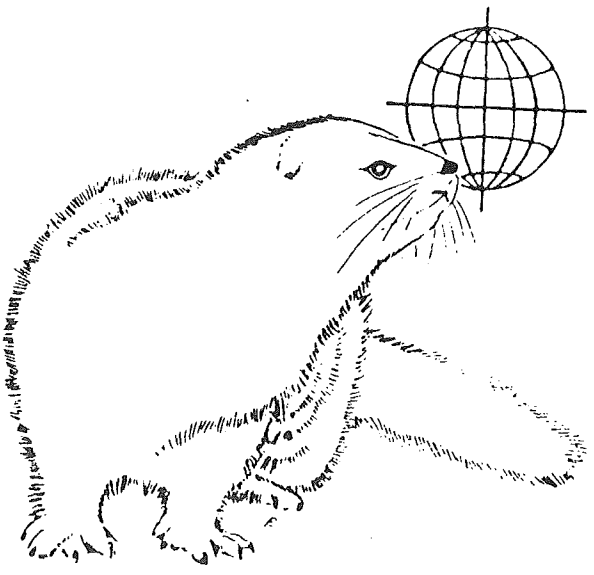

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Titles of other publications - not abstracted

The effect of play balls on fur bites, behaviour and stress level in mink. *Henrik Falkenberg, Leif Lau Jeppesen. Danish Fur Breeders Association, Technical Year Report 1990. pp. 269-278. In DANH. Code 10-11-3-M.*

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4. Nutrition

5. Reproduction

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7. Scientific meetings, symposiums and congresses

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Notes

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Even though fur animal production is still far from a satisfactory economic balance between skin prices and production costs, the latest development of the skin price level has spread optimism to all levels of the fur industry.

Thanks to the Fur Breeders Organizations under the EFBA-organization (European Fur Breeders Associations), who have donated up to DKK 285,000 equal to US$ 38,000 to the production and distribution of SCIENTIFUR in 1991, the optimism for the future is also high in the IFASA/SCIENTIFUR office.

Everybody has learned a lot from the now nearly historical crisis in the fur industry, and it is hard to believe that it will ever be repeated in the future.

If we look around, the conclusion must be that THE FUTURE HAS TO BE BASED ON INTERNATIONAL COOPERATION AND PLANNING AT ALL LEVELS OF THE FUR INDUSTRY.

Production reductions, reduction or elimination of research and innovation activites, elimination of even important staff functions have all been very severe in the countries of individualists who believe in free enterprise.

Through the establishment and membership of IFASA certain organizations as well as certain individual scientists have demonstrated their conviction THAT THERE IS A FUTURE - AND THAT THE FUTURE HAS TO BE BASED ON COOPERATION.

In the scientific world we have a good example of the necessity of cooperation. In fact, the policy of scientific activities in the EEC (European Economic Community) is integration. The EEC research budgets are increasing, and the national budgets decreasing. EEC funds can only be released if 2 or more countries are applying for a joint project.

Sooner or later this will ensure that to a very high degree the research activities have to be internationally directed.

Already this - for many readers relatively unimportant fact - tells us that international cooperation is not only necessary because Gunnar Jørgensen (your editor) says so.

Therefore, also for your own sake become a member of and support the activities of IFASA in all possible ways.

In the next issue of SCIENTIFUR we will present the idea of a SCIENTIFIC NETWORK which must necessarily be one of the areas where IFASA can show its importance as an umbrella for the worldwide fur animal science.

For those who read the Notes in SCIENTIFUR No. 1 this year, it is hereby stressed that the future is also depending on who has your address and knows your fields of scientific interest and capability in the area of fur animal research.

We still welcome your contribution in that matter to the editorial address.

Remember that the trains in France are now capable of running 542 km/h. The train for international cooperation in fur animal research will undoubtedly also reach a higher speed. Therefore it is important to form the right platform for being able to enter the train.

In this issue of SCIENTIFUR we bring a figure showing the information value of the journal. Of course the figure does not show the quality of the information, but the readers who have followed the development over the years will surely agree

that the decrease in the number of titles of the last years is to a higher degree a sign of more qualified information than a sign of fewer possibilities to give the most comprehensive information regarding fur animal production in the entire world.

We hope that the trend towards more abstracts of real scientific reports and more review reports will stimulate the number of subscribers.

DO YOUR COLLEAGUES, LIBRARY OR FRIENDS IN THE FUR BUSINESS SUBSCRIBE TO SCIENTIFUR? WHY NOT? HAVE YOU FORGOTTEN TO INFORM THEM? - and to tell them about the possibilities of receiving good information at the same time as they help us and you ensure the continued assistance and service.

