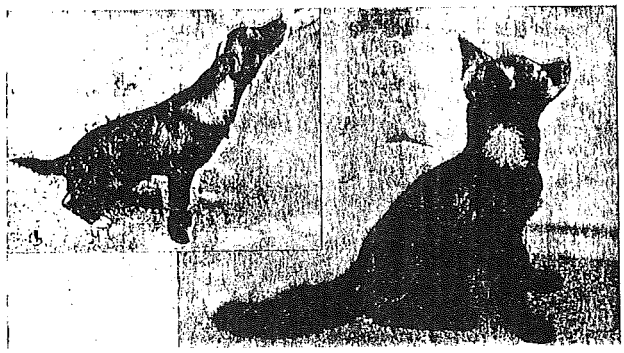


Рис. 1. «Подпалые» у щенков ручных серебристо-черных лисиц и у домашней собаки

*Genetika, 25;9, 1626-1635, 1989. 2 tables, 6 figs., 14 refs. In RUSS, Su. ENGL. Authors' summary.*

**Meiosis in male nutria.**

*N.I. Kasumova, G.N. Kuliev.*

In G-banded preparations, the number of chiasmata per cell averaged 40.0 plus or minus 0.3 and 40.0 plus or minus 0.06 in standard and white nutria resp. The correlation between the centromere indices of meiotic and mitotic chromosomes was 0.89. In nutria with low fertility, there was disturbance of the normal association between the X- and Y-chromosomes. Spermatogenesis began at 8 months of age.

*Izvestiya Sibirskogo Otdeleniya Akademii Nauk SSSR, Seriya Biologicheskikh Nauk, No. 2, 4, 1990. In RUSS. Only abstract received. CAB-abstract.*

**Mapping of the silver fox genes: assignments of the genes for ME1, ADK, PP, PEPA, GSR, MPI, and GOT1.**

*T.B. Nesterova, N.B. Rubtsov, S.M. Zakian, V.G. Matveeva, A.S. Graphodatsky.*

Evidence is presented for the assignment of seven fox genes on the basis of the segregation data for chromosomes and enzymes of fox x Chinese hamster somatic cell hybrids. The chromosomal loci of the following enzyme genes were determined: ME1, VFU1; ADK and PP, VFU4; PEPA, VFU5; GSR, VFU7; and MPI and GOT1, VFU15. The localization of these genes now extends the fox genetic map to 22 mapped genes. Based on comparative analysis of mammalian genetic maps, karyotype evolution in Carnivora is discussed. (see fig. 1).

*Cytgogenet Cell Genet 56, 125-127, 1991. 1 fig., 11 refs. Authors' summary.*

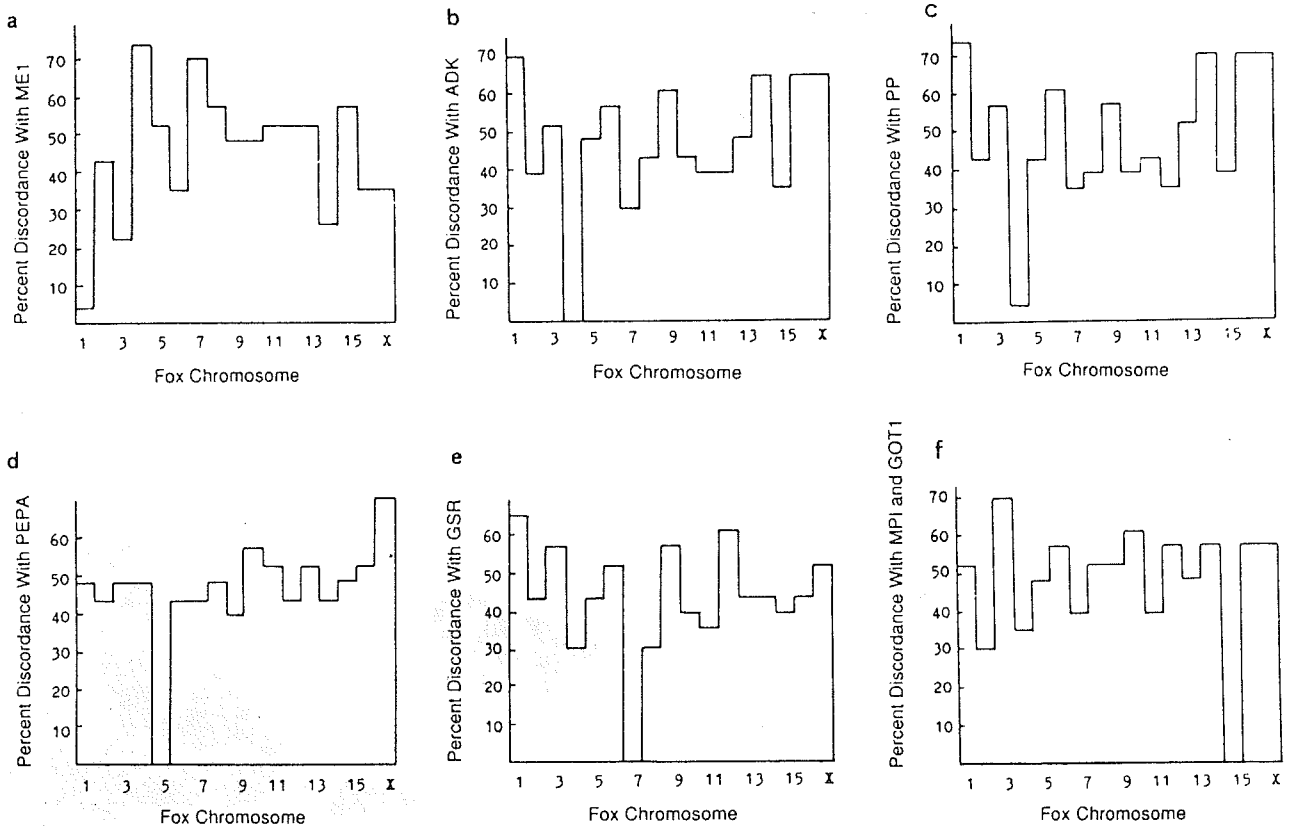



**Fig. 1.** Concordance of 17 fox chromosomes with the presence of the listed isozymes in the hybrid clone panel. Chromosome scores represent the consensus of karyotypic and isozyme scores: (a) ME1; (b) ADK; (c) PP; (d) PEPA; (e) GSR; and (f) MPI and GOT1.

*Original Report*

# Male mink (Mustela vison) premating examination

*Juan Carlos Bachmann*

*Calle 33 N 1133, (7607) Miramar, Argentina*

## Summary

During the years 1989 and 1990 after culling because of pedigree antecedents, individual quality and plasmacytosis test, all the males were examined before the mating season.

The examination consisted of a general examination which included belly, scrotum, testes, epididymis, scrotal circumference, prepuce, penis, forepaws and legs, and mouth, in this order.

Some of the pathologies findings were: wet belly, cryptorchidism, monorchidism, hypogonadism (small testes), epididymis tail aplasia, epididymitis, incomplete descent of the testicles, phimosis, paraphimosis, absense of the os penis, glans aplasia, callus in paws or legs, broken bones, supurative wounds, and deficient teeth formation.

The measurement of the scrotal circumference S C was used to cull males with small testicles (hypogonadism). The measure taken into account was the one established from the arithmetical average measure of the population, putting aside those smaller than a standard deviation under the average. This represented approximately 15% of the male population examined.

The reproductive information of previous years is compared with the present to evaluate the significance of the method used.

## Introduction

We know the importance of having healthy males and females for mating. In this research a sequence of examinations is described. This was done on male mink in two farms: Las Charitas and Uten Lauquen both in Batan - Buenos Aires - Argentina, whose owners kindly offered all their animals for the purpose of this work.

The examination consisted of both visual and manual exams to detect the most frequent pathologies that can affect reproduction, finding that these were similar to those found in previous research, with the addition of some which were seldom described like the penian pathologies (ref. 4-5-7-9).

The measuring of the scrotal circumferences S C was carried out to determine the arithmetical average measure of the population; from this result we could establish a low measure which we

qualify as hypogonadism, similar to the measurements in other species like bulls, for example.

The S C taken in sequence with intervals of 30 days shows a difference of more than 5% as the mating seasons approaches, as a sign of maturity. In the same way, but more abruptly, the decrease of the measures can be noticed after the mating season. This information coincides with previous communications which mention an increase or decrease of the weight of the testicles, according to the level of blood testosterone. The measuring of the S C determines quickly and safely the size of both testes, something which is very useful to predict the probable fertility of males with (ref. 2-5-8).

In other research only the testes (width) was measured. They were measured with a caliper which doesn't indicate the total volume of both testicles at the time (ref. 5-6-10).

In other research the measurement of height - width - thickness was used to express the volume using a formula described $V = \frac{4}{3} \frac{h \times w \times th}{8}$ but to measure a very big population of 2 or 3 thousands males, as in this case, it is not convenient nor practical (ref. 2).

Other ways to evaluate the fertility of males is by a testicle biopsy and epididymal lance samples, which requires very precise techniques, but don't assure that the samples represent really viable ejaculated sperm during mating (ref. 9-11).

There is also the electro-ejaculation technique which requires a long examination and anesthesia (15 to 29 minutes per animal) (ref. 1).

The last one is the sperm evaluation technique, where a sample is taken from the bottom of the vagina after mating. This one evaluates the males sperm taken from a female which may or may not have been receptive. It is sometimes contaminated with urine and it is practised during mating season, affecting the handling of the animals and other movements of the mink farm in that important busy time (ref. 9).

During the 1989 mating season, besides examining the males with the S C measuring technique, the sperm taken from the bottom of the vagina was also evaluated in the traditional way. It was determined that only 3% of the males considered healthy, produced samples without live sperm (progressive straight movement) after even 5 samples. It was also found that in the first examination a great number of them were negatives (up to 40%), this meant repeated extractions, a 2.2 average per male.

Mating in the traditional way 1 + 8 + 1 and not repeating the 2nd and 3rd covering with the same male, the possibility of having infertile coverings decreases to a low significance. We must have in mind how troublesome the method of evaluation is during the mating season, when the handling of the females would be more harmful for their fecundity than the culling of males.

As a complementary work during mating season, the males without sex drive were culled. No matter what techniques are used, it is very useful to evaluate the behaviour of the males at mating time (ref. 3-9).

To confirm the possibility of using the described method as the only way of evaluating male reproduction performance, the reproductive index of the wild variety were compared with the indices of the previous years, when the premating examination had not been done and only the sperm examination was made, with the premating exams of the males without sperm evaluation.

The performance of other colour varieties was not taken into account, nor the use of hormones, light and others, so as not to add information which does not refer specifically to the purposes of the present paper.

## Materials and methods

*Clinical exams 1989*

During the year 1989, 568 males of the Uten Lauquen minkfarm of the wild variety, were clinically examined. It was found that nearly 5% of them had different pathologies.

Table 1. Clinical exam results 1989.

| Examined | 568 | 100 % |
|---|---|---|
| Cryptorchidism | 0 | 0 |
| Monorchidism | 16 | 2.8 |
| Bilateral smaller testes (hypogonadism) | 1 | .1 |
| Lateral small testicle (left or right) | 3 | .5 |
| Epididimitis | 2 | .3 |
| Phimosis - paraphimosis | 0 | 0 |
| Postitis - balanitis | 3 | .5 |
| Others | 3 | .5 |
| TOTAL | 28 | 4.9 |

*Sperm examination 1989*
The sperm examination was made to all the mating males, after the premating exams and after culling the males with different pathologies as mentioned in table 1. The exams were done with a 400 x optical microscope.

Table 2. Sperm examination during mating 1989.

| Examined | 0 to 1 | % | Always 0 | % | 3 or more | % | Total exams |
|---|---|---|---|---|---|---|---|
| 540 | 213 | 39.4 | 8 | 1.48 | 106 | 19.62 | 1.177 |

An average of 2.2 examinations per male were practised in all, including the negatives or low performers. The scale value was the followings: (0) Without spermatozoids; (1) Only 1 spermatozoid per screen; (2) More than 1; (3) So many that it is impossible to count; (4) Exceptional sample; (5) Only dead spermatozoids

During the matings 1.4% of the males without libido were culled. They failed to mate showing no interest at all in the females.

Table 3. Total culled males 1989.

| | |
|---|---|
| Genital pathologies | 5 % |
| Sperm 0 to 1 after 3 exams | 24 % |
| Without libido | 1.4 % |
| TOTAL | 30.4 % |

*Scrotal circumference measures 1989*
During the clinical examination all the males were measured. The measure was made with a graduated scale (in cm and mm), that was adjusted to the middle of the scrotum, giving the circumference of it and taking both testes at a time.

It is important that the measurements are taken by a single person for a given population to be compared between them, to avoid differences in the way the scale is more or less adjusted to the scrotum. All animals to be compared must be measured in no more than 5 days time, because the difference taking place during maturity may spoil the samples.

Table 4. Scrotal circumference measures in 1989. Wild variety.

| S C $\bar{x}$ | widest | narrowst | 1 standard deviation | culled less than |
|---|---|---|---|---|
| 7.68 | 8.5 | 5.4 | .52 | 7.16 |

Smaller measures, which were impossible to take with the scrotimeter were directly culled. According to table 4 all wild males with measures under 7.1 should be culled because they have smaller testes than the average showing lack of development (hypogonadism).

*Clinical exams 1990*

During the year 1990, 742 wild variety males of Uten Lauquen and 1048 wild variety males of Las Charitas mink farms, were clinically examined. It was found that 7.3% had different pathologies.

Table 5. Clinical exams results 1990.

| | Uten Lauquen | % | Las Charitas | % | Total | % |
|---|---|---|---|---|---|---|
| Examined | 742 | | 1048 | | 1790 | 100 |
| Cryptorchidism | 5 | .67 | 0 | | 5 | 0.27 |
| Monorchidism | 17 | 2.29 | 25 | 2.38 | 42 | 2.34 |
| Bilateral smaller testes | 2 | .26 | 6 | .57 | 8 | .44 |
| Lateral small testicle | 6 | .80 | 5 | .47 | 11 | .61 |
| Epididimitis | 2 | .26 | 7 | .66 | 9 | .50 |
| Phimosis - paraphimosis | 6 | .80 | 2 | .19 | 8 | .44 |
| Incomplete descent of testicles | 1 | .13 | 21 | 2.0 | 22 | 1.22 |
| Os penis aplasia - smaller penis | 4 | .52 | 10 | .95 | 14 | .78 |
| Others | 0 | | 12 | 1.14 | 12 | .67 |
| Culled | 43 | 5.8 | 88 | 8.4 | 131 | 7.31 |
| Without libido | 3 | .4 | 38 | 3.6 | 41 | 2.29 |

*Scrotal circumference measures 1990*

During the premating examination in 1990, all males were measured, of all colour varieties to try to evaluate all possible differences between them. The measurements took place in August, after individual qualification, but before the mating season, which in this case started in the first days of September.

Table 6. Scrotal circumference measures 1990. Wild variety.

| $S C \bar{x}$ | widest | narrowest | 1 standard deviation | culled less than |
|---|---|---|---|---|
| 7.35 | 8.7 | 6.0 | .49 | 6.86 |

The smaller measures, which are impossible to take with the scrotimeter were directly culled. According to table 6 all wild males with measures under 6.9 should be culled because they have smaller testes than the average showing lack of development (hypogonadism). The figure 6.86 becomes 6.9 because the graduation of the scale is in mm only.

*Reproductive antecedents*

The reproductive antecedents of both farms, Uten Lauquen and Las Charitas, were taken to compare the results obtained. This was done only for the wild variety because the others have great differences in the percentage of male culling (pathologies) and also in the litter size, and weaned cubs per female.

If all the colour varieties had been taken into account the objective of the present work, which is to show the usefullness of the premating examinations exclusively, would have been spoiled. During this research we have also arrived to other conclusions which will be investigated and verified in the future.

Table 7. Reproductive antecedents 1989 - 1990.

| | Uten Lauquen | | Las Charitas | |
|---|---|---|---|---|
| | females | kits 2nd count | females | kits 2nd count |
| 1989 | 2.300 | 4.9 | 5.066 | 5.05 |
| 1990 | 2.362 | 5.5 | 5.415 | 5.21 |

These figures are for the wild variety only, kits count are at 21 days old, and for the two years during which the work was carried out.

**Discussion**

The premating examinations enables us to cull all males with pathologies affecting reproduction. Adding the S C measures, we have the means to qualify the testicles development in a mathematical way, and not in a subjective, empirical, or manual way, thus ensuring useful males for reproduction, and culling all of them with smaller testicles not detected by other methods.

The S C measurement doesn't affect the clinical exams, as it is made simultaneously with the semiological routine, previous to mating season, and not disturbing other farm work.

Comparing the figures of 1990, with previous ones, lets us suppose that the method used to cull males, which replace the ones used previously, is at least similar in results as the sperm evaluation method.

Probably all the merit of the litter size improvement is not due so much to culling infertile males, but also to the fact that the premating exams enables the farm workers to dedicate their time exclusively to controlling, inscribing the mated females, and changing the unreceptive females. In this way the general management of the covering is improved, without the interference of handling the females during the mating season.

The use of safer methods of evaluation of the males has always been the aim of breeders in order to reduce the risk of infertility. In fact it can be assumed that with a healthy genital system, with testicles of adequate size and tone, good libido and high service capability, we have more than safe indexes for a good mink production.

In addition the S C measure is useful to know in order to differentiate other degrees of testes maturity, as the testicles increase in size as the mating season approaches and decrease noticeably after it is finished. As a comparison we had the possibility of measuring males which has just arrived from the Northern Hemisphere (imported reproducers) in April, which showed a lack of seasonal development which they didn't recover with the change of latitude. This was shown by the S C measure, which was lower than 4 cm. At the time of mating, in general (92%) they were not useful. The remaining 8% were males with libido (they mated) but produced no litters.

The examination of the S C measure showed a marked difference in the other colour types, which coincides with the differences in the reproductive indexes found after birth and during the pups counting, especially for the extra dark variety. But this information as we said before is not analyzed now so as not to hinder the results of the present research.

In the future we shall have to improve the method of measuring and add the information about the tone of both testicles to the examination. This year we started the evaluation of the mentioned information to be able to analyze it in the future.

**Acknowledgements**

I would like to give special thanks to the owner of Las Charitas, Ing. Rafael Garcia Mata and his manager Mr. Carlos Carcia Mata, who offered all the animals for the purpose of the work.

Ing. Rafael Garcia Mata also did the hard work of the corrections of the paper and provided the bibliography which is the most diffucult task for a field worker like me, who lives most of the time on the farms, far away from the scientific centres.

I would also like to thank Mr. Adrian Maldonado, one of the enthusiastic workers of Las Charitas, who helped me with the field work and also with all the computer work, which is Greek for most vets of my age.

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*Original Report*

# Pre-breeding-season signs of oestrus and prediction of fertility in mink

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**Summary**

The onset of sexual maturity of mammals, its controlling neuroendocrine mechanisms, environmental factors influenced this processes are in centre of investigations of sexual system. The processes of sexual maturity plays a pivotal role in future reproduction.

The first signs of oestrus registered by means of vaginal smears appeared in mink in November (3%). The percentage of females in oestrus patterns correlated with folliculogenesis and in some degree determined the level of fertility in breeding season.

A homeostatic system controlling fertility in mink was demonstrated which depended on time of maturity in the large stock of standard female mink (1411) on the State Animal Fur Farm "Magistalny". A significant coefficient heritability in oestrus patterns between sibs (0.3) was found, which give the opportunity to use this trait in selection for fertility.