When you read these lines I am hopefully well home from the Scientific Symposium on Fur Animal Production in Czechoslovakia, April 22-25. There I will help our colleagues from the east european countries convince their authorities of the importance of full participation - also economic - in the activities of IFASA.

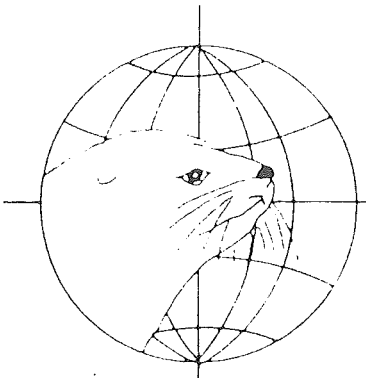
Have a good summer in the Northern and a good winter in the Southern Hemisphere.

Your optimistic editor,

Gunnar Jørgensen

Scientifur

&



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Original Report

Comparison of behavioral activities between Finnish and Japanese raccoon dogs

Hannu Korhonen[*], *Jaakko Mononen*[**], *Päivo Salonen*[**], *Mikko Harri*[**], *Paavo Niemelä*[*]

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Summary

This paper provides some comparative data concerning behavioural patterns and daily activities in two subspecies of the raccoon dog; the Japanese raccoon dog (*Nyctereutes procyonoides viverrinus* Temmink) and the Finnish raccoon dog (*Nyctereutes procyonoides* Gray 1834).

The results showed that Japanese raccoon dogs raised in Finland are more active during the autumn and early winter than Finnish ones. Diurnal activity of both subspecies can be considered half diurnal and half nocturnal. Activity pattern of the animals normally consisted of a system of shorter or longer burstes of locomotion supported by rather regular rest periods. Rest or inactivity, however, seems to be the most common daily behaviour observed in the raccoon dog in general. The whole behavioural repertoire of raccoon dogs was relatively scanty which is rather typical for this species in nature, too. No marked differences were observed in common behavioural patterns between the subspecies studied.

Introduction

The raccoon dog (*Nyctereutes procyonoides*) is a thick-furred canid endemic to the Far East. Although it has been previously classified as a procyonoid (*Frechkop, 1959*), a recent canid classification recognizes the genus as one of the Canidae (*c.f. Van Gelder, 1978; Ward et al., 1987*). The genus is monospecific and comprises 5-6 subspecies distributed throughout Asia, Japan and Europe (*c.f. Ellerman & Morrison-Scott, 1966; Heptner et al., 1974; Stains, 1975; Corbet, 1978; Ikeda, 1982*).

Between 1929-55 some 8850 raccoon dogs originally from eastern Asia were introduced throughout the USSR, including the European region, where the animals acclimatized most successfully (*Safonow, 1980*). Raccoon dogs crossed the Finnish border in the late 1930's, and are still spreading westwards (*Nowak & Pielowski, 1964*). The farm-raised raccoon dogs in Finland have originated from animals captured wild, and are thus descendants of animals from the eastern USSR (*Kornejev, 1954; Mäkinen, 1983*).

Chromosomal studies between Finnish (mainland form) and Japanese (island form) raccoon dogs have shown that there is a fundamental difference in the chromosome numbers of these two forms (*c.f. Mäkinen, 1974, 1983; Mäkinen & Fredga, 1980; Wurster-Hill et al., 1986; Ward et al., 1987; Wayne et al., 1987*). The diploid chromosome numbers (2n) of Japanese and Finnishe raccoon dogs are 42 and 56, respectively. The 2n=42 karyotype most likely has evolved from the 2n=56 karyotype by a series of centric fusions (*Mäkinen, 1983; Ward et al., 1987*).

In our previous paper (*Korhonen et al., 1991*) we compared the seasonal variation of voluntary feed consumption and body weight in Finnish and Japanese raccoon dogs. The results showed that significant differences exist in annual energy balance regulation between these two subspecies; the adaptability of Japanese raccoon dogs to markedly varying environmental conditions is considerably less in relation to that of Finnish ones. We observed also significant differencs in fur insulation between them, thus leading us to conclude that the Japanese raccoon dog is mainly adapted to the temperate marine climate of the Japanese islands and cannot very well survive the cold Finnish winter in nature.

The present paper continues the comparison between these two subspecies in an attempt to describe their behavioural patterns and general activities under farm conditions. Particular interest has been focused on their locomotor activity, with the aim of obtaining more data for their energy balance comparison.