**Introduction**

Anyone trying to raise productivity in females is faced with four basic factors responsible for the low effectiveness of selection for fertility:

1. Low heritability of fertility.
2. Signs of high fertility can be recognized only in the females.
3. Detecting high fertility in females is possible only once sexual maturity is reached.
4. Homeostasis operates in the reproductive system (*Land, 1974; Evsikiv, 1987*).

These problems can be overcome to a considerable degree by the use of physiological criteria related to the development of the reproductive function. One of the most basic of such physiological processes is sexual maturation, and it is no accident that the timeing of sexual maturation, its neuroendocrinological control, and factors influencing these are the focus of interest of many workers in the field (*Ojeda et al., 1983; Forster et al., 1985*). To a large extent the functioning of reproductive system during

ontogenesis is determined by the character of sexual maturation (*Svechin, 1985; Davis et al., 1987*) and it is thus of some interest to study sexual maturation with a view to finding ways of predicting future fertility in females. A particular interest in this regard are fur-bearing animals and among them the most numerous species, the mink.

As soon as mink achived the status of domestic animal, the nature of its oestrus cycle and its relation to fertility became the subject of intence study. Hansson (1974) and Abramov (1974) described the dependence of mink fertility on timing and frequency of mating; Evsikov (1987) worked out the complicated homeostatic system controlling fertility in mink; and Klotchkov (1991) was demonstrated the relation between mink fertility and pre-breeding-season signs of sexual activity.

In the present study a large stock of standard female mink on the State Animal Farm "Magistralny" was used in an attempt to predict fertility using measures of their sexual maturity.

## Materials and methods

Observations were made on 1411 young standard females. In the period 18-28 of December inclusive the onset of oestrus was assessed using vaginal smears according to standard methods (*Kabak, 1968*). Smears were taken once and fixed in 96% alcohol and stained in a solution of orsein. According to the appearance of smears, the functional state of the reproductive system was classified into dioestrus (D), dioestrus-proestrus (DP), proestrus (P), proestrus-estrus (PE), and estrus (E). Data concerning reproduction were recorded in the reproductive season (March).

## Results

Analysis of the smears shows that in December the females are distributed as follows according to the stage in the oestrus cycle: D - 21.7%; DP - 25.6%; P - 23.8%; PE - 17.5%; E - 11.4%. During the reproductive season, the fertility of mink belonging in December to group D and DP was 6.78 ± 0.07, while in those showing signs of oestrus in December (P, PE, E) it was 7.09 ± 0.07. The difference (+0.31) is statistically significant ($P<0.01$).

Regarding the frequency and average date of mating theree is no significant difference between the D, DP groups and those showieng signs of oestrus. However analysis of the last date of mating reveals a tendency, among the latter group for a higher percentage to mate in the earlier period (4-11 March) and a lower percentage in the later period (12-20 March and later). Thus the percentages of mated females which were in dioestrus in December are distributed in the periods 4-7, 8-11, 12-15, 16-19, 20 < March, as follows: 5.1, 19.1, 44.4, 27.2, 4,1 %; the corresponding figures for females showing signs of oestrus in December are: 8.0, 24.5, 42.1, 22.0, 3.4 %.

Analysis of the relation between fertility and date of last mating, and duration of pregnancy, reveals an interesting feature (table 1, fig. 1). In both groups of mink, increased fertility is associated with shorter pregnancy. In mink with the same duration of pregnancy, higher fertility is generally associated with earlier date of mating; on the other hand, mink mated in different periods do not differ in their fertility. Mink's homeostatic reproductive system and a definite level of fertility are maintained by a physiological mechnaism determined basically by two factors - the number of ovulated follicles (dependent on the date of mating), and the duration of pregnancy which is related to embryo mortality (*Evsikov, 1987*).

It should be noted that the smallest differnce in fertility between groups is observed in optimal conditions for reproduction (middle of the reproductive season: 8 - 15 March), and the difference drastically increased away from the optimum (table 1, fig. 1).

**Table 1.** Influence of pregnancy duration and date of mating on fertility in early and late maturing mink.

| Duration of pregnancy (days) | Dates of mating (March) | | | | | Fertility of females according to duration of pregnancy | Difference in fertility (early - late maturing f. |
|---|---|---|---|---|---|---|---|
| | 4 - 7 | 8 - 11 | 12 - 15 | 16 - 19 | < 20 | | |
| 60 | 6.1±0.7<br>4.4±0.6 | 5.1±0.5<br>4.3±0.8 | 3.0±1.0<br>4.5±0.5 | -<br>- | -<br>- | 5.4±0.4*<br>4.4±0.3 | +1.0* |
| 55-59 | 7.0±0.4<br>7.2±0.6 | 6.5±0.5<br>6.2±0.4 | 6.3±0.6*<br>4.4±0.5 | 4.5±1.0<br>3.6±1.0 | -<br>- | 6.6±0.2*<br>5.8±0.2 | +0.8* |
| 50-54 | 7.9±0.4*<br>6.8±0.3 | 7.3±0.2<br>6.5±0.3 | 7.1±0.2<br>7.1±0.3 | 7.8±1.0<br>5.6±1.5 | 6.0±1.5<br>- | 7.2±0.1<br>6.7±0.1 | +0.5* |
| 45-49 | 7.8±0.9<br>7.7±1.4 | 6.8±0.2<br>7.2±0.2 | 7.3±0.1<br>7.2±0.1 | 6.9±0.2<br>6.8±0.2 | 8.8±0.5*<br>7.0±0.6 | 7.1±0.1<br>7.1±0.1 | 0 |
| 40-44 | -<br>- | 9.0±1.0<br>7.5±1.8 | 6.9±0.2<br>7.1±0.2 | 7.3±0.2<br>7.1±0.2 | 7.9±0.4<br>7.3±0.3 | 7.2±0.2<br>7.1±0.1 | +0.1 |
| | Fertility of females according to date of mating | | | | | | |
| | 7.1±0.3*<br>6.1±0.4 | 6.9±0.1<br>6.7±0.2 | 7.1±0.1<br>7.1±0.1 | 7.1±0.1*<br>6.8±0.1 | 8.0±0.3*<br>7.3±0.2 | | |
| | Difference in fertility between groups | | | | | | |
| | +1.0* | +0.2 | 0 | +0.3* | +0.7* | | |

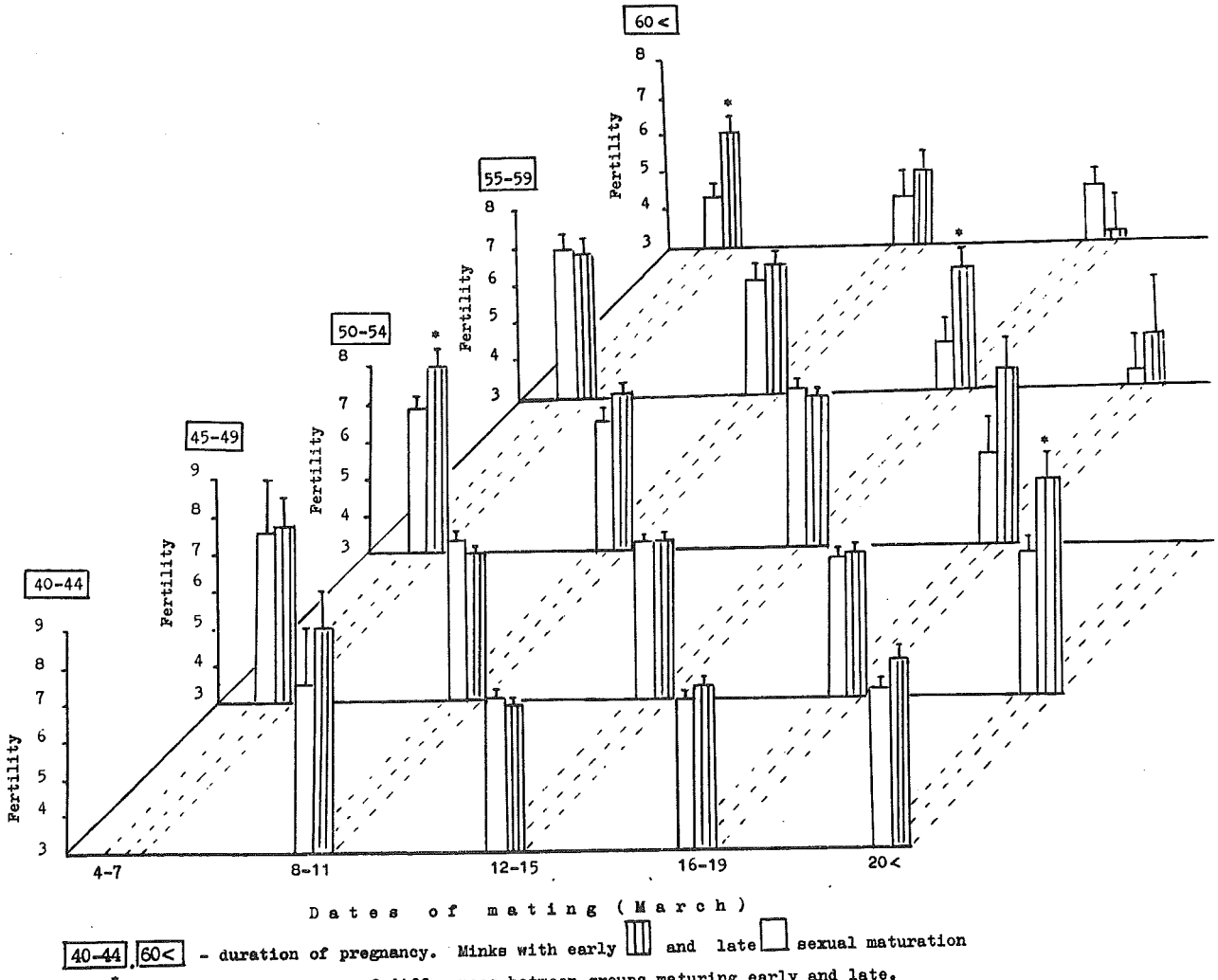
Notes: Upper line - date for females maturing early; lower - maturing later. Significance of differences between groups maturing early and late - *P < 0.05.

In the females showing signs of oestrus in December, there is a large increase in fertility by comparison with femalesin dioestrus, not only in those mating early (4-7 March 1.0 young, P < 0.05) but also those mating late (16-19 March 0.3 young, <20 March 0.7 young, P < 0.05). In animals having the same duration of pregnancy, the difference in fertility between early and late maturing females regularly increases according to the duration of pregnancy. So in pregnancies of 40-44, 45-49, 50-54, 55-59, <60 days, the increase in fertility in early maturing females by comparison with late maturing ones is respectively +0.1, 0.0, +0.5, +0.8, +1.0 young (table 1).

Thus measures of the sexual maturing seen in vaginal smears in December have a significant relation with mink fertility during mating and can be used to predict their potential fertility.

To answer the quesion whether these measures could be used in selection, the heritability coefficient for the character of the oestrus cycle was calculated using the formula $h^2 = 2r$ using data from siblings. It came to 0.28±0.06 (P < 0.001). According to this measure of heritability one would expect some definite improvement in fertility by selecting for oestrus cycle characteristics.

INFLUENCE OF PREGNANCY DURATION AND DATE OF MATING ON FERTILITY IN EARLY AND LATE SEXUALLY MATURING MINK




40-44, 60< - duration of pregnancy. Minks with early and late sexual maturation

* P< 0.05 - significance of differences between groups maturing early and late.

## Discussion

The timing of sexual maturation exerts an important influence on the development of the reproductive system in mink. Fertility is higher in early maturing than in later maturing individuals. In order to understand the role played by the timing of sexual maturation and the onset of the reproductive function, it is necessary to consider the homeostatic system controlling reproduction in mink, a system clearly revealed in the interrelations between maturing, duration of pregnancy, and size of litter. A detailed analysis of this system by Evsikov (1987) showed that a shorter pregnancy leads to increased fertility in females, and that fertility in females with the same duration of pregnancy depends on the date of mating. At the same time, in the population as a whole, the same fertility is found in mink mated at different times. This is explained by the fact that, among early mated animals, the proportion having a long pregnancy is considerably higher, thus decreasing the average fertility. As regards females mated at the end of the reproductive season, their lower potential fertility is compensated by a higher chances of survival among the embryos on account of the shortening of embryo diapause. In this way the fertility of the late breeding females so to speak "catches up" with the average for the population (*Evsiko, 1987*).

When this homeostatic system is factorised separately for early and late maturing females, one can see clearly that the fertility increase in the former takes place due to animals amated early and late within the breeding season. Females falling in the "optimal zone" in the middle of the reproductive season do not differ in their fertility. It may be that in females maturing early, there is diversification of reactions to seasonal environmental factors. On the other hand, the animals with the same duration of pregnancy, the increased fertility in early maturing females (by comparison with late maturing) as pregnancy becomes longer suggests a more favourable hormonal state in the pregnancy and a lower embryo mortality.

Thus the simple device of controlling the timing of sexual maturation in mink could provide a mean of predicting fertility, and also an additional character for use in selection for fertility.

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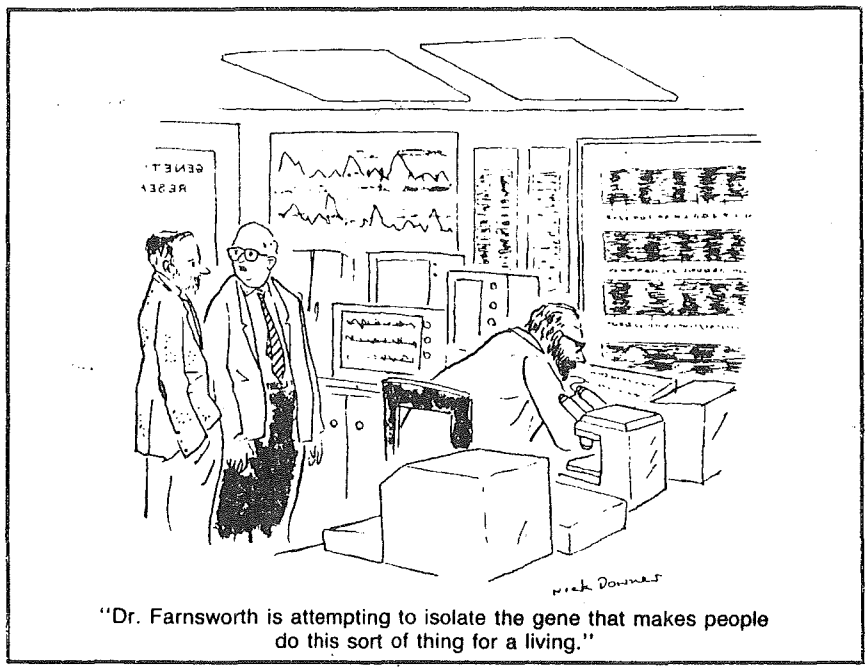

"Dr. Farnsworth is attempting to isolate the gene that makes people do this sort of thing for a living."

**Melatonin receptors are present in the ferret pars tuberalis and pars distalis, but not in brain.**

*David R. Weaver, Steven M. Reppert.*

The pineal hormone melatonin regulates reproductive function in seasonally breeding mammals. Recent studies using 125I-labeled 2-iodomelatonin (I-MEL) reveal that the distribution of putative melatonin receptors is species-specific; only the hypophysial pars tuberalis (PT) is a consistent site of I-MEL binding in all photoperiodic species examined.

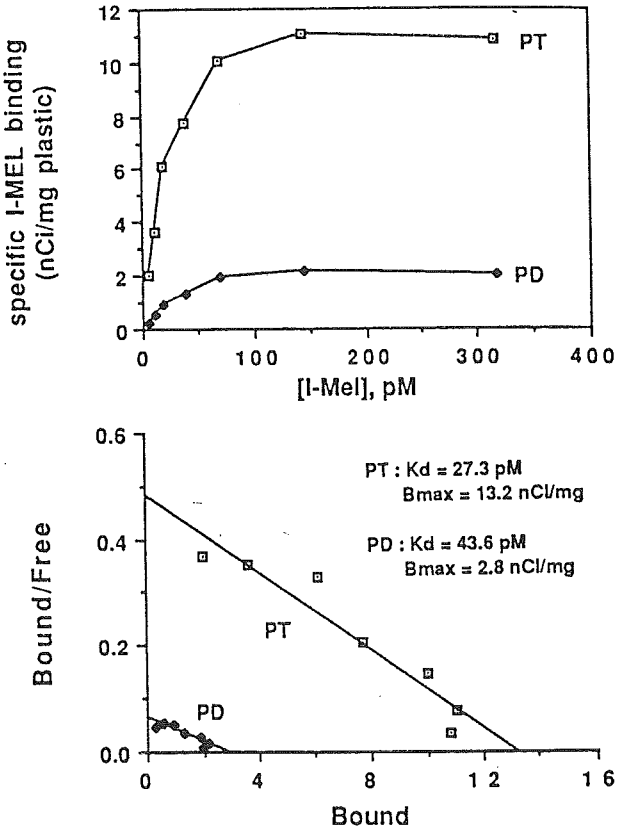


Fig. 2. Saturation curves (upper panel) and Scatchard plots (lower panel) of specific I-MEL binding in the pars tuberalis (PT) and pars distalis (PD) from a representative ferret. Values represent means of 2-4 sections at each point. The level of binding and Bmax values are reported in nCi/mg plastic of the 125I microscale standards.

In the present study, we used in vitro autoradiography to examine the distribution of I-MEL binding in the ferret brain and pituitary. We report that I-MEL binding is restricted to the PT and bars distalis (PD) of the pituitary; I-MEL binding is absent from brain. I-MEL binds in the PT and PD with high affinity (Kd values ca. 40 pM) and the rank order of potency for inhibition of I-MEL binding (6-chloromelatonin = melatonin > 6-hydroxymelatonin > N-acetylserotonin > serotonin) is the same as that observed for high-affinity melatonin receptors from other species. The consistent presence of high affinity melatonin receptors in the PT of a variety of photoperiodic species suggests that the PT plays a major role in mediating the effects of melatonin on neuroendocrine function.

*Endocrinology, 127; 5, 2607-2609, 1990. 2 figs., 20 refs. Authors' abstract.*

**Use of the GnRH analogue Gonavet for the induction of ovulation in mink females.**

*H. Hattenhauer, R. Krieg, P. Tschauschev.*

In 7 experimental series, the effect was tested of Gonavet® "Berlin-Chemie" - a Gn-RH analogue - on the mating performances and litter size with yearling mink females of the standard type. The best results were obtained with a dose of 2 µg per female. Higher doses (up to 4 µg per female) did not yield any higher effects, but lower doses (1 µg) reduced the mating performance and/or litter size.

*Wissenschaftliche Zeitschrift-Karl-Marx-Universität Leipzig, Mathematisch-Naturwissenschaftliche Reihe, 37; 3, 282-289, 1988. 15 tables, 6 refs. In Germ, Su. ENGL. Authors' summary.*

**Oestrus control in the ferret.**

*M. Oxenham.*

The use of proligestone (Delvosteron; Mycofarm) for the suppression of oestrus in the ferret is reported. Between 1984 and 1989, 192 doses of proligestone (0.5 ml given subcutaneously) were given to a total of 131 jills. From 1986 it was observed that 11 (8.4%) jills returned to oestrus between May and August following the injection and that this recurred in subsequent years in some individuals. In jills which had a second injection the same year, oestrus was suppressed for the rest of the summer with no ill effects and none of those which had returned to oestrus for the rest of the season had any signs of illness. Three of the 11 jills were accidently mated in May (litter of 4), June (litter of 3) or July (sterile pseudopregnancy), but fertility the year following the injection appeared to be unaffected (average 8.1 per litter).

A small area of alopecia occurred at the injection site of 7 (5.3%) jills, which remained for a variable length of time. When a jill in oestrus was injected with proligestone, the signs subsided over 3-4 days.