Materials and methods

General procedures
The experiments were undertaken at the research fur farm of Kuopio University, In Juankoski, situated in eastern of Finland. All of the animals used were farmborn, and housed according to conventional farming procedures before the experiments. They were fed a basal ready-mixed farm feed manufactured by the local central feed kitchen of Koillis-Savon Rehu Ltd. The feed was mainly composed of slaughter-house offals, fish and cereals. For the chemical composition of the feed see Korhonen & Harri (1986). Feed composition and ratios were based on the standards recommended by the Finnish Fur Breeders' Association.

Feeding each time occurred by the hand once daily. Water in summer, and snow/water in winter was supplied conventionally, and supplementation in water-cups took place as required.

Experimental animals
The Japanese raccoon dogs (*Nyctereutes procyonoides viverrinus* Temmick) were brought from Japan (Toho Mink Co., Ltd, Sapporo) to Finland in 1982. The animals were housed and bred at the research fur farm of the Finnish Fur Breeders' Association after which they were transferred to the experimental fur farm of Kuopio University in 1988. Altogether 8 Japanese raccoon dogs (2 males, 6 females) were alive then, and fit for use as experimental subjects. During 1989 two animals (both females) died for unknown reasons, and similarly, during 1990 we again lost two more females. So, by the end of the experiments in 1991 only four animals (2 males, 2 females) were left.

The Finnish raccoon dogs (*Nyctereutes procyonoides* Gray 1834) all came from the research fur farm of Kuopio University. Altogether 8 animals (4 males, 4 females) were selected for the study and data collection. They were all in good condition, and remained healthy during the course of the experimental period.

Body weight of the animals were measured monthly by Alfa-laval bow-balance.

Data collection and treatment
Data on the Finnish raccoon dogs was collected during 1982-1990 in two ways: (1) by means of a Miniscript Z Activity chart recorder whereby depression of a treadle by the active animal resulted in a mark on the recording paper run at a speed of 1 cm/h (*c.f. Korhonen, 1988*) and (2) by direct visual observations lasting for 24-h periods and made by two different persons simultaneously. Each behaviour was recorded on paper by certain codes, and analyzed later at the university. The observations were made from a car and, therefore, the animals were disturbed as little as possible.

Behaviour data on the Japanese raccoon dogs was collected during 1989-91 by means of direct visual observations as described above. The data was handled and analyzed at the Fur Farming Research Station in Kannus.

Results

The data for the most common behavioural patterns and activities are summarized in table 1. It provides an accurate comparison between the Finnish and Japanese raccoon dogs from the three entire months of October, November and January. Thus, the data deal with the most important times of the year for the raccoon dog, because during this time it normally very laboriously prepares for its winter rest.

Locomotor activity of the Finnish raccoon dog markedly decreases throughout the autumn and early winter period. Thus, in January the animals are already very inactive, with only 1.5 hours of movement. The level of locomotor activity of the Japanese raccoon dogs, on the other hand, is significantly higher; they are active for about 1.5 hours more on a daily basis than the Finnish raccoon dogs. Still, in January they walk almost 3.5 hours a day.

Table 1. Average monthly activities (in minutes) of Finnish (F) and Japanese (J) raccoon dogs housed in conventional Finnish shadehouse conditions. Total number of animals for F and J were 8 and 4, respectively.

VARIABLE MEASURED	OCTOBER		NOVEMBER		JANUARY	
	F	J	F	J	F	J
Locomotor activity	142	248	135	204	95	199
Sleeping	617	732	695	676	776	692
Lying awake	195	145	187	148	207	181
Sitting	353	144	312	207	211	219
Standing	83	121	70	125	109	86
Self-grooming	13	11	12	19	12	15
Eating	17	14	20	17	16	17
Drinking	13	3	6	3	2	3
Others	7	22	3	41	12	28

Table 2 provides us with a better understanding of their activity patterns. As can be seen, the proportion of dark:light activity shifts during the autumn and early winter, i.e. the animals are increasingly more locomotive during the dark as winter progresses. Furthermore, in October the Finnish raccoon dog is more diurnal as compared to its Japanese counterpart but in November, on the other hand, the situation is reversed. If the entire data is summarized, we can say that both subspecies are half diurnal and half nocturnal. The typical daily activity pattern of the animals consisted of a system of shorter of longer bursts of locomotor activity alternated with rest periods (figs. 1 and 2). Often, there was a lack of activity from 1 a.m. to 7 a.m. because the animals were sleeping. Rest or inactivity typically was the most common of the observed circadian behavioural patterns.

Table 2. Proportion (in percentages) of dark (D) and light (L) activity in Finnish and Japanese raccoon dogs.

	FINNISH		JAPANESE	
	D	L	D	L
October	13	87	36	64
November	46	54	40	60
January	89	11	94	6
Mean	49	51	57	43

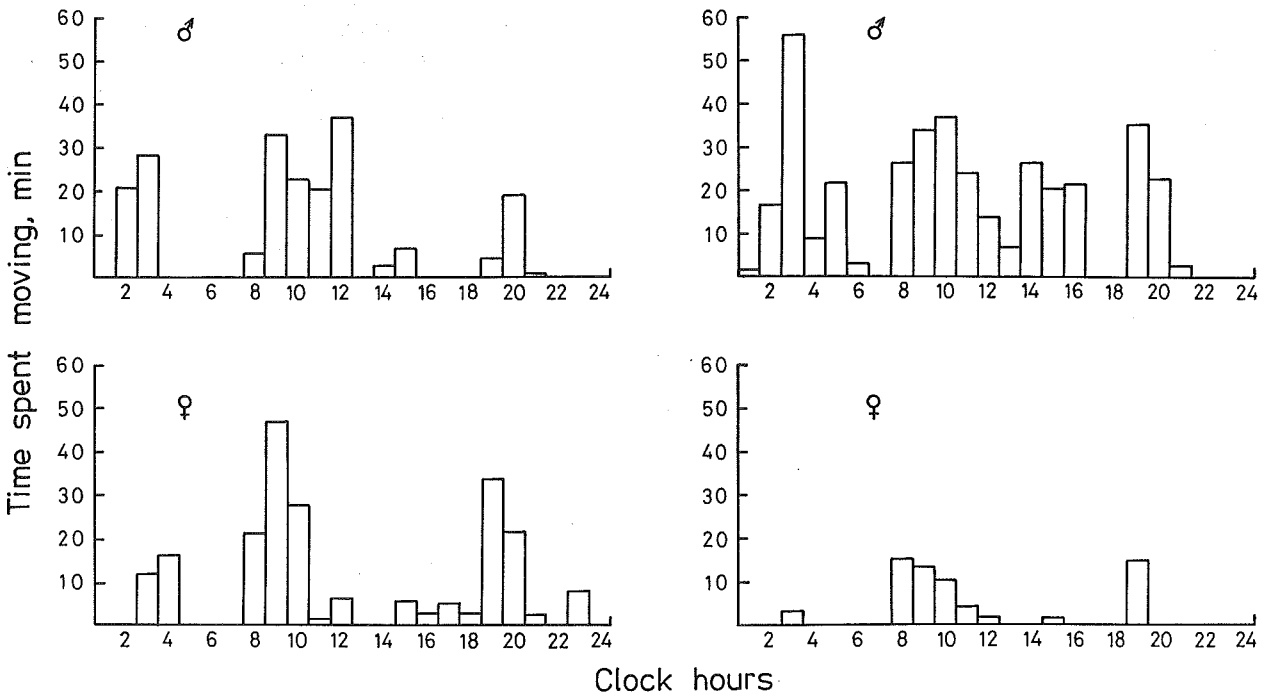

Fig. 1. Distribution of circadian locomotor activity in Japanese raccoon dogs in January. Based on observation data. Note the differences between individuals which are typical for them throughout the experimental period.