*Veterinay Record, 126; 6, 148, 1990. 2 tables, 3 refs. CAB-abstract.*

**Prospects of AI in fox breeding.**

*M. Valtonen, L. Jalkanen.*

In Finland in 1987, for 115,445 silver fox x blue fox matings, 6309 blue x blue matings, 16,164 silver x silver matings and 1398 blue x silver matings, the CR was 80.3, 80.5, 74.0 and 63.0% resp., and the number of cubs per female inseminated 4.42, 5.67, 2.54 and 1.58. Results are presented for 3 AI units.

*11th International Congress on Animal Reproduction and Artificial Insemination, University College Dublin, Ireland, June 26-30, Volume 4, Brief Communications Paper, No. 576, 3 pp, 1988. 2 tables, 4 refs. CAB-abstract.*

**The use of artificial photoperiods for advancing the breeding season in foxes.**

*Ib J. Christiansen.*

To investigate the possibility of shortening the intervals between periods of active spermatogenesis, 6 silver fox and 6 blue fox males were subjected to 3 experiments (between winter 1985 and winter 1986) in each of which males were exposed to a period of 5-h light:19-h darkness (5L:19D) followed by a period of 15L:9D. For blue foxes and silver foxes in experiment 1, 16 and 24 attempts resp, at semen collection resulted in 14 and 10 ejaculates; in experiment 2, after an interval of 171 and 165 days, 14 and 9 collections resulted in 6 and 5 ejaculations, and in experiment 3, after an interval of 163 and 171 days, 10 and 16 collections resulted in 7 and 10 ejaculates. Thus, 3 periods of spermatogenesis were induced in 1.5 yr by manipulation of the photoperiod.

*11th International Congress on Animal Reproduction and Artificial Insemination, University College Dublin, Ireland, June 26-30, Volume 4, Brief Communications Paper No. 401, 3pp, 1988. 1 table, 7 refs. CAB-abstract.*

**Reproductive traits of the ferret (*M. putorius furo*).**

*J. Rafay, V. Parkányi, D. Mertin.*

96 females of standard ferret of five consecutive generations and two populations (outbred, inbred) were used in studying five reproductive traits (duration of proestrus, duration of gravidity, number of ferrets born per litter, weaning, rearing). From the obtained results followed insignificant differences between outbred and inbred generations. Correlation coefficients between environmental temperature prior to the onset of estus, duration of estrus and duration of gravidity are highly significant with a negative value.

*Scientific works of Animal Production, Nitra, XXIV, 167-171, 1991. 2 tables, 7 refs. In CHEC, Su. ENGL, RUSS, CHEC. Authors' summary.*

**Nursing sickness in lactating mink (*Mustela vison*). I. Epidemiological and pathological observations.**

*Tove N. Clausen, Carsten R. Olesen, Otto Hansen, Søren Wamberg.*

In a retrospective survey, the epidemiological characteristics of nursing sickness in Standard Black and Pastel mink (*Mustela vison*) were examined on a Danish fur research farm. Based on the clinical diagnosis of the disease, the overall morbidity in a total of 1774 lactating females amounted to 14.4% and the case fatality rate to 7.8%. Apparently healthy females weaned an average of 5.0 kits per litter, while dams suffering from nursing sickness raised and weaned an average of 5.4 kits per litter ($p < 0.01$). Based on logistic regression analysis, the increasing age of the lactating dam, followed by litter size and female weight loss, appeared to be major determinants for the development of nursing sickness. The impact of additional covariates such as litter weight gain and female color type were remarkably low. At weaning (day 43) the mean individual live weight of the kits of either sex did not differ between healthy and sick dams. In Standard Black, the total biomass of the offspring raised by sick dams was significantly larger than that of the healthy controls ($p < 0.01$). During the final two weeks of lactation, apparently healthy dams lost on average 14% of their body mass, whereas those affected by nursing sickness had a mean weight

loss of about 31% ($p < 0.001$). Postmortem examination of 25 dams with severe nursing sickness verified the clinical findings of progressive dehydration and emaciation. The gastrointestinal tract was empty and gastric ulcers and melaena were frequently present. Other common findings included small livers, enlarged adrenals and pitted kidneys. Histopathological examination disclosed variable degrees of hepatic lipidosis as well as distinct vacuolization of hepatocytes and renal tubular epithelial cells which may indicate the existence of a progressive catabolic state.

*Can J Vet Res, 56, 89-94, 1992. 3 tables, 29 refs. Authors' summary.*

**Nursing sickness in lactating mink (*Mustela vison*). II. Pathophysiology and changes in body fluid composition.**

*Søren Wamberg, Tove N. Clausen, Carsten R. Olesen, Otto Hansen.*

An investigation of the pathophysiological characteristics of nursing sickness in mink was carried out as a follow-up study of a previous epidemiological survey at a Danish fur research farm during the 1989 breeding season. In a total of 48 nursing females of the Standard Black and Pastel type, concentrations of several pertinent biochemical constituents of whole blood, plasma, urine and skeletal muscle were determined in order to identify nutritional and metabolic factors involved in the origin and development of the disease. Compared to the reference data obtained in 17 apparently normal lactating dams the findings in 31 females suffering from nursing sickness presented varying clinical and biochemical signs of progressive dehydration and emaciation: aldosteronism, hypovolemia, hyponatremia, hyperkalemia (in the face of muscle potassium depletion), hyperglycemia and azotemic acidemia. Neither ketosis nor severe lactacidemia were observed. The urine was almost devoid of sodium and chloride, and urinary potassium concentration diminished by approximately 50%. The concentrating ability of the kidneys was reduced to less than one third of the maximum value. The results were consistent with severe dehydration and emaciation due to heavy losses of energy, water and body mass along with increasing milk production. The progressive nature of the disease supported the hypothesis that nursing sickness is due to the combined effects of heavy milk production and excessive tissue catabolism along with reduced or ceased dietary intake, and maybe increasing environmental stress. In the advanced stage of the disease coma and death appear to be the inevitable outcome of the metabolic strains for continuing milk production.

*Can J Vet Res, 56, 95-101, 1992. 6 tables, 3 figs., 36 refs. Authors' abstract.*

**Milking of females with different litter sizes.**

*Tove N. Clausen, Carsten Riis Olesen*

Examination of the content of protein, fat and lactose in mink milk of females with 3 respectively 8 kits per litter. Females with 3 kits in the litter do not show the same increase in percent of milk fat and dry matter in milk during the nursing period as females with 8 kits in the litter, maybe because the lactation period lasts longer in females with only a few kits in the litter. In one female with a litter size of 8 kits, greasy kits were found on May 24th. Two days before the female had been milked, and at that time she had a very high percent of fat in the milk. A hypothesis regarding the development of greasy kits could be that a high percent of fat in the feed results in a higher percent of fat in the milk. If kits develop the capability to digest fat slowly (low lipase activity in the first 4 weeks) they might have a fat-conditioned diarrhoea followed by a secondary bacterial infection.

*Danish Fur Breeders' Association. Technical Year Book 1991. 210-216. In DANH. 3 figures.*

*Original Report*

# Feeding devices reduce feed waste in mink farming

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## Summary

Mink (*Mustela vison*) are usually fed on cage wire, which increases feed waste. In this study different feeding devices were compared to the conventional feeding method. The experimental groups were 1) dry pellets in a feeder, 2) control, wet feed on wire, 3) wet feed on wire with a spill tray, 4) wet feed in a slant tray feeder, and 5) wet feed in a cup feeder. The first experiment was run on the suckling period during two consecutive weeks each lasting five days. There were five females with their litters per group. The second experiment, also lasting five days, was performed on the growing-furring period. Each group included two males and three females. The feed consumption and the amount of feed wasted were measured on a dry matter (DM) basis. The influence of dietary DM on the amount of feed wasted was also clarified. During the suckling period, the animals in the feeder groups wasted significantly less feed (week 1; 7-10%, week 2; 5-12%) than the control group (17%, 21%), respectively ($p<0.05$). During the growing-furring period, the average amount wasted in the feeder groups (1-3%) was also significantly lower than the control (6.5%, $p<0.05$). One percent decrease in the dietary DM increased the feed waste by 3.8 percent, when the DM content declined from 33 to 25%.

## Introduction

Farm-raised mink are usually fed with a porridge-like wet diet compounded mainly of fish, slaughterhouse waste, dried protein feedstuffs and cereals. The rations are delivered either manually on top of the wire mesh of the rearing cages or pumped with automatic feeding machines. this requires, however, good consistency in the feed mixture and limited water content. In order to maintain the consistency, the cereals used have to be added (*Berg, 1986; Jørgensen, 1985*). Furthermore, in this type of feeding some feed is wasted through the wire, which increases the feeding cost of the animals. Earlier, when fur animal feed was largely based on slaughter waste and high quality cereals, feed consistency was good and only a little was wasted. According to Mäkelä and Immonen (1972), the waste percentage was only 2% when dietary dry matter was as low as 27%. However, higher inclusion levels of the inexpensive dried protein feedstuffs, such as fish meal and meat meal are known to impair the consistency of fur animal feed although the dry matter content of the diet would be higher (*Berg, 1986; Mäkelä & Immonen, 1972*).

Developing the use of feeding devices appropriate for wet feeds with different dry matter contents

would enable formulation of diets with different levels of dry matter. More water could be provided to the animals directly in the diet, which is a very important factor especially during the suckling period and the winter season (*Berg, 1986*). Furthermore, these devices would help to reduce the feeding costs and improve the economy of the farm by diminishing the amount of feed wasted. Moreover, during the first weeks of early growth, when the mink kits begin to consume solid feed, it is important to provide them with easy access to the feed. In practice, many ranchers feed the litters in the nest boxes. This may, however, enhance cannibalism by causing feed spots on the fur of the kits. The litter mates usually start to suck on such an individual. Feeding devices could also help in improving the hygienic conditions in the nest box.

The purpose of the present study was to develop and test different types of feeding devices for mink during the early growth and growing-furring periods. The main emphasis was on decreasing the amount of feed wasted. The effect of the water content in the diet on feed waste was also studied.

## Materials and methods

The experiments were performed at the Fur Unit of the Nova Scotia Agricultural College, Truro. The animals were housed in 50.8 x 58.4 x 30.5 cm (width x length x height) cages provided with nest boxes. The cages were constructed of 2.5 x 2.5 cm wire mesh. The feeding devices on trial were as follows: 1) dry pellet feeder, 2) control, wet feed on the cage wire, 3) wet feed on wire with a spill tray, 4) wet feed in a slant tray feeder, and 5) wet feed in a cup feeder. The devices are illustrated in figure 1. The animals in group 1 were fed with commercial dry feed (National® Early Growth and Grow Fur pellets). Groups 2-5 were fed with a wet feed mixture compounded of fish, beef and poultry offal, cereals and water. The dry matter (DM) content of the wet diet was approximately 30%. The experiments were conducted during the suckling period and during the growing-furring period.

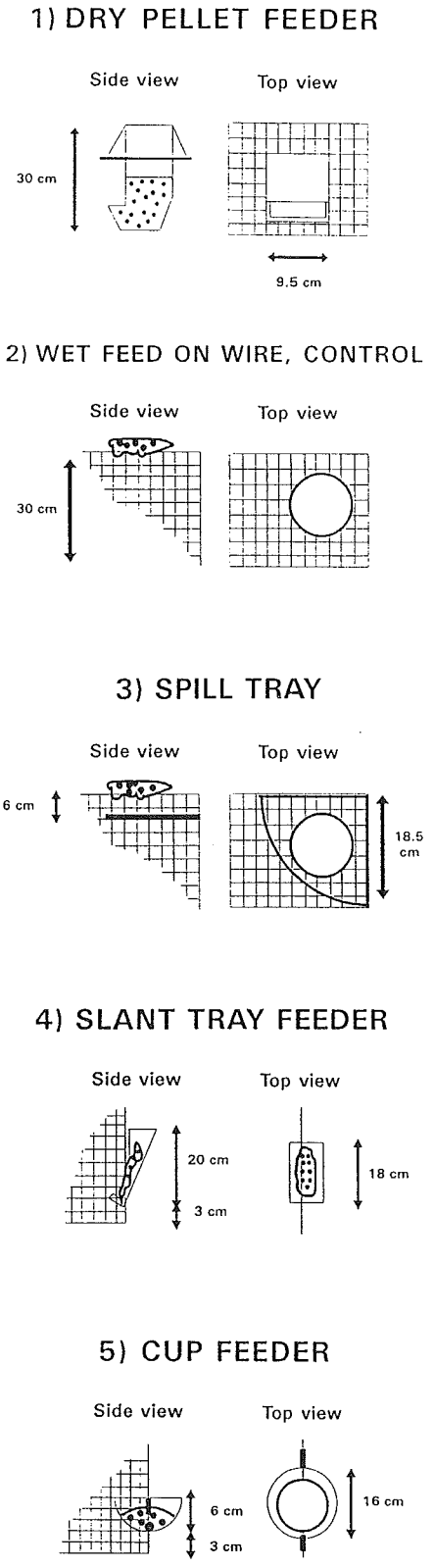


**Fig. 1.** Experimental groups and the respective feeder models used in the study.

In the suckling period experiment, 25 female mink with litters ranging from 3-7 kits were used. There were five females per treatment. However, one female with seven kits from the dry pellet feeder group (1) had to be excluded from the trial during the first week because of nursing sickness. The number of kits per device group varied between 25-26 during the first trial week, except in group 1 (17 kits). During the second week, there were 23-25 kits in each device group. The experiment was conducted during June 1991 in two consecutive five-day periods when the kits were approximately 6-7 weeks of age, i.e. just prior to their weaning time (*Jørgensen, 1985*). The animals were allowed to adjust to the devices for two days. The female and the kits were weighed individually at the beginning and at the end of the collection period. A weighed amount of feed (500-1400 g) was given daily to each female and her litter according to their consumption. The dry feeders were kept full at all times. The feed wasted from the previous day was collected from a plastic sheet located below the cages, and the rejected feed was collected from the feeding devices. Moreover, the feed carried to the nest boxes was treated as rejected. The feed delivered and the feed collected as waste or rejected were weighed and analyzed for their DM content. In the analysis, a weighed sample was dried on a tinfoil cup at 105-110°C for 24 h. Each analysis was done in duplicate. The waste percentage was calculated using the total feed allocation corrected by subtraction of the leftovers. The adjustment was done because the leftover of the feed offered is usually reused in commercial production.

The growing-furring period experiment was performed during October 1991. It included 10 male and 15 female mink born in the spring. Each experimental group consisted of 2 males and 3 females, which were caged singly. The trial lasted for five days with a preliminary two days for adjustment to the feeding devices. The initial and final body weights of the animals were recorded. The daily wet feed portions varied from 200-300 g per animal, according to its appetite. The dry feeders were filled when necessary. The collection of the leftovers and waste, and the analysis and calculations were done as described previously.

The amount of feed wasted at different dietary water contents was determined without animals. Three hundred (300) grams of feed was delivered on top of 10 cages (2.5 x 2.5 cm wire) at 9:00 a.m.. The feed that fell through was collected from a plastic sheet at 3:00 p.m.. Waste percentage was determined on a DM basis for five different dry matter contents ranging from 24.9-32.5 %.

The differences between the experimental groups were tested by the General Linear Models (GLM) procedure of the Statistical Analysis System (SAS Institute Inc. 1985). In the suckling period trial, the main effects tested were the experimental group and litter size. In the case of the growth of the kits, sex was also included in the model. In the growing-furring period trial, the effects of the experimental group and sex of the animal were tested. When the effects were statistically significant, differentiation among the mean values was done by the Student-Newman-Keuls test ($p<0.05$). The dependence of the feed waste on the dry matter content of the diet was calculated by linear regression (SAS Institute Inc. 1985).

## Results

*Suckling period*

In the suckling period trial (table 1), the average litter size per female was 4.92 ± 1.41 kits. The average age of the kits was 40 ± 1 days during the first trial week and 47 ± 1 days during the second week. During both weeks, feed consumption was equal in all groups when calculated as dry matter. However, the amount of feed wasted through the wire was significantly higher in the control group (2, wet feed on wire) than in the feeder groups (1, 3-5). During the second week the animals in the dry feeder group 1 wasted significantly less feed than the ones fed the wet diets (groups 2-5). In addition, the litter size was shown to significantly affect the feed consumption of the animals during both experimental weeks, litters of 5-7 kits consuming more than the litters of 3 and 4.

The best weight gain of the suckling kits during the first trial week was obtained in the cup feeder group 5 (table 1), the growth of which (19 g $day^{-1}$) was significantly higher than in the dry feeder (12 g $day^{-1}$) or the spill tray (15 g $day^{-1}$) groups (1 and 3, respectively). During the second week, no significant differences were observed in the growth of the kits (table 1). Moreover, during the first week, the litter size significantly affected the weight gain of the litters, and during the second week there was a significant group and litter size interaction. The device group did not affect the weight loss or gain of the dams during the suckling period.

**Table 1.** Average daily feed consumption, waste percentage, and body weight gain for mink dams and their litters during the suckling period *.

| | Feeding device group | | | | | Significance | | |
|---|---|---|---|---|---|---|---|---|
| | 1 Dry feeder | 2 Cage wire | 3 Spill tray | 4 Slant tray | 5 Cup feeder | Group | Litter size | G x L |
| *Week 1* | | | | | | | | |
| Feed cons., g DM | 172.5±54.0 | 134.0±26.0 | 141.3±18.0 | 157.1±28.3 | 167.7±17.9 | NS | <0.001 | NS |
| Waste % | 6.9± 5.5$^{b}$ | 17.1± 6.7$^{a}$ | 9.0± 2.9$^{b}$ | 9.8± 2.8$^{b}$ | 7.3± 3.0$^{b}$ | <0.05 | NS | NS |
| Weight gain | | | | | | | | |
| Dam, g | -9.4±17.7 | -7.8± 8.7 | -13.4± 2.0 | -14.4±14.2 | -10.8± 6.8 | NS | NS | NS |
| Litter, g kit$^{-1}$ ♀ | 13.4± 6.2 | 16.4± 3.9 | 14.3± 2.7 | 17.4± 4.1 | 13.8± 5.3 | | | |
| ♂ | 11.6± 6.7 | 17.1± 6.5 | 16.2± 3.2 | 17.3± 4.2 | 23.4± 5.8 | | | |
| | | | | | | <0.001 | <0.001 | NS |
| ♀+♂ | 12.3± 6.4$^{c}$ | 16.7± 5.0$^{ab}$ | 15.1± 3.1$^{b}$ | 17.3± 4.1$^{ab}$ | 19.0± 7.3$^{a}$ | | | |
| *Week 2* | | | | | | | | |
| Feed cons., g DM | 239.0±55.8 | 204.7±41.4 | 247.6±24.1 | 249.4±14.9 | 229.1±42.2 | NS | <0.05 | NS |
| Waste % | 5.0± 2.4$^{c}$ | 21.3± 1.9$^{a}$ | 11.6± 1.6$^{b}$ | 8.7± 3.2$^{b}$ | 10.8± 2.8$^{b}$ | <0.001 | NS | NS |
| Weight gain | | | | | | | | |
| Dam, g | 4.9±16.7 | 10.0±16.8 | 3.0± 7.4 | 8.0± 9.1 | 5.0± 9.4 | NS | NS | NS |
| Litter, g kit$^{-1}$ ♀ | 22.3± 5.4 | 22.4± 4.4 | 18.9± 2.7 | 20.8± 5.9 | 20.8± 2.8 | | | |
| ♂ | 31.3± 8.2 | 30.0± 4.9 | 31.2± 5.4 | 28.3± 4.6 | 28.4± 1.7 | | | |
| ♀+♂ | 26.6± 8.1 | 26.3± 6.0 | 25.8± 7.6 | 25.0± 6.3 | 23.5 ± 4.5 | NS | NS | <0.001 |

$^{a-c}$: means±SD. not sharing any common postscript are significantly different ($p<0.05$).