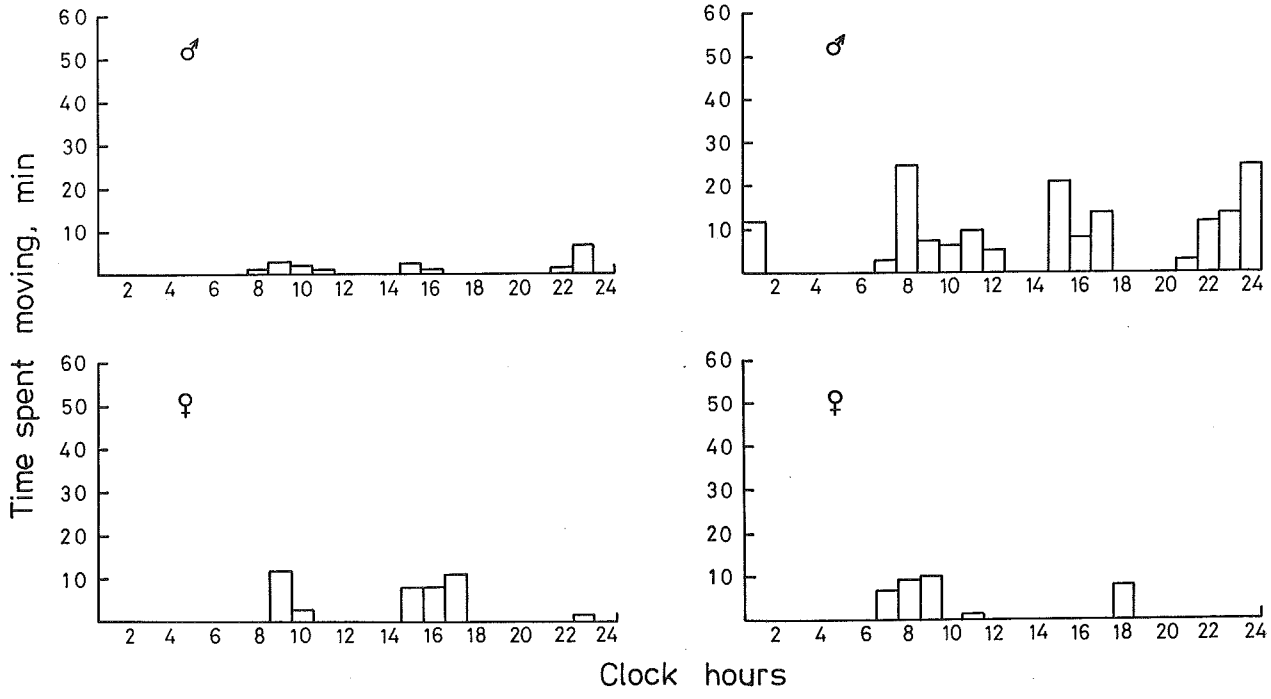

Fig. 2. Distribution of circadian locomotor activity in Finnish raccoon dogs in January. Data based on consecutive 24 hours observations. Individual differences are seen here also.

Time for sleeping did not markedly differ in the subspecies studied. If we combine the time spent sleeping with the time used for lying awake, we can approximate the total time used for inactivity or rest. In Finnish and Japanese raccoon dogs it varied from 812 to 983 minutes and from 824 to 875 minutes, respectively. Therefore, the inactive period did not vary very significantly between these subspecies. Finnish raccoon dogs, however, seemed to spend much more time sitting, especially in the autumn period compared to Japanese raccoon dogs. The frequency of defecation and urination was very low in all of the animals studed, i.e. only few times during the 24 hour period.

Both supspecies spent about the same time on self-grooming, eating and drinking. The term 'others' includes such activities as vocalizations, digging, listening, stretching, rolling, sniffing and yawning. The duration of such activities was often short and, therefore, the time given in table 1 is more or less approximate, and thus not presented in details.

Generally speaking, it seems obvious that the majority of the behaviours observed in both subspecies are rather similar, and no marked differences can be noted in spite of their very different geographical origins. Also individual differences found in both species were of about the same order of magnitude. Table 3 provides an example of such a variation in the Japanese raccoon dogs.

The body weights of Japanese raccoon dogs in October, November and January were 5.9 kg, 5.8 kg and 5.7 kg, respectively. The corresponding values for Finnish raccoon dogs were 7.0 kg, 7.1 kg and 6.9 kg, respectively.

Table 3. An example of variation in the most commom behavioural activities (expressed in minutes per 24 hours) in the Japanese raccoon dogs, based on observation data gathered between 16th and 17th October.

VARIABLE MEASURED	MALE-1	MALE-2	FEMALE-1	FEMALE-2
Locomotor activity	253	249	292	198
Sleeping	770	638	604	919
Lying awake	94	133	212	142
Sitting	81	165	187	146
Standing	164	143	109	70

Discussion

Data concerning the daily activities and behavioural patterns of the raccoon dog, especially those of the Japanese one, are still rather scarce in the literature. Heptner et al. (1974) has mentioned that wild raccoon dogs in nature are mainly nocturnal, although during the summer one can meet them occasionally also during the light hours. Especially during the winter their locomotor activity is confined to the darkest part of the day, and during March-May the animals are known to be extremely careful during daytime.

Brzozowski & Kaleta (1985) have described the daily activities and some of the behavioural patterns of farmed raccoon dogs during the summer period in Poland. According to their observations raccoon dogs are nocturnal under farm conditions as also in the wild. Because of very limited number of animals (only three males) the validity of the data is rather limited, however.

The above mentioned sources deal only with the activity patterns of the mainland form, i.e. that called the Finnish raccoon dog in the present paper.

A third study concerning the same subspecies is that of Korhonen (1988a) in which the activity pattern of farm-raised raccoon dogs was characterized by almost a rhythmic alternation of shorter or longer periods of locomotion and rest. However, those animals were mainly diurnal, but less so in relation to circadian light rhythm than to other

farming activities. It is tempting to conclude, according to the present results, that the present raccoon dogs were not necessarily diurnal or nocturnal but were in a rather loose relation with light conditions. Similarly, it has been observed in many other farm animals that activity patterns in captivity differ from those observed in the wild. Klochkov (1969) noted that the diurnal activity of mink on farms differed from that of wild mink that have a looser relation with environmental conditions. Thus their activity peaks were confined to the time of feeding, being more independent of the sunrise or sunset. Furthermore, Gerell (1970) stated that diurnal activity of freeliving ranch mink in nature is different from that observed in wild mink; the ranch mink sustained its farmlearned activity pattern also in the wild state with a looser relation to the dark:light rhythm.