*: during the first trial week the average age of kits was 41±1 days and during the second week 47±1 days.

*Growing-furring period*

In the growing-furring period experiment, the feeding devices significantly decreased the amount of feed wasted (table 2). The growth of the animals during the trial was, however, significantly lower in the device groups (1 and 3-5) compared to the control (group 2). The sex affected the feed consumption of the animals due to the males being heavier. The average DM consumption for males was 81.8±8.2 g and for the females 61.7±5.4 g daily. There was also a group and sex interaction in the weight gain of the animals. The males in the spill tray and the slant tray groups did not differ from the control, while the weight gain of the females and that of the males in the dry feeder and cup feeder groups was significantly poorer.

**Table 2. Average daily feed consumption, waste percentage, and body weight (BW) gain during the growing-furring period *.**

| | Feeding device group | | | | | Significance | | |
|---|---|---|---|---|---|---|---|---|
| | 1 Dry feeder | 2 Cage wire | 3 Spill tray | 4 Slant tray | 5 Cup feeder | Group | Sex | G x S |
| Feed cons., g DM | 71.8± 14.1 | 67.9± 12.5 | 65.9± 13.1 | 71.9± 14.1 | 71.4± 9.8 | NS | <0.001 | NS |
| Waste % | 0.9± 0.5[b] | 6.5± 3.2[a] | 3.1± 2.1[b] | 2.9± 2.2[b] | 1.3± 1.2[b] | <0.01 | NS | NS |
| Initial BW, g | 1415.4±526.7 | 1359.8±462.6 | 1396.4±456.4 | 1391.2±459.0 | 1433.0±481.2 | NS | <0.001 | NS |
| Final BW, g | 1432.6±504.0 | 1478.8±436.4 | 1447.4±473.6 | 1462.4±514.8 | 1457.4±467.7 | NS | <0.001 | NS |
| BW gain, g day$^{-1}$ | 3.4± 7.2[b] | 23.8± 8.3[a] | 10.2± 7.2[b] | 14.2± 12.1[b] | 4.9± 5.2[b] | <0.01 | NS | <0.05 |

[a-b]: means±SD. not sharing any common postscript are significantly different ($p<0.05$).

*: average age of animals six months.

*Effects of Dietary Dry Matter*

The amount of feed wasted (y) was shown to increase linearly, according to the following equation $y = 122.72 - 3.79 x$ ($R^2 = 0.880$, $p<0.001$), when the dry matter content of the diet (x) was decreased (fig. 2). One percent increase in the water content of the diet thus increased the amount of feed wasted by 3.8 percent, when dietary DM was below 33%.

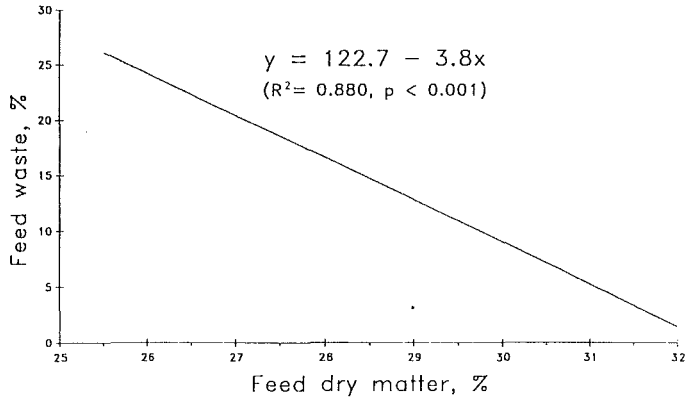


**Fig. 2. Dependence of feed waste percentage (y) on the dry matter content of mink feed (x), n=50.**

*Economical aspect*

Using an estimate of $ 7.00 (Canadian) per hour for labour costs, and the price of the materials used, the cost of each spill tray (group 3) would be $ 1.64, each slant tray (group 4) $ 2.22, and each cup feeder (group 5) $ 3.49. The amount of time it would take for these devices to pay for themselves, at a feed cost of 40 $ per kg, would be 46, 56 and 86 days, respectively. It should be noted, however, that if feed, material and labour costs varied, the number of days would also vary.

## Discussion

All feeding devices employed in this study significantly reduced the amount of feed wasted when compared to conventional feeding on the wire. The average waste percentage in conventional feeding during the suckling period was 17-21 %, while in the wet feeding device groups (3-5) it varied from 7-12 %. In addition, slightly less feed was wasted on dry matter basis (5-7 %), when dry pellets were used in comparison to wet feed. In the growing-furring period trial, 6.5 % of the feed was wasted when fed on the wire. In the dry feeder (1) and wet feeding device groups (3-5) the waste ranged from 1-3 %. In an earlier study (*Mäkelä & Immonen, 1972*) during the growing-furring periods of 1970-71, feed waste percentage was observed to be only 2% when the animals were fed on the wire. This is largely explained by the different composition of fur animal diet at that time. Since then the economical dried protein feedstuffs have been used in increasing quantities to replace the fresh feedstuffs of animal origin in order to lower the feeding costs (*Berg, 1986; Jørgensen, 1985*). This has brought along an increase in dietary dry matter and an impairment in feed consistency.

In the conventional feeding on the wire, the amount of feed waste was shown to be significantly dependent on the amount of water in the diet. One percent decrease in the dietary dry matter increased the waste through the cage wire by nearly four percent. This part of the study was, however, carried out without animals. The average dry matter content of the wet diet used in the growing-furring period trial was 30%, which resulted in 6.5% waste. According to the theoretical equation the waste would have been approximately 9%. The difference is simply explained by the fact that the animal would eat part of the feed that is falling through the cage.

During the first trial in the suckling period, the weight gain of the litters in the dry feeder (1) group was significantly lower than in the control (2), the slant tray (4) and cup feeder (5) groups. The spill tray group (3) also resulted in a poorer growth than the cup feeder group. This is probably due to the placement of the feeders. The cup feeder and the slant tray were placed lower and closer to the opening of the nest box allowing easy access to the feed for the kits. From these devices it may also have been easier for the dam to carry feed to the nest box. Moreover, the spill tray may have functioned as an obstruction for the young kits when they are yet unable to climb well.

In the growing-furring period experiment, the body weight gain of the animals was lower in the feeding device groups (3-5) compared to the control (2). This may be due to the increased activity of the animals induced by reducing the bareness of the cage environment (*Jeppesen & Falkenberg, 1990*). This is supported also by the fact that the feed consumption of the animals did not differ between the treatments. However, reduced body weight gain at this time of the year does not necessarily mean poor growth and shorter pelts, because the weight gain in the later growing season is mainly caused by fat accumulation. Increased activity may also be a temporary phenomenon and calm down when the devices have lost their novelty value (*Jeppesen & Falkenberg, 1990*).

The economical calculations presented are based only on the reduction in feed waste during the suckling period. An important factor during the long term is, however, the increased labour in feed delivery and cleaning. During the suckling period, the mink are taken care of very intensively. At this time, when the number of animal units to be fed and the number of feeders required is still low, additional costs and labour are justified. When the kits are weaned the number of units to be taken care of would multiply. Moreover, later in the growing season, the animals are not as susceptible to dehydration. They may be fed diets of higher dry matter, which will also reduce the amount of feed wasted. In addition, other important factors, which may affect the profitability of the devices during the suckling period, would be the growth of the kits and kit mortality. To clarify these effects, further study with larger animal numbers would be required.

Based on the results of this experiment, we can conclude that when low dry matter diets are used in order to provide animals with more water directly in the feed, wet feeding devices minimize the amount of feed wasted. The best device models to be used during the early growth period would be the slant tray (group 4) and the cup feeder (group 5). These models were, however, subjectively rated as being also the most laborious in terms of feed delivery and cleaning.

**Acknowledgements**

The Nova Scotia Fur Institute is gratefully acknowledged for financially supporting this study. We also thank Ms. Pamela McKay for technical assistance, and Mrs. Merridy Rankin, B.Sc., and Mras. Mary Hamilton from the NSAC Fur Unit for their co-operation.

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**Effects of diet on water turnover and water requirement in mink.**

*Maria Neil.*

The objectives of the present investigations were to identify dietary factors influencing water turnover and water requirement in mink and to study effects of these factors. Water consumption in feed and drinking-water and water excretion with urine and faeces were measured in comparative balance experiments with adult mink males. The factors investigated were dry diets, drying methods and methods for heat treatment of cereals, types and levels of water absorbents, levels of dietary protein, fat and carbohydrates and dietary water content.

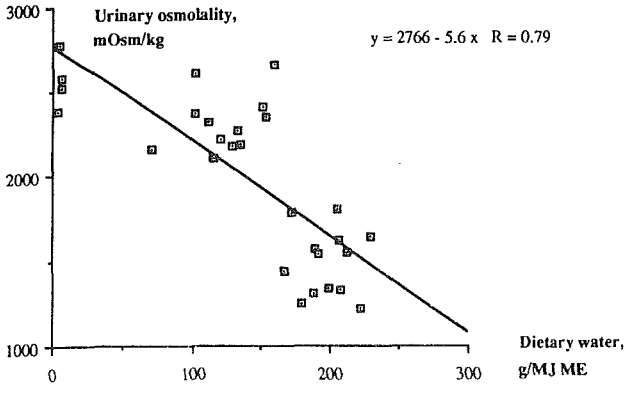


Fig. 1. Dietary water contents and concentrations of urine in the experiments of papers I-II.

The main findings were the following: 1) Dry diets, heat drying of feed, and use of water absorbents increased the amount of faecal water. 2) Total water consumption was increased when the level of dietary water content increased, and when the amount of faecal water increased strongly. 3) Dry diets and very large amounts of faecal water increased the ingestion of drinking-water. 4) The urine water excretion decreased when amounts of faecal water increased. 5) High dietary water content increased the urine water excretion. Since water supply may be critical during the late lactation period, the practical significance of the results was evaluated in a production experiment with supplementary dietary water to mink during the period of lactation and early kit growth, in which animals receiving supplementary dietary water showed superior performance, i.e., females tended to lose less live weight during lactation than controls, and male kits grew faster. It was concluded that dietary factors do influence water turnover and water requirement in mink, and that the effects are of practical significance.

*Ph.D. Thesis. Swedish University of Agricultural Sciences, Department of Animal Nutrition and Management, Report No. 213, 1992. 1 fig., 64 refs. Author's summary.*

**List of papers included in the thesis:**

I. Neil, M. 1986. Feed-related factors affecting water turnover in mink. Swedish J. Agric. Res. 16, 81-88. *Scientifur, Vol. 11, No. 3, pp 240.*

II. Neil, M. 1988. Effects of dietary energetic composition and water content on water turnover in mink. Swedish J. Agric. Res. 18, 135-140. *Scientifur, Vol.13, No. 4, pp 307.*

III. Neil, M. 1992. Supplementary dietary water to mink in lactation and early kit growth. Submitted to Swedish J. Agric. Res. *Summary in present issue of Scientifur.*

**Supplementary dietary water to mink in lactation and early kit growth.**

*Maria Neil.*

Effects of supplementary dietary water on female live weight loss, early kit growth and occurrence of nursing sickness were studied in an experiment with 45 lactating sapphire mink and their litters. A conventional wet diet was compared with the same diet with 15% supplementary water added. The experiment started at an average kit age of 15 days and ended when the kits were 9 weeks old. Feed consumption on an energy basis was higher in animals receiving supplementary water. There was a non-significant tendency for females fed supplementary water to lose less weight in lactation than controls. Male kits on supplementary water treatment were significantly heavier at 3 and 6 weeks, and tended to be heavier at 9 weeks. No nursing sickness occurred in the experiment, probably due to the cool weather in spring that year. It is concluded that supplementary water in

the diet could improve water supply and thereby female and kit performance. Probably, the difference between treatments would have been greater in a year with more normal weather conditions.

*3 tables, 21 refs. Author's summary.*

**Fish oil and rapeseed oil as the main fat sources in mink diets in the growing-furring period.**

*Anne-Helene Tauson, Maria Neil.*

Effects of dietary fat source and level on feed consumption, weight gain, fur quality characteristics and some physiological parameters were investigated in 9 groups of pastel mink kits. The fat level was moderate or high (main fat source 18% or 25% each of slaughter-house offal and poultry wastes; 3% or 6% fish oil; 3% or 6% OO-variety rapeseed oil, respectively, on a wet diet basis). High fat slaughter offal products and fish oil-based diets were supplemented with vitamin E according to standards or with extra 6 mg per animal and day. Slaughter offal, rapeseed oil and the moderate level of fish oil supported a normal and similar growth rate. On the high fish oil level, weight gain and ME intake were impaired and white underfur was recorded. Hemoglobin and hematocrit values confirmed the incidence of anemia in these groups, the rate however being lower when extra vitamin E was given. Anemia was probably caused by high levels of dietary PUFA. Animals fed rapeseed oil had significantly higher $T_4$ values and elevated ME intake compared with the slaughter offal control. Fur quality characteristics were superior in the rapeseed oil-based diets and worst in the slaughter offal groups, which was explained by differences in fatty acid composition.

*Journal of Animal Physiology and Animal Nutrition, 65; 2, 84-95, 1991. 6 tables, 1 fig., 35 refs. In ENGL, Su. GERM. Authors' summary.*

**Varied dietary levels of biotin for mink in the growing-furring period.**

*Anne-Helene Tauson, Maria Neil.*

An investigation was carried out into the effects of varied levels of dietary biotin with 5 groups, each of 20 male and 20 female mink kits of the standard and the sapphire colour types, respectively. A balanced diet was fed without or with 0.1 mg biotin supplementation per kg dry matter (DM). Further, a diet based on feedstuffs with low natural biotin content was fed without biotin supplementation, with biotin supplementation up to the minimum requirement for growth or to double this level. The analysed biotin contents were above the calculated for all diets, but the contents of the low biotin diet were close to the minimum requirement for growth. No symptoms of biotin deficiency were documented. Only moderate differences in performance were found between groups. The weight gain of animals fed the low biotin diet was somewhat poorer than for animals fed the standard diet, regardless of biotin supplementation, which was explained by differenes in palatability between diets. There was a tendency for a rougher hair coat of the animals on the lowest biotin level during the rearing period but this was not confirmed when the pelts were graded for fur quality characteristics, apart from a tendency for a higher frequency of fur defects in this group. There were no clear-cut positive effects of extra biotin supplementation of a balanced diet. It was concluded that biotin deficiency in practical feeding when no avidin-containing feedstuffs are used is unlikely to occur.

*J. Anim. Physiol. a. Anim. Nutr. 65, 235-243, 1991. 5 tables, 25 refs. In ENGL, Su. GERM, ENGL. Authors' summary.*

**Absorption of tylosin after oral administration in mink.**

*Rikke Westh.*

Tylosin was given orally at 7, 14 and 21 mg/kg body weight, respectively, to 3 groups of 3 female mink, and its absorption rate studied by tests on blood samples taken 30, 60 and 90 minutes after treatment. It was shown that a dose of 15-20 mg/kg gave a therapeutic serum concentration.

*Dansk Veterinaertidsskirft, 73; 8, 458-459, 1990. 1 table. CAB-abstract.*

**Fermented meat-and-bone meal in the diets for mink.**

*V.V. Nester, A.I. Snitsar', G.S. Kupriyanova, E.G. Kvartnikova.*

Hydrolysed meat-and-bone meal (HMBM) was produced by hydrolysing slaughter wastes with Protosubtilin G3x (with proteolytic activity of 70 units/g) for 4 h at 40° to 50° C. The meal was of 2 types: type 1 consisted of 30% bone, 50% soft tissues (lungs and liver) and 20% blood; the 2nd type was 30% bone, 40% soft tissues and 30% blood. The limiting amino acids in the 2 types were methionine plus cystine, with score of 33 and 37 % for types 1 and 2, respectively; isoleucine 65 and 54 %; threonine 82 and 85 %. Digestibility of HMBM in vitro using the pepsin-trypsin method, was 89 plus or minus 3%. For feeding fur-bearing animals HMBM should provide 10 to 30 % of dietary digestible protein. In a trial, male and female mink in 3 groups were fed on a basal diet, or that diet with 10 % of the animal protein replaced with type 1 or type 2 HMBM. The body weight of females after 4.5 months of feeding was 1160, 1250 and 1286 g, respectively; that of males was 2070, 2214 and 1995 g. Pelt size of males was 925, 921 and 861 $cm^2$.

*Zootekhniya, No. 6, 52-54, 1989. 4 tables. In RUSS. CAB-abstract.*

**Effect of para-aminobenzoic acid on polar fox cubs with retarded growth.**

*Y.K. Svechin, A.G. Egorova.*

A total of 110 male and female (Arctic) fox cubs, 40 days old, were given diets with p-aminobenzoic acid (PABA) 0, 0.5, 1.0 or 1.5 mg/kg liveweight. Liveweight and body length of female cubs were higher in female cubs given PABA 1.0 mg at 4 months old and higher in all male cubs given PABA than in male controls. Serum protein content of cubs given PABA was higher than controls at 3 months old. It is concluded that PABA 1 mg/kg liveweight is the optimum dose to increase growth.

*Soviet Agricultural Sciences, No. 12, 52-54, 1989. 2 tables, 5 refs. In ENGL. CAB-abstract.*

**Clinical and laboratory findings in small companion animals with lead poisoning: 347 cases (1977-1986).**

*Rhea V. Morgan, Frances M. Moore, Laurie K. Pearce, Thomas Rossi.*

Three hundred forty-seven cases of lead poisoning in small companion animals were reviewed. The yearly prevalence and overall incidence rates were examined for the 10 years before and after enactment of strict federal regulations pertaining to lead content in paint products. Biographical data, clinical signs, and laboratory results were analyzed for the 6 types of affected animals (i.e. dogs, cats, birds, rabbits, a chinchilla, and a raccoon). Clinical and laboratory findings of these animals were then compared with findings of other studies of lead intoxication.

*JAVMA, Vol. 199, No. 1, 1991. 5 tables, 35 refs. Authors' summary.*

**Demographic data and treatment of small companion animals with lead poisoning: 347 cases (1977-1986).**

*Rhea V. Morgan, Laurie K. Pearch, Frances M. Moore, Thomas Rossi.*

Three hundred forty-seven cases of lead poisoning in small animals, diagnosed after 1976 were reviewed. The types of treatments used and their outcomes were analyzed. Changes in blood lead concentrations following various treatments, as well as the sources of lead exposure, were also reviewed. The geographic origins of the cases were traced, and demographic factors were studied to determine possible correlates that might explain the regional distribution of cases.

*JAVMA, Vol. 199, No. 1, 1991. 3 tables, 1 fig., 27 refs. Authors' summary.*

**Chemical analyses and quality analyses - swedish food control 1991.**

*Eva Aldén.*

Within the Swedish fur farming the voluntary chemical and quality control of feed mixtures and feed ingredients includes the main part of feed

produced for fur bearing animals. 56 feed kitchens had during 1991 analyses made for 140 samples of wet feed mixtures and 101 feed ingredients.
During the production periods the average content of dry matter in the mixtures varied from 27.7 (January-whelping) to 32.0% (September-December) and the average ash content was 3.0% the first six months of the year and was then 2.8%. The average content of crude protein was 13.0 (January-whelping), 12.9 (whelping-30th of June), 13.2 (1st of July-31st of August) and 13.5% (1st of September-31st of December), respectively. Corresponding values for fat were 5.8, 6.5, 7.5 and 7.9 % and for carbohydrates 5.9, 5.6, 6.8 and 7.8 %. Calculated mean contents of metabolizable energy per kg feed mixture during the corresponding periods were 4.7, 4.9, 5.5 and 5.7 MJ.
Distribution of metabolizable energy to protein, fat and carbohydrates (%), was calculated for the mixtures based on analyzed chemical composition and calculated digestibility coefficients for protein, fat and carbohydrates and were within the Scandinavian countries recommended energy coefficients.
During the four production periods the average calculated metabolizable energy, % from protein, was 44, 41, 38 and 37. Corresponding values for fat and carbohydrates were 41, 45, 47 and 47, and 16, 14, 15 and 16 %, respectively.
Regarding feed ingredients the main divergences from expected values were higher contents of water in filleting scrap from fish, and higher fat contents in slaughterhouse offal.

*Stenciled report, 11 pp. 9 tables, 5 refs. In SWED. Author's summary.*

**A note on the diet of stone marten in southeastern Romania.**

*Jerzy Romanowski, Grzegorz Lesinski.*

We studied the diet of stone martens *Martes foina* (Erxleben 1777) inhabitating the ruins of the Byzantine temple near Enisale (southeastern Romania). Based on the analysis of 103 excrements, birds and mammals predominated in the diet, constituting 45.2% and 36.1% of consumed biomass. Reptiles, amphibians, insects and fruits were supplementary food. We also found bats, items rarely reported in the marten's diet. The diet was characterized by a high contribution of animals associated with steppe habitat and by a low share of anthropogenic food.

*Acta Theriologica 36 (1-2), 201-204, 1991. 1 table, 12 refs. Authors' summary.*

**The diet of the European badger in a Mediterranean coastal area.**

*Giorgio Pigozzi.*

The feed of European badgers *Meles meles* Linnaeus, 1758 in a dry Mediterranean coastal habitat in central Italy was determined by faecal analysis. between February 1983 and November 1985. The badgers fed primarily on fruits and insects, which made up a combined volume of about 90% of the total amount of feed eaten each year. Insects and fruits were exploited alternately, the former mainly during winter and spring, the latter mainly during summer and autumn. A significant change in this pattern was found in autumn 1985 when the occurrence of insects was higher and that of fruits was lower, respectively, than in the previous years. Other less important feed resources included myriapods, molluscs, birds and mammals. Earthworms did not play an important role in the diet in any period of the year. It is suggested that badgers might adjust to their seasonally fluctuating feeds by changing their feed choice so as to maximize their intake from the available resources.

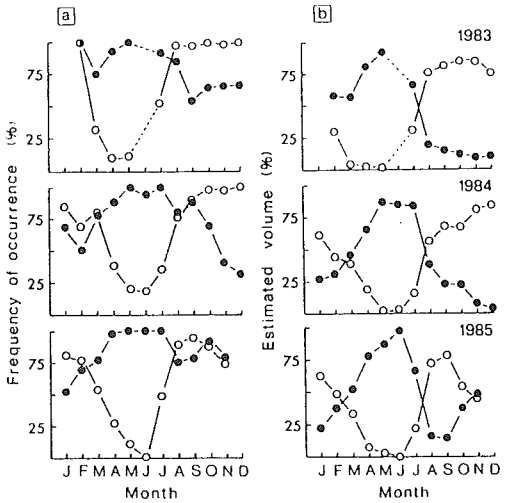


Fig. 3. (a) Frequency of occurrence (%) and (b) estimated volume (%) of insects (●) and fruits (○) in the diet of the badger in the Maremma Natural Park between February 1983 and November 1985.

*Acta Theriologica 36 (3-4), 293-306, 1991. 2 tables, 5 figs., 27 refs. Author's summary.*

**Taste appeal trial: Poultry offal in the feed for nursing mink females.**

*Bente Lyngs.*

Taste appeal trials with poultry offal for scanbrown females in the nursing period (1-5 weeks after birth) were carried out at the Research Farm North in 1991. The conclusions of these experiments were:

- The immediate reaction of the animals to feed containing poultry offal (approx. 19%) was positive but only significant for the amount of wet feed.

- In weeks 2 and 3, where the animals only had access to one of the feed mixtures, feed intake was higher in the experimental group than in the control group.

- After 2 weeks of adaptation, where the animals were only offered the control and the experimental feed, in week 4, they showed a clear preference for the experimental feed. The differences were significant and even more pronounced than in the first week.

- The weight development of the kits was not different in the two groups and must be regarded as not different from corresponding animals not in experiment.

- The kits in the experimental group had a significantly higher weight gain and thus also a higher final weight compared to the kits of the control group.

Based on this experiment it can be concluded that poultry offal (boiled and frozen, Danish) in the amount used here has a positive effect on the taste appeal of the feed.

*Danish Fur Breeders Association, Technical Year Book 1991. 71-76. In DANH. 6 tables. Author's summary.*

**Taste appeal trials: Sand eel or herring byproducts for mink kits in the early growth period.**

*Bente Lyngs*

Taste appeal trials with sand eel and herring byproducts for scanbrown mink kits in the early growth period (age 10-14 weeks) were carried out at the Research Farm North in 1991.

The conclusions were:

- The immediate reaction of the animals to feed with either sand eel or herring byproducts (approx. 27%) was indifferent. No difference was found in feed intake measured as g of wet feed, g of dry matter or energy (kcal).

- In weeks 2 and 3, where the animals only had access to one of the feed mixtures, feed intake was not different in the two groups measured as wet feed and dry matter. Measured in energy, the experimental group had a significantly higher feed intake than the control group.

- After two weeks of adaptation, where the animals in the two groups were only offered the control and the experimental feed, respectively, both groups ($p < 0.05$) preferred the experimental feed in week 4 (herring byproducts).

- The weight gain of the animals was not different in the two groups, but apparently it varied a great deal from week to week.

Based on this experiment it can be concluded that young mink kits prefer herring byproducts to whole sand eel.

*Danish Fur Breeders Association, Technical Year Book 1991. 77-81. In DANH, 4 tables.*

**Taste appeal trials: Poultry offal in the feed for mink kits in the late growth period.**

*Bente Lyngs.*

Taste appeal trials with poultry offal for scanbrown mink kits were carried out in September-October of 1991 at the Research Farm North.

The conclusions were:

- The immediate reaction of the animals to feed containing approx. 20% poultry offal was positive. The animals ate comparatively more of this feed than of a corresponding feed without poultry offal (measured as grams of wet feed, grams of dry matter and energy).

- In weeks 2 and 3, where the animals only had access to one of the feed mixtures, feed intake was not different in the two groups.

- After two weeks of adaptation, where the animals in the two groups were offered only the control or the experimental feed, respectively, there was in both groups a significant preference for the experimental feed in week 4 ($p < 0.05$).

- The weight gain of the animals was not different in the two groups, but there was a large individual difference in weight gain which must be ascribed to the stage of the physical and physiological development of the animals.

This trial confirms the two other experiments with poultry offal in the feed for mink. Mink prefer feed containing approx. 20% poultry offal to feed without this raw material. This is valid for nursing females, kits in the early growth period and kits in the late growth period.

*Danish Fur Breeders Assocation. Technical Year Book 1991. 82-87. In DANH. Author's summary. 5 tables.*

**Taste appeal trial: Fish conserved with sulphuric acid + acetic acid + ethoxyquin or with formic acid + ethoxyquin.**

*Bente Lyngs.*

Taste appeal trials with conservation of fish with sulphuric acid + acetic acid or with formic acid were carried out with scanbrown mink kits in October and November of 1991 at the Research Farm North. The conclusions were:

- The immediate reaction of the animals to the two kinds of feed was that they preferred feed conserved with sulphuric acid + acetic acid. The animals of both groups ate significantly more of this feed than of the feed conserved with formic acid (measured as g of wet feed, g of dry matter and energy).

- In weeks 2 and 3, where the animals only had access to one of the feed mixtures, feed intake was not different in the two groups. After two weeks of adaptation, the control group still preferred the feed conserved with sulphuric acid + acetic acid, whereas the experimental group had apparently grown accustomed to the feed with formic acid. The difference was, however, only significant for the experimental group.

- Weight and growth of the animals were not different in the two groups, but there was a large individual variation in growth in the individual weeks.

*Danish Fur Breeders' Association. Technical Year Book 1991. 88-92. In DANH. 5 tables.*

**Ensiled salmon and salmon byproducts for mink in the summer period.**

*Georg Hillemann.*

In the summer of 1990 an experiment was carried out at the Research Farm North with Norwegian ensiled salmon for mink.

No important differences were found neither in the development of the animals, nor in the appearance of the faeces, change of pelt or other relevant factors.

No positive or negative effects were seen on skin size.

Based on the results and the entire progress of the experiment as well as on price relations it can be concluded that ensiled salmon can very well be included in mink feed in the summer period in a quantity of 10-12% of the ready feed.

*Danish Fur Breeders' Association. Technical Year Book 1991. 103-111. In DANH. 10 tables.*

**Heat-treated soybeans for mink in the growth period.**

*Georg Hillemann.*

In the summer of 1990 an experiment with heat-treated, whole soybeans was carried out at the Research Farm North. The beans were included with 5 and 10% of the ready feed, respectively. The development and health of the animals were satisfactory, but skin results, especially the overall impression of the skins, did not quite reach the results obtained in the control group. It can therefore be concluded that heat-treated soybeans

should not, with the protein level used, be included with more than 5% in the feed and that it will probably be appropriate to start later in the summer period than in the experiment.

*Danish Fur Breeders' Association. Technical Year Book 1991. 112-120. In DANH. 10 tables.*

**Restrictive feeding of mink in the growth period.**

*Georg Hillemann.*

In the summer of 1990 experiments with restrictive feeding were carried out at the Research Farm North. With a reduction of the amount of feed at different times in the summer period, measured in relation to feeding ad libitum, it was attempted to illustrate which types of mink can stand a reduction, how much the reduction could amount to, and at which time. Standard, pastel and wild mink were used. The feed was delivered from a feed kitchen. The experiment showed that the males become smaller, and that the size of the females is not influenced considerably by restrictive feeding. The quality is largely the same, but the guard hairs are longer. In a single group (23) the quality of pastel was significantly better than that of the control group. The saving on feed is approx. DKK 3.- at a 12% reduction from August 25th. This date was, however, clearly too early both for a 6 and 12% reduction on account of skin size. It can be concluded that restrictive feeding implies a large risk of producing small skins without the skins getting better. A small reduction, approx. 6%, from September 7th seems to be more positive than negative for all three types. In practice, this means that the mink are fed so that they eat up completely from this date.

*Danish Fur Breeders' Association. Technical Year Book 1991. 121-147. In DANH. 14 tables, 10 figures.*

**The effect of lysozyme on the whelping result of mink females and on the growth and pelt development of kits.**

*Bente Lyngs and Georg Hillemann.*

Lysozyme is an enzyme found, for instance, in the egg white of hen's eggs. The enzyme is said to hamper the growth of certain bacteria in chickens, such as Pseudomonas fluorescens and Salmonelle seftenberg (Cunningham et al., 1990). Previous investigations (Valfre et al., 1989) have indicated a positive effect of lysozyme on the number of weaned kits and their later growth and fur priming. The effect is supposed to come from a stabilising influence of lysozyme on the microflora of the intestine.

In 1990, experiments with addition of lysozyme to mink feed were carried out at the Research Farm North. The experiment was carried out in cooperation with Società Prodotti Antibiotici S.p.A., Milan, Italy, who delivered the product. Lysozyme was added to the feed in two levels (25 and 50 mg, respectively, per animal per day). There was also a control group not given lysozyme. The experiments started with breeding females in the winter period and continued with the kits from these females.

The results were as follows:

the breeding period:

- females given 25 mg lysozyme per day had the same whelping result as females not given lysozyme, but apparently they were better milkers, as they were slimmer and their kits heavier at weaning,

- 50 mg lysozyme per day seemed to have a negative effect on feed intake and whelping result,

- there were quite a few greasy kits in both groups given lysozyme.

the growth and fur priming period:

- 25 mg lysozyme per day seemed to have a positive effect especially on the growth and final size of the males. There was, however, a tendency towards a negative effect on skin quality. The skins were less dense and had coarser guard hairs (hair type D),

- 50 mg lysozyme per day seemed to have a negative effect on the feed intake of the kits. This resulted in smaller skins. On the other hand, the previously mentioned negative effect on quality was not found at this level,

- effects from the nursing period were especially a tendency towards longer skins and a better colour in group 14 of the nursing period and a tendency towards more flat skins among animals

given lysozyme in the nursing period.

Some of the results from these experiments were not immediately very logical. For instance in group 14 the quality was apparently poorer, whereas there was a good quality in group 15 (also after correction for size). This, coupled with the fact that a comparatively heavy outbreak of greasy kits was seen on the research farm, makes new experiments interesting. It is also a question how large a proportion of the lysozyme was actually eaten by males and females, respectively, in the growth and fur priming period.

The antibacterial effect of lysozyme would probably be more significant in contaminated feed. In this connection, it would be extremely interesting to examine the effect of lysozyme in a feed containing for instance large amounts of poultry offal.

*Danish Fur Breeders' Association. Technical Year Book 1991. 148-160. In DANH. 10 tables, 2 references.*

**The importance of glycogenic amino acids to the development of mink kits in the nursing period**

*Hans-Jørgen Risager.*

The purpose of the trial was to examine if the protein requirement of lactating females above 40% of metabolizable energy from protein could be covered by non-essential amino acids, and if the females could cover their carbohydrate requirement from glycogenic amino acids when they were given a feed low in carbohydrates (2% of ME).

5 x 20 wild mink females with a litter size of 6.8 kits were used.

Groups 1, 2 and 4 were used as control groups, where the protein level was increased with fish meal, so that ME from protein was 40.6%, 47.7% and 55%, respectively, with a constant relation between non-essential and essential amino acids of 1.2. The content of protein in groups 3 and 5 was raised with crackling protein, so that ME from protein was 48.9% and 56.0%, respectively, with an increasing relation between non-essential and essential amino acids of 1.9 and 2.3, respectively.

No significant difference in kit loss was found, even though the loss varied between 0.4 and 1.2 kits/litter. No difference was found in female weights on day 2 and day 29. On day 43 the females in group 4 weighed, with statistical significance, less than the females in group 2. Group 1 had the best kit growth (male kit growth and biomass growth) and at the same time had the most kits at weaning. Group 5 had the poorest kit weight. This should be seen in the light of the high frequency of greasy kits. No statistically significant difference in the frequency of nursing disease was found. There was a statistically significant difference in the frequency of greasy kits. In group 5 as many as 70% were greasy. The experiment was therefore disturbed so much that no conclusion could be drawn from the effect of the various feed mixtures.Something seems to indicate that the occurrence of greasy kits can be correlated to the percent of water in the feed. The experiment indicates that when the percent of water in the feed exceeds 70% the risk of greasy kits increases.

*Danish Fur Breeders' Association. Technical Year Book 1991. 176-184. In DANH. 8 tables.*

**The importance of mink feed to the fatty acid composition of adipose tissue and of milk**

*Tove N. Clausen.*

An examination of changes in the fatty acid composition of adipose tissue as a result of a change in the fatty acid composition of the feed and an examination of the fatty acid composition of mink milk in females fed different sources of energy were carried out in 1987 and 1991. The results showed that the adipose tissue of mesentery and kidney showed large changes of fatty acid composition immediately after a change of feed, and after 15 days the most important changes had taken place. In the following months a further but slow approximation to the fatty acid composition conditioned by the other feed took place. As far as adipose tissue of the body was concerned, no particular changes in fatty acid composition took place during the first 15 days. After a month the most important changes had taken place and after yet another month the fatty acid composition was at the same level as in the group given the feed in question during the entire period. As regards the fatty acid composition of

the milk, as opposed to the percent of fat of the milk it was very constant in the animals that had been fed the same feed in the winter and nursing period. This made it easier for us to evaluate the possible importance of the composition of milk fatty acid to the occurrence of greasy kits. Because the females fed linseed oil had no greasy kits, but females fed pig's fat had many, coupled with the fact that the fatty acid composition in the milk of females fed the same feed was very constant and feed-dependent, it was decided, in the nursing period of 1990, to examine the correlation between feed fat, milk fat, adipose tissue and a possible occurrence of greasy kits.

*Danish Fur Breeders' Association. Technical Year Book 1991. 185-189. In DANH. 6 tables.*

**Variations in the dry matter content of the feed and its importance to the occurrence of nursing disease in mink females.**

*Hans Jørgen Risager, Tove N. Clausen and Carsten Riis Olesen.*

The experiment was carried out with 3 x 40 wild mink females with an average litter size of 6.7 kits (5-9 kits) in the period from May 8th to June 17th. The groups were given the same feed, to which water was added to reach a dry matter percent of 37.0, 30.7 and 25.0, respectively. The last group was fed in cups in the cage. The feed used had an energy distribution of 37.3:41.7:21.0 as this composition had in the 1990-trials given a high frequency of nursing disease. Feeding with very wet feed for females and kits in the nursing period gave good results as regards the weight at weaning of both kits and females. The females in the group given feed with the lowest content of dry matter did not drink water also, as their need for liquid was covered by the feed. The frequency of nursing disease in the group was low, whereas the frequency of greasy kits was very high (53%). It will be attempted to find the reason in the nursing period of 1992. Despite a low dry matter percent, nursing disease still occurred, and a high amount of water in the feed was therefore not enough to prevent this disease.

*Danish Fur Breeders' Association. Technical Year Book 1991. 190-197. In DANH. 6 tables.*

**The importance of the feeding conditions in the growth period to the nursing period of primiparous mink females.**

*Carsten Riis Olesen and Tove N. Clausen.*

The purpose of this experiment was to test feeds in the growth period to find out whether the basis of a certain development of the later nursing period of the females is already decided here. Furthermore, the possibility of saving considerable amounts on feed production if a protein reduction does not have a negative influence on the development of the nursing period was investigated. Litters were graded as greasy litters, if the kits were suppurating from rectum and were moist all over their bodies. Most of them had diarrhoea the next day. Besides, the result also includes a few litters with hairless kits. It is well-known that loss of hair is often seen in kits that have been greasy. Females which had greasy kits gave birth a day later and had more kits at birth, 6.0 kits/litter against 4.9 in healthy females, but due to the high mortality rate of greasy kits, there were 3.6 and 4.3 kits, respectively, when the two groups were weaned. Weight at weaning of the greasy kits was considerably lower than that of healthy kits. A statistically significant difference was found in the frequency of greasy kits between the growth period groups and the nursing period groups. By means of a multiple regression analysis to find the factors most important to the occurrence of greasy kits, number of live kits at birth, date of birth, feeding in the growth and nursing period were found to be the most important factors. In conclusion, feeding in the growth period with an energy distribution of 40:47:13, alternatively with 30:55:15, combined with a winter-nursing period feeding with an energy distribution of 60:30:10 was recommended. In both cases "common" raw materials such as fish offal, industrial fish, silage and poultry offal are recommended.

*Danish Fur Breeders' Association. Technical Year Book 1991. 198-209. In DANH. 7 tables, 10 references.*

**The importance of the nutritive composition of the feed in the nursing period to the growth of mink kits, the frequency of greasy kits and the body condition of the female.**

*Carsten Riis Olesen and Tove Clausen.*

With this experiment, started on April 15th, it was the purpose to demonstrate whether it is the feeding in the winter period or in the nursing period that is of importance to the occurrence of greasy kits. The frequency of greasy kits increases when the kits metabolize increasing amounts of fat. After two years of experiments showing the correlation between level of fat and the frequency of greasy kits, it can be concluded that the strongest effect of the feed in relation to the occurrence of greasy kits lies in the nursing period. The feeding in the winter period probably only affects the body condition of the females.