The most comprehensive document concerning the behaviour and locomotor activity of the Japanese raccoon dog is probably the doctoral thesis of Hiroshi Ikeda (1982) published in Japan, with radiotagged animals. In that paper, it is emphasized that Japanese raccoon dogs can be classified as 68-80% nocturnal. Ikeda (1982) describes the activities of only three animals but they all have relatively similar activity patterns despite the differences in age and observation period. The clearcut end of nocturnal activity was seen within an hour after sunrise, and the beginning varied slightly, but it took place within two hours at around sunset. There were also considerable decrements of activity level around midnight. Although those Japanese animals showed nocturnal pattern, a changing of the site or movement was sometimes detected by radio location also during the daytime. Ikeda (1982) stated that most of the locomotor activities observed during the daytime can be classified as slight movements or grooming.

Our Japanese raccoon dogs were on the average half dayactive and half nightactive. So, their activity pattern is different from that described by Ikeda (198) for the wild raccoon dogs in the Japanese islands. Here, the explanation is probably the fact that activity patterns of animals in captivity often are different from those observed in nature, as previously cited. Nocturnal habits in nature probably are adaptations to the availability of prey and are also aimed at avoiding possible enemies. Under farm conditions, however, such pronounced factors are not present, which undoubtedly affects activity patterns. The other explanation for the differences observed in behavioural patterns between Japanese raccoon dogs in Japan and Finland could be the geographical and climatic differences. However, if we consider the facts known concerning differences in activity patterns between farm and wild life among the other carnivorous species, the former explanation seems to be more probable (*c.f. Ikeda, 1982*).

As already mentioned by Ikeda (1982), the amount of time spent in activity in a day and the time duration for active bouts are more intense and longer in the raccoon dog as compared to other carnivores. The raccoon dog expresses a wide spectrum of food items which are relatively small in size and amount. Thus the longer bout and substantial amount of active time are necessary in the searching and treatment of small food items.

In nature, Finnish raccoon dogs normally hibernate superficially during the coldest part of winter in a burrow or den (*c.f. Heptner et al., 1974*). It is assumed that as early as November, their locomotor activity decreases because the animals are preparing for their winter rest which generally occurs between December-May. The present results confirm such a speculation because the animals clearly decrease their locomotion towards January. However, it is known that ambient air temperatures markedly affect locomotor activity and the feeding behaviour of raccoon dogs during the winter (*c.f. Korhonen, 1987*). When the temperatures are low, the animals stay inside their nests sleeping or superficially hibernating but occasionally, when the temperatures rise, the animals may leave the nest in search of food. When the temperatures are between 0-5°C, the animals are normally rather active (*c.f. Korhonen, 1988b*). Therefore, it has to be emphasized that the data presented in the present paper was collected during several years under various temperature conditions, which, to some extent, can affect the results obtained.

It has been presented that the availability of a winter nest may affect the daily activities of farmed raccoon dogs (*Korhonen, 1988a*). That paper concluded that animals having an available nest remained inside it during the regular workday - even during feeding time. But, later in the evening they emerged for an exercise period which generally lasted several hours. This pattern resembles that of wild animals. The total daily activity of animals with and without nests, however, was of the same order of magnitude. It appears that a nest reduces the visual disturbance of the animals and changes their daily behavioural pattern in such a way that it more closely resembles that of wild animals (*c.f. Ikeda, 1982*). Rest inside the nest is, of course, a natural strategy for survival during winter (*Heptner et al., 1974*). The data presented in the present pa-

per was collected from animals which were not allowed use of a winter nest and, therefore, must be taken into consideration when dealing with the present data.

Acknowledgements

Thanks are due to Matti Tengvall, Pentti Tuovinen, Mikko Ikäheimo, Paula Henttonen and Sanna Karhusaari for willing co-operation and assistance in carrying out the experiments. Financial support for this investigation was provided by the Betty Väänänen Foundation and by the University of Kuopio.

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Original Scientific Report

A Quantitative Histological Study on Melatonin Induced Autumn Molt in Mink Skin

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Abstract

The changes of mink skin that accompany the early autumn molt induced by melatonin implantation were investigated histologically. We related the molt to histological changes of the skin and examined these changes quantitatively by using a light microscope. Histological parameters, i.e. thickness of epidermis and dermis, length of hair follicle, number of underfur and hair activity changed correspondingly to each other and the melatonin treatment shifted all of the histological parameters to 5-6 weeks earlier than controls. More than 5 mg melatonin in males and 2.5 mg in females effectively induced early autumn molt in mink skin.