*Danish Fur Breeders' Association. Technical Year Book 1991. 217-225. In DANH. 7 tables, 1 figure.*

**Growth of blue fox kits treated with iron.**

*Niels Therkildsen.*

The injection of an iron preparation approx. 23 and 58 days after birth did not have a positive or negative influence on growth and skin length in 36 blue fox kits in comparison with their 33 littermates acting as an untreated control group. From the age of 8 weeks and till the end of the growth period there is a statistically significant difference in the weight of blue fox males and females, respectively. The average weekly weight gain is large from 8 to 19-20 weeks. In this experiment a little more than 500 g for the males and a little more than 400 g for the females. The correlation coefficients between skin length and body weight increase evenly during the growth period and reach a maximum of 0.49 and 0.55 for males and females, respectively, in week 42 (in the middle of October). The correlation coefficient between weight and skin length decreases to 0.45 and 0.37 for males and females, respectively, at pelting in week 49 (the beginning of December). In the experiment a better correlation was found between body weight and skin length in October than at pelting at the beginning of December. Based on the above mentioned experiment there is under normal conditions no reason to give blue fox kits additional iron besides the iron contained in the feed.

*Danish Fur Breeders' Association. Technical Year 1991. 286-291. In DANH. 6 tables, 2 references.*

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*Original Report*

# Current knowledge of nursing sickness in mink

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## Abstract

Clinically, nursing sickness in mink is characterized by inanition, emaciation and severe extracellular volume and electrolyte depletion. In breeding seasons 1989/1990 the mean overall incidence risk at Fur Research farm "West" amounted to 12.8% with a case fatality rate of 7.2%. Sick dams raised significantly larger litters and suffered heavier weight losses than apparently healthy females. In advanced stages of the disease, varying degrees of uremia, azotemic acidosis, hyperglycemia and *hyperinsulinemia* were associated with hypovolemia, aldosteronism, hyponatremia and hyperkalemia. Neither ketosis nor severe lactacidemia was observed. Urinary osmolality and solute concentrations were remarkably low. The clinical and biochemical features and the histological findings of the disease supported the hypothesis, that nursing sickness is due, at least in part, to the combined effects of genetic predisposition, heavy lactation, inanition and/or inadequate nutritional supplies and enviromental stress.

## Introduction

Nursing sickness is a widespread and well-known disease in lactating mink in all countries where mink farming is of economic importance. It occurs sporadically in female mink during the latter part of lactation or shortly after weaning apparently without affecting the offspring adversely (*Hartsough, 1955; Hunter & Schneider, 1991; Clausen et al., 1992*). The rates of morbidity and mortality due to nursing sickness vary considerably between localities and breeding seasons and, according to recent investigations, the incidence risk is particularly high among multi-parous females raising larger litters (*Hartsough, 1955; Henriksen, 1985; Hunter & Schneider, 1991*). In the literature, only a few original reports on nursing sickness are found (*Clausen et al., 1992*) and in several current textbooks on mink farming (*Kennedy, 1951; Gorham et al., 1972; Wenzel, 1982*) the information available on nursing sickness does not suffice for an adequate solution of the complex of potential environmental, nutritional and

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genetic factors thought to be involved in the etiology and development of the disease.

## Aim of study

The main objective of this report was to present current knowledge of nursing sickness with particular reference to the results of our recent investigations in the epidemiological, pathological and biochemical characteristics of the disease obtained at a Danish research farm. In addition, the biochemical data obtained in blood and urine from apparently healthy lactating mink provided a suitable source of reference values for future studies on metabolic disorders in female mink during the period of reproduction.

## Materials and methods

All the data presented in this report were obtained during the 1989 and 1990 spring seasons in a retrospective survey of the breeding stock of female mink at the Fur Research Farm Vest, Holstebro, Denmark. Following the exclusion of 517 barren females and of 31 nursing females dying from dystocia and sepsis the present investigation encompassed a total of 3617 lactating mink of the Standard Black and Pastel color mutants (Table 1). Females that succumbed from nursing sickness a few days before or after normal weaning term (day 43) and sick dams subjected to postmortem examination (see below) were included in the group of sick dams. The standard managing procedures at the research farm, including housing, feed preparation and schedules for feeding and weighing the animals etc., were those described previously (*Clausen et al., 1992*).

*Sampling and analysis*

Heparine-stabilized blood samples were obtained in sick and healthy lactating females by heart puncture during light sodium pentobarbital anesthesia (20 mg/kg) as previously described (*Wamberg et al., 1992a*). Severely affected dams were killed by an overdose of the anaesthetic and subjected to post mortem examination as described by Clausen et al. (1992). The small samples of spot urine usually voided during handling of the animals were collected in disposable vials, filtered and stored at -20°C until analysed. Samples of whole blood were stored in ice-water and the acid-base status determined within 2 hours. Following centrifugation aliquots of plasma were frozen for subsequent analysis of sodium, potassium, magnesium, urea, creatinine, glucose and immuno-reactive insulin and aldosterone. The analytical methods employed were those given in previous publications (*Clausen et al., 1992; Wamberg et al., 1992a*). The differences observed between sick and healthy dams were compared by means of Student's t-test and statistical significance was set at the 5 per cent level.

**Table 1.** Number of dams studied, average litter size and total litter biomass at weaning (day 43).

| | | | | | Average litter size (day 43) | | Total litter biomass (day 43) | |
|---|---|---|---|---|---|---|---|---|
| Year | 1989 | | 1990 | | 1989 | 1990 | 1989 | 1990 |
| | N | (%) | N | (%) | | | g | g |
| Healthy dams | 1518 | (85.6) | 1637 | (88.8) | 4.9±2.0 | 4.6±2.0 | 1582±662 | 1389±508 |
| Sick dams, total | 256 | (14.4) | 206 | (11.2) | 5.4±1.9* | 5.3±1.9* | 1706±599 | 1460±487 |
| Recovered | 139 | (7.8) | 63 | (3.4) | 4.8±2.0 | 5.0±1.9 | 1549±645 | 1459±457 |
| Dead | 117 | (6.6) | 143 | (7.8) | 6.1±1.4* | 5.5±1.8* | 1894±478 | 1462±500 |
| Total no. of dams | 1774 | | 1843 | | | | | |

Values are mean ± SD. * Significantly different from healthy dams ($P < 0.05$).

## Results and discussion

*Epidemiology*

The epidemiological characteristics of nursing sickness in mink obtained during the 1989 and 1990 breeding seasons are given by the data presented in Table 1. Thus, based on a total of 3617 lactating dams the mean overall incidence rate of nursing sickness amounted to 12.8 per cent with a case fatality rate of 7.2 per cent.

The evaluation of major epidemiological factors in nursing sickness was performed by means of logistic regression analysis, and according to the results obtained in a previous study (*Clausen et al. 1992*), the prevalence of the disease was significantly higher among second and third-year dams ($P < 0.01$) raising larger litters (e.g., more than 5 kits) than in first-year dams. Similarly, taking all lactating dams of the present study those suffering from nursing sickness raised on average 5.4 kits per litter compared to 4.8 kits per litter in healthy controls ($P < 0.05$).

*Live weight changes*

During the initial four weeks of the lactation period all lactating dams included in this study lost weight at an average rate of about 4-6% of their initial body mass (Fig. 1).

In the final two weeks of lactation, however, sick dams recovering from the disease suffered an average loss of initial live weight of about 24 per cent, i.e., a two-fold increase of the 12-13 per cent weight loss observed in the control group ($P < 0.01$). Nursing dams that succumbed within a few days before or after normal weaning (day 43) suffered even greater weight losses, averaging approximately 33% of their initial body mass, which is in keeping with recent observations published by Hunter & Schneider (1991).

By contrast, when considering the average live weight of the kits as well as the total litter biomass at weaning (day 43) the differences between the offspring of sick and healthy dams (Table 1) were *not* significantly different ($P > 0.05$).

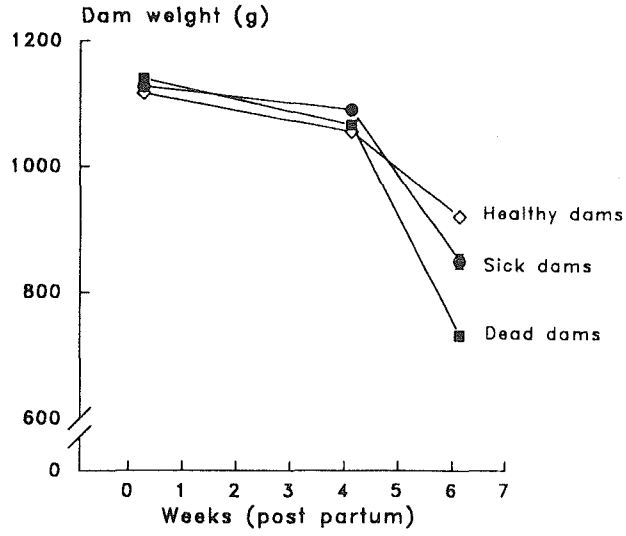


**Fig. 1.** Live weight changes in nursing female mink during the six-week lactation period. Symbols denote: ◇ apparently healthy dams (n = 3155); ● dams suffering (and recovering) from nursing sickness (n = 202); and ■ dams dying from the disease (n = 260) within a few days before or after weaning, respectively. (See Table 1).

*Pathology*

During the latter part of the lactation period, the identification of female mink suffering from nursing sickness was based on a combination of the following clinical signs: loss of appetite, severe dehydration and emaciation, rapidly increasing weakness, staggering gait, ataxia, lethargy and, in the final state, coma and death. Postmortem the major findings were severe loss of body mass due to dehydration and emaciation with complete absence of visible body fat. The mammary glands were involuted. The gastrointestinal tract was empty and disseminated hemorrhages and melaena, both common signs of the uremic syndrome (*Boucot et al., 1960*), were usually present.

The adrenals were enlarged due to hypertrophy of the cortical zone. Histological examination of liver and kidneys disclosed distinct vacuolization

of hepatocytes; and clusters of renal epithel cells containing vacuoles and large numbers of distinct red-colored lipogranulomas were found in microscopic preparations stained with Oil-red-O.

In general, the postmortem findings of our study were in accordance with those reported in the literature (*Hartsough, 1955; Henriksen & Elling, 1986*), although the pathological changes observed by Seimiya et al. (1988) could be of a different origin (*Clausen et al., 1992*).

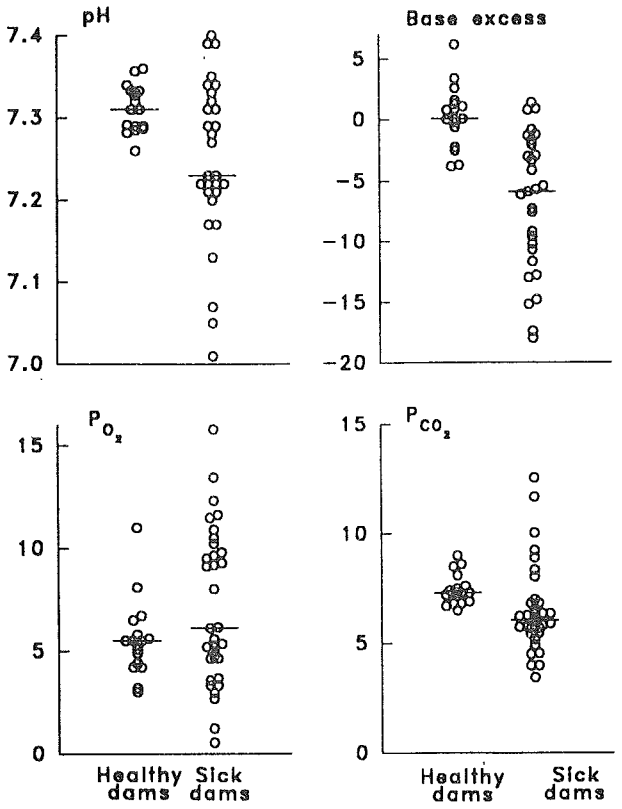


Fig. 2. Whole blood pH, base excess (mmol/L) and $PO_2$ and $PCO_2$ (kPa) values in healthy and sick lactating mink. In each group, the bar indicates the sample *median*.

*Whole blood and plasma*

The blood acid-base data of Fig. 2 documented the presence of mild respiratory depression (low $PO_2$ and high $PCO_2$ values due to the anaesthetic procedure) and variable degrees of azotemic ('metabolic') acidosis as indicated by the presence of elevated plasma urea and creatinine and negative blood base excess values. Interestingly, however, neither ketosis nor severe lactacidemia was observed in these animals. Several major changes of the extracellular fluid composition in sick dams are shown in Figs. 3-4. The extremely low plasma concentrations of sodium and chloride in sick dams, associated with a ten-fold increase in plasma aldosterone documented the existence of severe extracellular volume depletion in nursing sickness (*Hartsough, 1955; Henriksen, 1985; Clausen & Hansen, 1989*). The remarkably high concentrations of potassium and magnesium, on the other hand, indicated intracellular depletion of these constituents, which may at least in part explain the clinical signs of lethargy, progressive muscular weakness and ataxia (*Hartsough, 1955; Knochel, 1982; Rand et al., 1990*). The increase in total plasma osmolality was accounted for mainly by the elevated concentrations of urea and glucose.

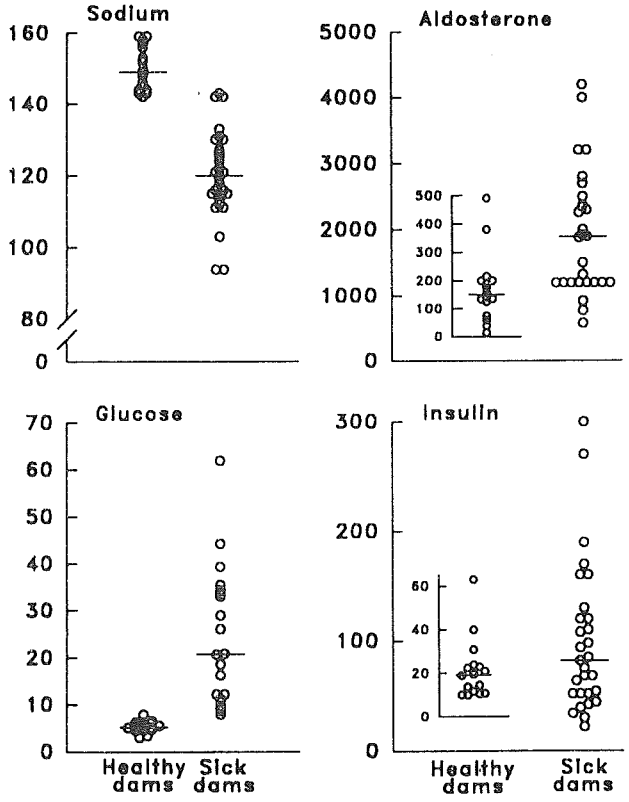


Fig. 3. Plasma concentrations of sodium, glucose (in mmol/L) and of immuno-reactive aldosterone (pg/mL) and insulin (μIU/mL) in healthy (insert) and sick lactating mink. The bar indicates the sample *median*.

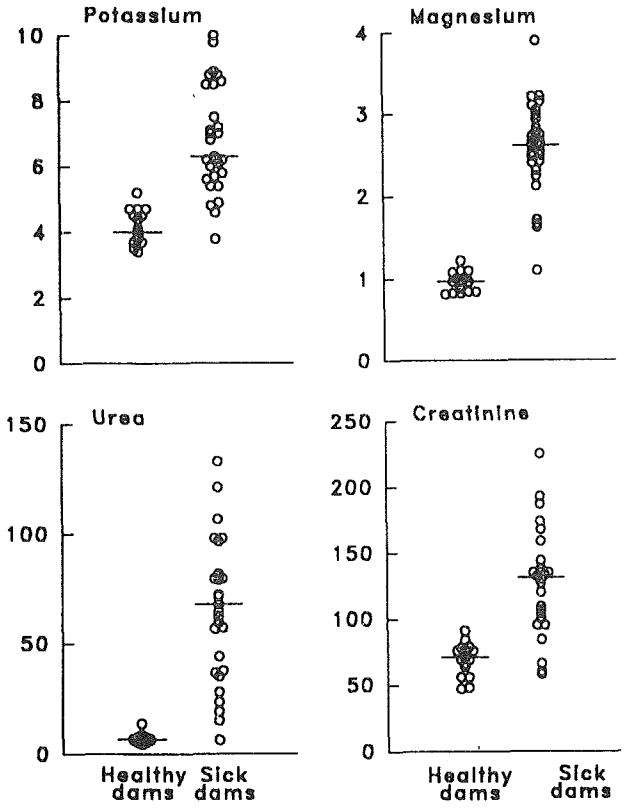


Fig. 4. Plasma concentrations of potassium, magnesium and urea (in mmol/L) and of creatinine (μmol/L) in healthy and sick lactating mink. The bar indicates the sample *median*.

By contrast, the *effective osmolality* (i.e. the concentration of non-permeative constituents) of the extracellular fluid was somewhat lower than normal. Finally, the presence of hyperglycemia, in spite of a concurrent five-fold increase in plasma immunoreactive insulin, indicated the existence of severe disturbances of glucose homeostasis (*Clausen & Hansen, 1989; Wamberg et al., 1992b*) along with increasing tissue catabolism and malfunction of vital organ systems such as the liver, the kidneys and neuromuscular tissues (*Hartsough, 1955; Arieff & Guisado, 1976; Knochel, 1982; Wamberg et al., 1992a*).

*Urine*

In sick dams the urine was almost devoid of sodium and chloride reflecting avid sodium reabsorption in response to extracellular volume depletion *and* a reduced or ceased dietary sodium intake (*Hartsough, 1955; Wamberg et al., 1992a*). The hypovolemic state, in turn, resulted in impaired renal perfusion and a significant decrease in urinary osmolality (Fig. 5), reflecting a pronounced reduction in the concentrating ability of the kidneys towards about 40 per cent of the reference value found in healthy lactating mink dams (*Clausen & Hansen, 1989; Wamberg et al., 1992a*).

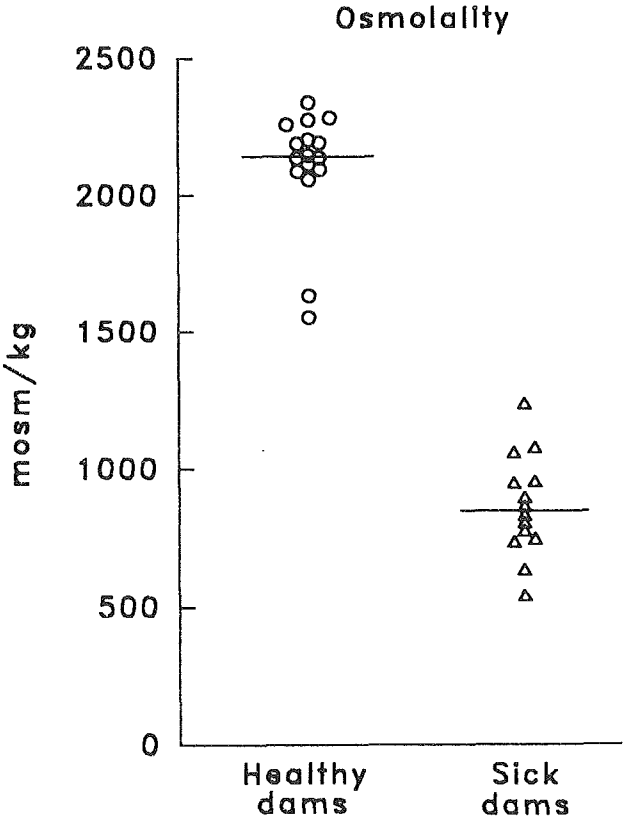


Fig. 5. Urinary osmolality (mOsm/kg) in healthy and sick lactating mink. The bar indicates the sample *median*.

## Summary

In conclusion, nursing sickness in mink is characterized by the development of a deteriorative nutritional status with severe extracellular volume and electrolyte depletion and profound metabolic disturbances, presumably resulting from the combined effects of genetic predisposition, inanition and/or inadequate nutritional and water supplies and environmental stress. This condition may, in turn, impose strongly negative effects on the ability of the lactating female to meet the extreme demands for adequate milk production, particularly during the latter part of the lactation period. Further studies are in progress at the Fur Research Farm Vest with the aim of obtaining reliable and feasible clinical and biochemical measures for the purpose of early identification of females suffering from nursing sickness.

## Acknowledgements

R. Sandø Lund, Head of the Fur Research Farm Vest and the permanent staff of the research farm are acknowledged for valuable support. We also wish to thank Ms. Lis Horne, Ms. Lis Hygom, Ms. Lise Larsen, Ms. Annette Linde and Mr. Toke Nørby for skilled technical assistance.
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*Review*

# Nursing disease in mink

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An in-depth study of nursing disease was conducted at the University of Guelph in 1989 and 1990. The initial phase involved a detailed clinical and pathological case-control study of a high-risk population on one ranch. In the second phase, several epidemiological studies of a cross-sectional sample of 64 ranches in southern Ontario were conducted. The purpose of this report is to summarize the findings from these studies, in the form of a comprehensive overview of this disease. Technical papers concerning the individual studies are published elsewhere (*Schneider and Hunter, 1991; Schneider et al., 1992a, 1992b*).

Nursing disease accounted for 58 percent of all adult female mortalities occurring during the lactation period on the 64 ranches in the study. The incidence among ranches ranged from zero to 11.8 percent of lactating females, with a median rate of 1.2 percent. On some Scandinavian and European ranches the incidence has been as high as 13 to 15 percent (*Pastirnac et al., 1984; Hansen, 1985; Henriksen and Elling, 1986*), and in Denmark, it has been estimated that 30,000 to 150,000 mink are lost annually because of this disease (*Henriksen and Elling, 1986; Clausen et al., 1989*). In quantifying the impact of these losses to the industry, it must also be noted that nursing disease specifically involves selected breeding stock, not just kits slated for pelted, and that highly productive females are preferentially affected (ie. those with large litters).

Though the clinical signs and physical lesions of nursing disease are relatively nondescript, the disease is actually very complex, involving both chronic and acute components, and a highly multifactorial causal pathway. Description is the initial step in the understanding of any disease, and we begin this review with the following summary of the main features of nursing disease.

1. Who: Nursing disease occurs only in lactating mink, and those who have just completed lactation. All color phases and ages are affected.

2. What: Clinically, nursing disease is characterized by progressive weight loss, followed by a sudden onset of lethargy, inappetence, and dehydration. Deterioration is rapid, and death usually occurs in one to five days after the onset of clinical signs. At necropsy, the only significant lesions are marked weight loss and dehydration. There is no evidence for an infectious agent as a necessary cause of this disease, though concurrent infectious disease may occur as a secondary phenomenon. Several biochemical abnormalities, including an increase in the serum osmolality, total protein, urea nitrogen, creatinine, phosphorus, glucose and potassium, and a decrease in sodium and chloride, are characteristic features. In addition, affected females are acidotic, the urine specific gravity is decreased, and the hemogram is consistent with a stress leukon.

This research was supported by grants from the Canada Mink Breeders Association and from the University Research Incentive Fund of the government of Ontario.

3. Where: Nursing disease occurred on 92 percent of the ranches in the cross-sectional study, and it has also been reported in European, South American, and Japanese ranches (*Martino, 1986; Seimiya et al., 1988; Wamberg et al., 1992*). Cases do not cluster within individual cage rows, but west facing rows appear to have a higher incidence than east facing rows.

4. When: Disease onset is highly correlated with the duration of lactation. In the cross-sectional study, most nursing disease cases occurred at around 42 days after whelping, with remarkable consistency, regardless of ranch of origin or date of whelp.

With regard to the cause of nursing disease, and the process by which it occurs, the most reasonable hypothesis is that of "energy exhaustion". This hypothesis is developed in detail below, beginning with a summary of the relevant epidemiological results. Salt deficiency has also been proposed as the cause of nursing disease, but we found that the blood electrolyte levels were completely normal until immediately prior to disease onset (which is after the peak of lactation); control females on the same feed did not have a physiological response consistent with salt deficiency (ie. aldosterone was not elevated); and some of the ranches where nursing disease occurred had been suplementing their feed with 0.5 percent salt. These findings suggest that salt deficiency is not the primary cause of nursing disease, but direct experimental proof is still required.

With regard to individual-level epidiological factors, risk was found to increase with increasing litter size. Color phase was also significant, though the color at greatest risk varied from ranch to ranch. It appears that as ranchers select blood lines based on color characteristics, they sometimes inadvertently select for, or perpetuate, a predisposition to nursing disease, implicating a genetic component to this disease.

There was up to an order of magnitude difference in the incidence rates observed among ranches, demonstrating the importance of ranch-level factors in the development of nursing disease. Most of this variation was not accounted for in the exploratory set of variables that were examined, but feed source, ranch size and temperature were significant. Climatic factors are also implicated by the marked variation in incidence known to occur from year to year on individual ranches, as little else changes so dramatically on this time scale.

Two main conclusions are drawn from the epidemiological findings. First, the tight correlation of time of onset to date of whelp, resulting in a discrete "window of susceptibility" at the end of the lactation period, implies a physiological basis for the disease. Second, causation is multifactorial; a number of individual and ranch-level factors influence the probability that any given female will become clinically ill during the period of susceptibility, but none are necessary or sufficient to cause the disease on their own.

As to the actual process by which nursing disease occurs, the following explanation is proposed.At the most fundamental level is the energy deficit normally experienced by all female mink during lactation, resulting in a progressive utilization of body energy stores (*Tauson, 1988; Korhonen, 1991*). Toward the end of the lactation period, as energy losses reach a maximum and energy stores reach a minimum, all females enter a period of susceptibility to "energy exhaustion" and clinically manifest disease. This hypothesis provides a physiological basis for the "window of susceptibility" described above.

Disease, in this view, is simply the extreme manifestation of a normal physiological process, and the determination of which females actually become ill is dependent on genetic predisposition and a variety of other epidemiological factors (fig. 1). We speculate that the occurrence of this disease in commercial mink may be in part a consequence of confinement of the dam, resulting in greater and prolonged lactational energy loss than occurs under natural conditions. Genetic selection for maximal kit growth may also play a role in this regard. The absence of pathological lesions, other than weight loss and dehydration, rules out many other organic causes, but is precisely wht is expected under the hypothesis of energy exhaustion.

Most females can compensate for the energy depletion, and maintain all homeostatic mechanisms until the kits are weaned and energy reserves can be restored. Under various combinations of risk factors, however, some females reach a point where they are no longer able to compensate, and a self-reinforcing cycle of events rapidly leads to clinical disease and death. This hypothesis of acute decompensation is supported by the rapid transition from normal activity to clinical disease, the absence of long-term biochemical changes, and the absence of chronic pathological lesions other than weight loss, observed in our studies.

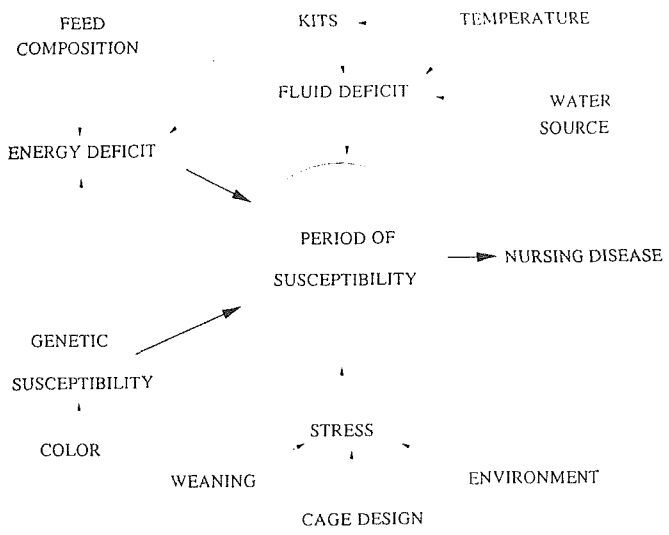


**Fig. 1.** Flow diagram for the pathogenesis of nursing disease in mink.

Regardless of what factor triggers the final decompensation, the process involved is very consistent among all affected females. Renal dysfunction and dehydration are two of the earliest abnormalities, and even healthy females have mild changes of this type in their final week of lactation. In the actual decompensation, the renal dysfunction and dehydration appear to reinforce each other in a rapidly evolving vicious cycle, accompanied by, or due to, a systemic metabolic collapse. At some point there is a loss of integrity of cellular membranes, and/or malfunction of the sodium-potassium pump, resulting in a movement of sodium into cells and potassium out of cells, leading to the characteristic electrolyte imbalance observed in affected females. A variety of secondary processes account for the other biochemical changes that are typically observed. Within a matter of days, and sometimes in as little as 24 hours, the animals move from normal activity to a moribund state, and death, as a consequence of cardiopulmonary failure, follows soon after.

Some females do not decompensate until immediately after weaning, but this only occurs if weaning takes place during the peak period of nursing disease susceptibility (ie. around 42 days).

This is still consistent with the hypotheses presented, as the recovery of body condition in female mink is usually not observed until a week after weaning (*Tauson, 1988*), and the immediate effect of weaning may actually be to trigger decompensation in females that are highly susceptible at that point in time. As the post-weaning cases are very similar to the other cases in all other respects, it may be more appropriate to refer to this disease as lactational exhaustion than nursing disease.

The large difference in incidence among ranches demonstrates the importance of external risk-factors, and implies that preventive measures stand a good chance of being successful, even though the fundamental susceptibility to nursing disease, relating to the physiology of lactation, cannot be eliminated. Further research is needed to identify the risk-factors with the most potential for manipulation, and to design appropriate preventive strategies. Based on the available information, it is recommended that the kits be weaned as early as possible (preferably before six weeks), especially if the female is noticeably thin; kits from large litters should be fostered to smaller litters; the barns should be kept as cool as possible in June (apply a reflective roof coating, plant shade trees, etc.); ample water must provided at all times; and because of a potential genetic component, all affected females and their litters should be eliminated as breeding stock. The recommended therapy for clinically ill females is weaning and the administration of oral and intraperitoneal electrolyte solutions, as has been described elsewhere (*Hunter and Schneider, 1991*). Antibiotics are not indicated unless secondary infections are present, and the use of steroids and a shock therapy is contraindicated because of the extreme dehydration in these animals.

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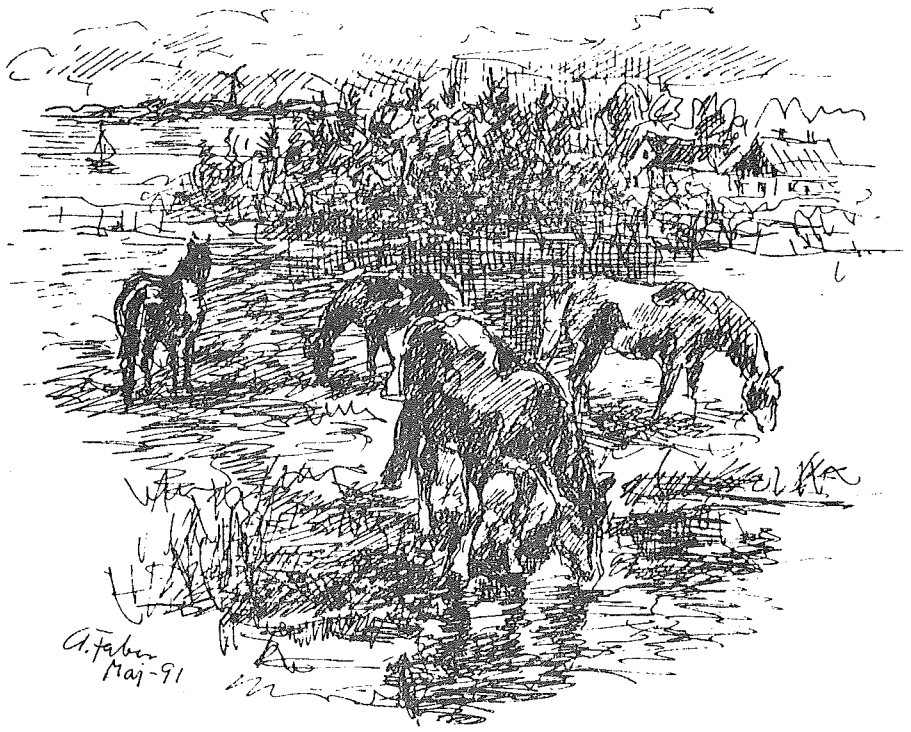

**Epidemiological and experimental studies on a new incident of transmissible mink encephalopaty.**

*R.F. Marsh, Richard A. Bessen, Scott Lehmann, G.R. Hartsough.*

Epidemiological investigation of a new incident of transmissible mink encephalopathy (TME) in Stetsonville, Wisconsin, USA, in 1985 revealed that the mink rancher had never fed sheep products to his mink but did feed them large amounts of products from fallen or sick dairy cattle. To investigate the possibility that this occurrence of TME may have resulted from exposure to infected cattle, two Holstein bull calves were injected intracerebrally with mink brain from the Stetsonville ranch. Each bull developed a fatal spongiform enchephalopathy 18 and 19 months after inoculation, respectively, and both bovine brains passaged back into mink were highly pathogenic by either entracerebral or oral inoculation. These results suggest the presence of a previously unrecognized scrapie-like infection in cattle in the United States.

*Journal of General Virology, 72, 589-594, 1991. 1 table, 2 figs., 21 refs. Authors' summary.*

**Pathogenesis of disease caused by Aleutian mink disease parvovirus.**

*Søren Alexandersen.*

A review of the pathogenesis of Aleutian mink disease parvovirus (ADV) infection based on recent knowledge gained by the author and collaborators is given. The review focuses mainly on the following topics.

1) *Development of an easy, sensitive and fast assay for detection of ADV antigens and antibodies directed against these antigens.* A highly sensitive rocket line immunoelectrophoretic assay (RLIE) was developed. This assay turned out to be 32 times more sensitive than the counter current electrophoresis assay routinely used to detect anti-ADV antibodies in ADV eradication programs, and moreover, ADV associated antigens could simultaneously be quantitatively detected in the same electrophoretic run. Later, the assay was improved to make it more economical and easy to use and finally the assay, now termed the counter current line absorption immunoelectrophoresis (CCLAIE) assay, was slightly modified to adapt the test to screening programs.

2) *Examination of surface properties of the virus and the antigens expressed during in vivo infection.* In this chapter studies on the surface charge properties of ADV are described. Using charge-shift crossed immunoelectrophoresis the occurrence of amphiphilic proteins associated with ADV is shown and the significance of these findings in regard to biological properties are discussed. The first demonstration of intact ADV strutural and nonstructural proteins in mink tissues is described and it is shown that the structural proteins of the cell culture adapted strain of ADV (ADV-G) also in vivo is 2-3000 dalton smaller than those of other ADVs, i.e. 75,000 and 85,000 daltonin ADV-G as opposed to 78,000 and 88,000 dalton in the other ADVs.

3) *Studies on the pathogenesis of interstitial pneumonia caused by ADV in newborn mink kits.* The features of ADV-induced interstitial pneumonia are described. Using Southern blot and in situ hybridization techniques it is shown that ADV replicates to high levels in alveolar type II cells and it is suggested that the permissive replication of the virus in these cells causes direct cytopathology, followed by decreased surfactant production and development of the characteristic clinical and pathological features of respiratory distress and yaline membrane disease.

4) *Comparison of the pathogenesis of acute versus chronic disease caused by ADV infection.* The data obtained by in situ hybridization analysis of ADV infected adult mink, mink kits, and mink kits treated with anti-ADV antibodies are compared. The accumulated data suggested that the development of severe acute ADV-induced disease is linked to low or absent antibody titers paired with high levels of viral replication. In contrast, chronic disease is associated with high antibody titers and low levels of viral replication.

5) *The molecular biology of ADV with special reference to the pathogenesis of disease caused by this virus.* The biological significance of the DNA nucleotide sequence, the open reading frames, and the palindromic termini of ADV are briefly summarized. The transcription program and putative protein translotion scheme of ADV-G is mentioned in detail and the similarities with and differences from the transcription maps of other parvoviruses are discussed. Finally, the possible roles of the unique features found in ADV trans-

cription are related to the special pathogenic features of this virus.

*Thesis. Apmis, Supplementum No. 14, Vol. 98, 1990. 179 refs. In ENGL, Su. DANH, ENGL. Author's summary.*

This thesis is based on the following previous publications:

1. Alexandersen, S. 1986. Acute interstitial pneumonia in mink kits: Experimental reproduction of the disease. Vet. Pathol. 23:579-588. *Scientifur, Vol. 11, No. 3, pp 252.*

2. Alexandersen, S. and B. Aasted, 1986. Restricted heterogeneity of the early antibody response to Aleutian disease virus in mink kits. Acta Path. Microbiol. Immunol. Scand. Sect. C. 94: 137-143.

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**Epidemiological studies of Aleutian disease in mink.**

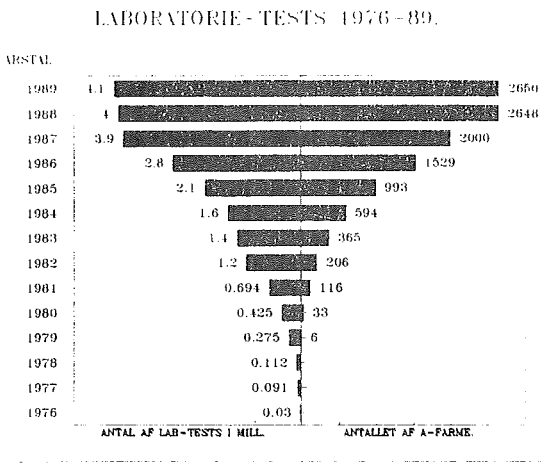
*Mariann Chriél.*

The Ph.-D. Thesis consists of 6 chapters summarized in the following.

**Chapter 1. Aleutian disease in mink.** There is a short view over the published literature about Aleutian Disease in mink. The biology of the mink is described shortly. The morphology of the Aleutian Disease virus is described. The pathogenesis of the disease, the special immunologic circumstances, the macroscopic and microscopic findings in mink affected with Aleutian Disease is described. Finally the possible routes of transmission and reservoir hosts are described, and the

methods of disease control in Denmark are noted.

**Chapter 2. The test program at the Danish Fur Breeders Laboratory.** There is a short describtion of the Danish test system anno 1990. There is a view of the maximum allowed number of AD-reactants of each test category, and the test program.




**Chapter 3. Calculation of the specificity of the CEP-test and the kappa coefficients for the re-tests of questionable results.** The result of the CEP-testing that has been done at the Danish Fur Breeders Laboratory has been used for calculations of the specificity of the test during the years 1987-1989. It varies very little, but is strongly influenced by the laboratory staff that is performing it. The 3 kinds of tests used for testing doubtful AD-positive tests have been compared by kappa-coefficients. It has been shown that the result has a moderate agreement, but the lack of a standard makes it difficult to determine the best method for AD-testing.

**Chapter 4. Possible aerogenic transmission of Aleutian Disease Virus.** After having registered the exact placement of the mink farms in Denmark, the influence of aerogeneous spreading of Aleutian Disease Virus has been investigated. It has not been possible to prove statistically the effect of aerogenous virus-spreading. It has been shown that there is a straight forward proportional effect of having neighbour minkfarms within a range of 2000 meters. Both the number of registered breeders and the prevalence of Aleutian Disease has a significant effect on the risk of getting Aleutian Disease. This effect of neighbour farms increases for reduced distance to the neighbour farms.