Introduction

Mink exhibit a seasonal molting cycle that occurs twice a year, once in spring and the other in autumn. The seasonal molt is induced by a seasonal fluctuation of daylength similar to the seasonal breeding cycle. Transformation of this phototic information to an organic signal is the role of the pineal gland and its hormone, melatonin. What mechanism induces the seasonal molting cycle is not clear, but melatonin treatment induces gonadal regression including the supression of LH and FSH secretion (*Trakulrungsi et al., 1979; Domanski et al., 1975; Soares & Hoffmann, 1981*), and accelerates the daily gain in body weight. Melatonin probably affects not only reproductive organs and skin but the organism as a whole.

In 1984 Rose et al. reported that melatonin treatment of mink soon after the summer solstice induced an early autumn molt. This effect is confirmed in other seasonal molting animals (*Rust & Meyer, 1969; Lynch & Epstein, 1976*). However, the histological changes of skin in relation to the early autumn molt induced by melatonin have not been reported.

The purpose of the present study was to explore quantitatively the histological changes in early autumn molting mink skin induced by melatonin using five parameters: 1) hair activity; 2) number of underfur; 3) length of hair follicles; 4) thickness of epidermis, and 5) thickness of dermis.

Materials and methods

Male and female demi-buff mink born in May by the same sire were used. All mink in this study were exposed to the natural photoperiod and the ambient temperature throughout the experimental period. They were fed general ranch food and allowed water *ad libitum*.

In early July, soon after the summer solstice, melatonin pellets were implanted subcutaneously into the interscapular area of the minks. Implants (PRIME-X, Wildlife laboratories USA) weigh 22-25 mg, contain 10% (w/w) melatonin, and release melatonin gradually. Male mink were divided into four groups, three of which were implanted with pellets, 1 dose (about 2.5 mg melatonin), 2 doses (5 mg) and 5 doses (12.5 mg) respectively and one group was used as control. Females were divided into two groups; one was implanted with 1 dose only and the other was the control group. Each group consisted of 10 mink and a randomly selected one of them was used at every sampling point.

After the melatonin treatment, a skin biopsy was taken from the middorsal region every other week. Under ether anesthetization, hair was shaved from about 5 cm^2 areas and then a 1 cm^2 of skin with subcutaneous fat was cut. After the biopsy was taken the incision was sutured.

Skin samples were fixed in 10% formalin immediately and kept until sectioning.

Sections 10-20 μm thick were cut sagittally and vertically to the hair follicle by cryostat and stained with Hematoxylin and Eosin.

To follow histological changes in molting skin by means of an optical microscope, the following five parameters were used: 1) proportion of underfur in active phase to total number of underfur (hair activity); 2) number of underfur; 3) length of underfur follicles; 4) thickness of epidermis and 5) thickness of dermis. In every sample, 100-150 points of each parameter were counted on 10-20 sections and its average is shown in the results.

Parameters 1) and 2) were measured in detail in two different zones of the section vertical to the hair follicle, one in the upper zone of the sebaceous gland (pore level), and the other in the zone of the sebaceous gland where individual hair follicles were distinguishable (follicular level). Whether the underfur was in the active phase or not was determined by the presence or absence of hair medulla. Parameters 3-5 were measured using micrometer. Length of underfur follicle was measured along the hair follicle as the distance between the hair bulb and follicle contact with the stratum corneum.

Epidermal thickness was measured as the distance between the upper margin of the stratum corneum and the epidermal basement membrane. Dermal thickness was measured as the distance between the epidermal basement membrane and the upper margin of the subcutaneous fat.

Results

1. Hair activity

In both male and female control minks, hair activity decreased from late in July to early in Aug. (fig. 1). For about one month, there was scarcely no underfur in the active phase. Activity increased markedly from early in Sept. and reached a peak at the middle of Oct., and the peak value was 80-90% (about 70% in pore level). Thereafter this activity linearly decreased toward the middle of Nov., and in late Nov. it became 0%.