**Chapter 5. Factors influencing the number of AD-reactors in mink farms.** Some of the risk factors for getting Aleutian Disease reactants have been investigated. The investigation was analysed by use of the logistic regression model. It showed that there was a direct effect of the number of breeders on the farm, and the placement of the farm in Denmark influenced the risk. There is an increased risk of AD-reactants if the farms were built on AD-infected soil, and if there were AD-infected mink on the farm the previous year. Farms placed close to other mink farms increased the risk of getting Aleutian Disease. The estimated risks have been illustrated grafically.

**Chapter 6. The influence on reproduction of Aleutian Disease.** The influence of Aleutian Disease on the breeding result has been investigated. The multible regressions model was used for analysis. The breeding result is positively influenced by the number of breeders. Big farms produce on average more mink kits per female than small farms. There is a positive influence of having a high percentage of wild mink. The percentage of barren breeders reduce the breeding result. There is a negative effect of Aleutian Disease on the breeding result. This means that the heavily infected farms (G-farms) on average have a deficit of 57,000 DKr. per year.

*Ph.D. Thesis. The Royal Vet. and Agricultural University. 19 tables, 42 figs., 89 refs. In DANH, Su. ENGL. Author's summaries.*

**Replication of Aleutian mink disease parvovirus in lymphoid tissues of adult mink: Involvement of follicular dendritic cells and macrophages.**

*Shiro Mori, James B. Wolfinbarger, Masaaki Miyazawa, Marshall E. Bloom.*

By using strand-specific in situ hybridization and immunohistochemistry, evidence for replication of the Aleutian mink disease parvovirus was observed in cells resembling macrophages and cells resembling follicular dendritic cells at 10 days after infection but only in macrophages at 60 days. Sequestration of the Aleutian mink disease parvovirus in larger numbers of macrophages and follicular dendritic cells was noted at both 10 and 60 days.

*Journal of Virology, Vol. 65, No. 2, 952-956, 1991. 3 figs., 25 refs. Authors' summary.*

**Compatibility of Nitrofurantoin in prevention of urinary calculi of mink.**

*H. Zimmermann.*

The use of Nitrofurantoin was successful in the prevention of urinary calculi in mink kits. The compatibility was very good, also after the five-fold overdosage. Within human medicine the application of Nitofurantoin is problematic during pregnancy. Experiences are not available in mink. Therefore the use of Nitofurantoin is not advisable for pregnant females.

*Der Deutsche Pelztierzüchter 66, 3-4, 1992. 2 tables, 4 references. In GERM. Author's abstract.*

**Phagocytic activity of peripheral blood leukocytes in polar blue foxes infected naturally with canine distemper virus (CDV).**

*W. Deptula, B. Tokarz.*

Adherence and engulfing of bacteria by phagocytes, number of phagocyting cells, oxidation and bacteriocidic activity of peripheral blood leukocytes of sick (12 animals), suspected (10 animals) of distemper and normal (10) female polar foxes, 2-4 years old were examined. Blood was collected at days 1, 4, 7, 10 and 13 of the disease. In all the animals which died up to day 13 of the disease and in animals sacrificed clinical signs were noted, and anatomopathological and virological examinations were performed. The direct immunofluorescence test (IFb) with the samples of brain, lungs, spleen and liver using the Gammakon CVD (Bioveta-Nitra) conjugate was used. It was found that in infected foxes typical symptoms and gross lesions of distemper appeared. The IFb test confirmed that CD virus was the cause of disease. Blood examinations showed that in naturally infected foxes with CDV the activity of the examined parameters of phagocytosis of peripheral blood leukocytes increases, and that just before death this activity decreases.

*Medycyna Weterynaryjna, 46, 9, 341-344, 1990. 3 tables, 28 refs. In POLH, Su. ENGL. Authors' summary.*

**Short Communication: Optimal conditions for in vitro mitogen-induced proliferation of peripheral blood lymphocytes in breeding foxes.**

*Krzysztof Kostro, Krzysztof Wiktorovicz.*

The proliferative response of fox peripheral blood lymphocytes to nonspecific mitrogens: leucoagglutinin (LA), concanavalin A (Con A) and pokeweek mitogen (PWM) was studied. Microcultures were kept at 39°C in a humidified atmosphere containing 5% $CO_2$. The highest $^3H$-thymidine incorporation was observed, when Con A was used, while LA and PWM showed weaker but significant stimulatory action. Optimal doses of mitogens were: 5μg/ml for Con A, 5μg/ml for LA and a dilution of 1:100 for PWM. The maximal stimulation index for Con A was about 240 and up to 100 for LA or PWM. The maximal lymphocyte proliferation was observed when culture media were supplemented with 10% serum. When proliferation kinetics were studied, the peak response was observed on day 2.

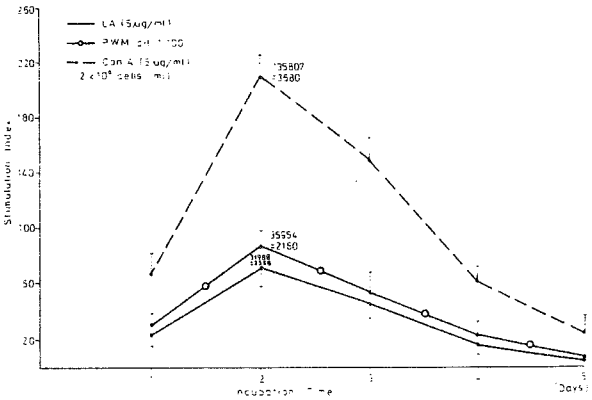


**Fig. 2.** Kinetics of proliferation of fox peripheral blood lymphocytes stimulated with optimal doses of LA, PWM or Con A. Each point represents mean values of stimulation indices (SI)±standard deviation from five experiments.

*Veterinary Immunology and Immunopathology, 29; 183-188, 1991. 3 figs., 12 refs. Authors' summary.*

**Usefulness of oxyphendazole and pyrantel tartrate in combating roundworms in breeding foxes.**

*S. Paciejewski, J. Gorski.*

The studies were carried out on 300 adult foxes and 1115 young foxes. On the basis of coprosco-

pic examinations and at necropsy there was found Toxocara infection in 94% of adult foxes, Toxocara canis in 13%, Uncinaria stenocephala vulpis and Dipylidium caninum in 13%. Young foxes aged 5-6 weeks were infested with Toxocara canis and Uncinaria stenocephala in 13% while in the animals 10-12 weeks old infestation with these parasites was 86% and 5%, respectively. A high effectiveness of oxyphendazole (96%) against Toxocara canis was found at the rate of 10-11.3 mg/kg body weight. Pyrantel tartrate administered at a dose of 10 mg/kg reduced Toxocara canis infestation in 86% of animals. Foxes given the drug at the rate of 100 mg/kg body weight did not show any signs of poisoning; nor were there found any changes in the blood. Oxyphendazole administered at a dose of 200 mg/kg caused apathy, somnolence, faster breathing and vomiting. These signs disappeared after 6 hours without treatment. In contrast, pyrantel tartrate given at the rate of 200 mg/kg resulted in acute signs of poisoning and within an hour all animals treated (one group) died.

*Medycyna Weterynaryjna, 47, 3, 131-133, 1991. 3 tables, 17 refs. In POLH, Su. ENGL. Authors' summary.*

**Experimental infection of sable with canine distemper virus.**

*S.V. Aulova, Ye.I. Marasinskaya, N.M. Chaplygina.*

In clinically healthy sables, when submitted to a laboratory challenge with CPV, the presence of viral genome and antigen in brain and spleen was observed. The question about virus isolation from the sable and its pathogenecity require additional study.

*Veterinariya, No. 2, 33-34, 1991. 13 refs. In RUSS, Su. ENGL. Authors' summary.*

**Comparison of treatments for coccidiosis in nutria.**

*P. Zurliiski, A. Vladimirova.*

Anticoccidials effective against Eimeria nutriae, E. seideli and E. pellucida were "Coccistop-2000" from Intervet, Netherlands (containing sulfadimidine sodium, fulfadimethoxine sodium and diaveridine) "Coccibio" from Iffa-Merieux, France (a combination of 3 sulphonamides) and "Baycox" from Bayer (toltrazuril), given in drinking water.

*Veterinarna Sbirka, 87;4, 48-49, 1990. 1 table, 15 refs. CAB-abstract.*

***Echinococcus multilocularis* in a nutria *(Myocastor coypus).***

*H. Worbes, K.H. Schacht, J. Eckert.*

Larval *Echinococcus multilocularis* was found in a nutria (*Myocastor coypus*) on a fur farm situated south of the Thuringian Forest near the border of the Federal Republic of Germany. This finding is of epidemiological importance. Investigation of 67 red foxes (*Vulpes vulpes*) originating from this area and the whole Erfurt Region (Thuringia) did not reveal the presence of adult *E. multilocularis*.

*Angewandte Parasitologie, 30; 3, 161-165, 1989. 3 figs., 23 refs. Authors' summary.*

**A note on diseases of mink.**

*P.E. Martino, J.J. Martino, J.A. Villar.*

The paper describes in brief the findings in 5,616 autopsies of adult mink, performed at the Institue of Pathology-CIC, La Plata, during the last five years. Nearly all these carcasses, coming from the most important ranches, were examined bacteriologically and histopathologically. Observations about the incidence of different causes of death, its distribution annually and prophylactic measures were reported. It concludes that Aleutian disease is the most important cause of death and produces severe economic losses.

*Journal of Veterinary Medicine; Series B, Vol. 38 (3), 227-230, 1991. 1 table, 15 refs. Authors' summary.*

**Summary of the results of pathological and bacteriological examination of mink in the Leipzig area of Germany between 1976 and 1989.**

*U.D. Wenzel, G. Albert.*

Bacterial diseases, encountered in 370 of 3773 mink, included salmonellosis associated with 20 serovars (mainly S. typhimurium) in 149 cases, pasteurellosis in 60, necrobacteriosis in 55, staphylococcal infection in 46 and streptococcal infection in 34. Viral diseases, diagnosed in 267

mink, included 159 cases of plasmacytosis (Aleutian disease), 79 of viral cases, including 535 cases of either vitamin E deficiency or excessive peroxide supply, and 254 of botulism. Urolithiasis occurred in 140 mink and cardiovascular failure/-heat stroke in 124.

*7 Arbeitstagung über Haltung und Krankheiten der Kaninchen, Pelztiere und Heimtiere, 31 Mai bis 1 Juni 1990 in Cell, p 317-319. In GERM. CAB-abstract.*

**Preliminary studies of methods to detect parvovirus in solid material.**

*Åse Uttenthal and Tove Vang.*

A method was established to extract virus from solid materials, such as mink feed, mink feces or organ homogenates from mink. The extract was cultivated on cat kidney cells to show whether live virus was present. The typing of virus was done by peroxidase labelling assay (PLA) in mikrotiter cultivation trays. For all samples tested, we tested a sample after addition of known cell culture virus, to prove that the sample did not in any way inactivate the virus. Antigen ELISA was used to measure the contents of mink enteritis virus (MEV) antigens in the first passage of the virus. Counterimmunoelectrophoresis (CIEP) was used to test the presence of Aleutian disease virus (ADV) antigen. Mink feed representing 2 feed kitchens - a total of 15 samples - were tested. No virus could be detected in any of the sample. However, from all the samples with added MEV we showed both infectious virus and the presence of viral antigen. In a feces sample from a mink with a history of recent MEV the virus could be detected with rather high titers. In organ homogenate from mink 10 days after infection with ADV we could show that infectious virus was present, but viral antigen was not detected by CIEP.
In conclusion, we did not detect virus in any of the feed samples. In samples with known high titers, i.e. feces from mink with acute MEV or organ homogenate from mink with acute ADV, infectious virus could be detected. There is a good correlation between PLA and ELISA to detect MEV, but the CIEP is not sensitive enough to detect ADV antigen after passage. As earlier shown, the cultivation of ADV is far more difficult than is MEV cultivation.

*Danish Fur Breeders' Association. Technical Year Book 1991. 292-296. In DANH. 1 table.*

**The effect of vaccination of mink against mink enteritis virus as tested by natural and experimental virus exposure.**

*Åse Uttenthal and Christian Munck.*

Mink enteritis virus (MEV) is a common virus and many mink farmers chose to vaccinate their mink either as a prophylactic procedure or to stop an acute outbreak. There are several companies and several combinations of vaccines on the market, and we wanted to compare how effective the vaccines are if used prophylactically. Mink free from Aleutian disease (AD) were vaccinated with 5 different vaccines. At least a month after the vaccination they were either transferred to a farm with acute MEV or given oro-nasal challenge with MEV. Each transferred group of mink included some unvaccinated control mink. Dropping was tested for the presence of virus by ELISA, and blood samples were collected at pelting time and tested for specific antibodies towards MEV. None of the transferred mink died from MEV, showing that the disease is very mild. They have, however, been exposed to virus on all farms, as the unvaccinated animals have sero converted to MEV. Virus excretion in feces was a rather common feature in the unvaccinated animals. In feces from prophylactically vaccinated animals virus could not be detected not even after experimental virus challenge. At pelting time (usually 2-3 months after virus exposure) the vaccinated mink had lower antibody titers compared to the non-vaccinated. This shows that the infection is severely influenced by the vaccine. Evaluation of antibody production after either challenge or natural exposure to MEV shows that the vaccines are considerably more effective today than 5-6 years ago, when comparable experiments were conducted. There are no significant differences among the vaccines tested, as long as they are used prophylactically. The vaccines were not compared for their efficiency to stop an acute outbreak of MEV.

*Danish Fur Breeders' Association. Technical Year Book 1991. 297-303. In DANH. 1 table, 2 figures, 1 reference.*

## Transmissible spongiform encephalopathies of animals

In November 1986 a new disease of cattle was discovered in the United Kingdom and was named bovine spongiform encephalopathy (BSE). Immediately recognised as a scrapie-like disorder, BSE became the subject of intensive epidemiological studies which continue today, over 50,000 cases later. The epidemiological studies revealed that the disease arose from residual scrapie infectivity in meat-and-bone meal which, at the time, was widely used in the diets of cattle, especially dairy calves. Legislation imposed in 1988 cut off that source, resulting in a fall in incidence in the two-year-old age group by 1991. It is predicted that the incidence of confirmed BSE in three- and four-year-old animals will also begin to fall by the end of 1992, followed by eventual eradication. It is fortunate that unlike scrapie of sheep, BSE is not contagious and does not appear to spread by maternal transmission. The entire BSE story to date forms the foundation of this issue of the *Review* in the chapter by Dr. R.H. Kimberlin who has had a professional lifetime of experience and achievement in the research of scrapie and is also an acclaimed international consultant on scrapie, BSE and related diseases.

The chapter on scrapie by Dr. L.A. Detwiler is remarkable for its breadth of coverage of the natural disease in sheep, goats and moufflon, as well as the experimental disease in sheep and mice. Some of the very latest data is given on genetic and transmission studies. Control is covered in depth, drawing on knowledge distilled from many countries across the world. The areas of uncertainty are identified.

Transmissible mink encephalopathy (TME) is a rare but devastating disease of farmed mink which is presented in the third chapter written by the acknowledged experts Professor R.F. March and Dr. W.J. Hadlow who deal concisely and clearly with this interesting disease. Sections are given on the aetiology, epidemiology, clinical features, pathology, pathogenesis, diagnosis and control of TME.

Specialists Dr. E.S. Williams and Professor S. Young, who have studied another rare and geographically-localised spongiform encephalopathy - chronic wasting disease - for many years, have provided for the first time in one place a vivid account of the epidemiology and clinical signs of the disease as well as sections on aetiology, pathology, diagnosis, prevention and control.

The chapter on molecular biology of scrapie-like agents is comprehensive, and written in a clear manner for such a complex subject by Drs. A.D. Bennett, C.R. Birkett and C.J. Bostock who are amongst the foremost researchers in this area. They cover the use of rodent models, offer a detailed account of the scrapie-associated fibril protein (PrP) and the host gene that encodes it, and finally discuss the merits of current hypotheses on the structure of the agent.

*OIE Scientific and Technical Review, Volume 11, No. 2, June 1992. In ENGL, FREN, SPAN. pp 333-634. 6 chapters, 9 tables, 22 figs., 390 refs.*

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The editor

## Hematology, Antioxidative Trace Elements, the Related Enzyme Activities and Vitamin E in Growing Mink on Normal and Anemiogenic Fish Feeding

*Jouko Treuthardt*

Abstract

The feeding of mink with so called anemiogenic fish species is known to inhibit the absorption of iron (Fe). Poor fat quality and insufficient intake of antioxidative nutrients cause similar symptoms as iron deficiency, i.e. anemia and pigmentation failure of the fur.

The trace elements copper (Cu) and zinc (Zn) interact with iron absorption and metabolism. Copper has a direct role in the formation of the dark pigment of the hair. All the studied trace elements Fe, Cu, Zn, manganese (Mn) and selenium (Se) participate in the antioxidative defence due to the high amount of unsaturated fats. In the antioxidative defence mechanism vitamin E is the most important fat soluble antioxidant in cell membranes.

Because of the important multifunctional and interconnected role of the mentioned nutrients in the mink, the interaction of these nutrients was studied in normally fed Finnish dark mink. The possible effect of fish induced iron deficiency on the absorption, metabolism and requirement of these nutrients was also investigated.

The fish induced anemia was caused by strong and specific inhibition of iron absorption. Especially the early growing period (July-September) was critical in this respect. The other trace elements studied - Cu, Zn, Mn and Se - were normally or better absorbed during iron deficiency as compared to control mink. The metabolism of these trace elements, measured as incorporation into antioxidative enzyme proteins, was not affected by iron deficiency. Generally, the concentrations of Fe, Cu, Zn and Mn in Finnish mink feeds were lower than in other countries, e.g. Denmark. It is suggested that the content of these trace elements in feeds could be increased considerably, e.g. 2-5 times of the current amounts depending on feed raw materials and the particular trace element.

The vitamin E status was significantly lower in mink on fish feeding than in the control groups, especially during the early growing period (July-September). This was probably due to the higher requirement of this vitamin during fish feeding. The supplementation of vitamin E to the anemiogenic feeds (100 mg dl-α-tocopheryl acetate/kg fresh feed) prevented in vivo lipid peroxidation in the liver of the fish fed mink and had a slighty beneficial effect on the fur quality.

*34 tables, 14 figs., 255 refs. Author's abstract.*

**TECHNICAL YEAR BOOK 1991**
**Editor N. Glem-Hansen**
**Danish Fur Breeders Association**
**60 Langagervej, DK-2600 Glostrup, Denmark**

The book consist of 305 pages and is in Danish. Besides general reports from research farms and technical committees, the report covers more than 25 research reports which are all abstracted in this issue of SCIENTIFUR (Vol. 16, No. 3, 1992).

The report can be ordered - free of charge - at the above address.
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June 25, 1992

Dr. Gunnar Jørgensen, Editor
Scientifur
PO Box 13
DK-8830 Tjele, Denmark

Dear Friend Gunnar,

How I wish I could be with you and my other friends at the Congress in Oslo in August. Unfortunately, editorial finances do not make my trip possible. We haven't seen one another for four years, and I wish we could correct that.

This letter is to bring you some personal news: After working with mink and fox farmers since 1950 (the year we started Blue Book of Fur Farming) and frequently since 1956 (when we started the modern Fur Rancher), I am going to retire from day-to-day journalism on August 31. It's simply time to quit.

I do expect to do some more writing in the field, though not for my current employer, and also, as invited, to speak to fur farmer groups, in North America, Europe, and, if asked, elsewhere.

It would be appreciate if you'd note my retirement in your Notes in Scientifur. Too, if you can send me Scientifur on a complimentary basis for a few issues, I would appreciate it.

For your information, and it can be used in Scientifur, my home address is 18305 Saint James Road, Brookfield, Wisconsin 53045. Our home telephone number is (414) 781-3042.

I count you among my dearest friends, and you are the first outside my family to be advised of my plans.

Warmest regards,

Bruce W. Smith