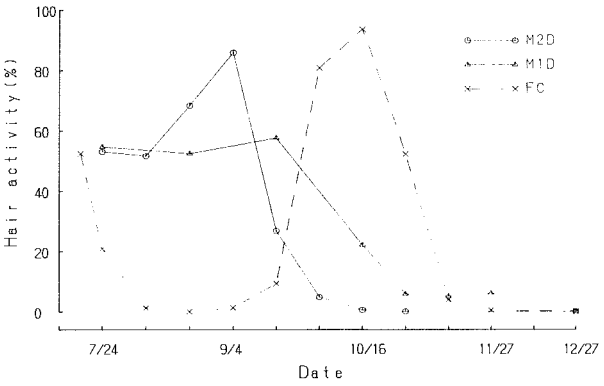

Fig. 1. Hair activity of mink skin during autumn molt. Measuring was done in two different zones of the section vertical to hair follicle as described in the MATERIALS and METHODS. But only results at the follicular level are given. The hair activity of the male control mink changed in the same manner as the female control mink (FC), so it is not shown. M2D, 2 dose male melatonin treated mink; M1D, 1 dose treated male mink.

Although a more noticeable change was observed at the follicular level than at the pore level, the changing pattern of hair activity was the same at both levels. So in figure 1, only the values of hair activity at the follicular level were plotted.

In contrast to the controls, without exception each melatonin treated mink exhibited the different pattern of hair activity (fig. 1), and had no quiescent phase (telogen) after the spring molt. In figure 1, the results of the male that received 5 doses and the female that received 1 dose of melatonin were not shown because they were almost the same as the results of the male that was treated with 2 doses of melatonin.

The hair activity of the 5 dose male (M5D), the 2 dose male (M2D), and 1 dose female (FM) melatonin treated minks remained around 50% from late July to early Aug., then it increased and reached a maximum value of 70-80% (at the pore level about 60%) from late in Aug. to early in Sept. After a decrease during the latter half of Sept., the hair activity became 0% by mid Oct. The hair activity of M5D, M2D and FM reached a peak and then dropped to 0% 5-6 weeks earlier than the control group.

On the other hand, the male mink treated with 1 dose of melatonin (M1D) showed no peak of hair activity, but it was maintained around 50% until the latter half of Sept. Although the hair activity decreased linearly toward the end of Oct., its value of 6% was maintained by late Nov. and then dropped to 0% by the end of Dec.

Ultimately, M1D showed no telogen of summer coat, no peak of hair activity, no apparent cyclicity of molt and later prime of winter coat.

2. Number of underfur

In the female control mink (FC), the number of underfur per one pore and per one follicular group kept a constant value (10-13) from late in July to early in Sept., i.e. during the summer coat (fig. 2).

The number of underfur per one pore increased from the middle of Sept. and reached a peak (28.3) in the middle of Oct. From late Oct., the number of underfur per pore showed a constant value of 20-22 (winter coat).

On the other hand, the number of underfur per one follicular group gradually increased from the middle of Sept. but did not show a peak and reached a plateu (19-22) in the middle of Oct.

Throughout the increasing phase the number of underfur per one pore was greater than the number per one follicular group.

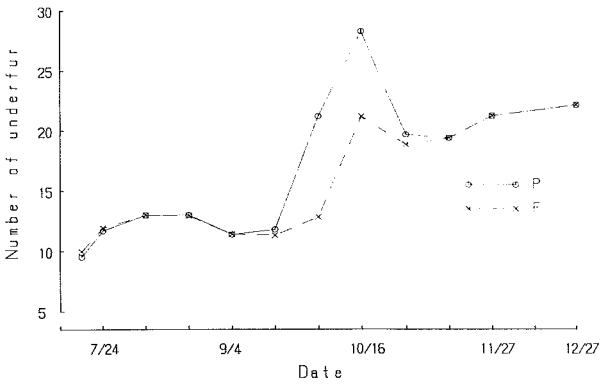

Fig. 2. Number of underfur in the female control mink skin during autumn molt. Measuring methods are the same as the fig. 1. The number of underfur per one pore (P) and one follicular group (F) are given.

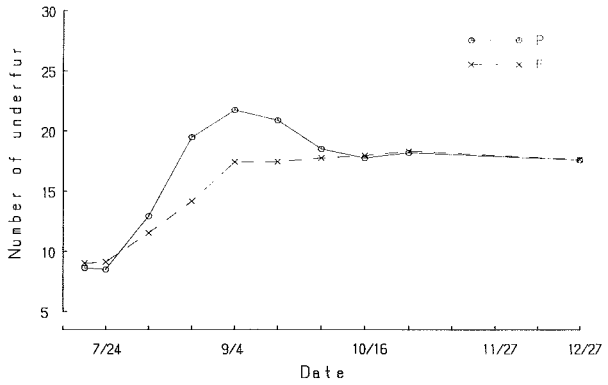

Fig. 3. Number of underfur in the female melatonin treated mink skin during autumn molt. Measuring methods and abbreviations are the same as in fig. 2.

Figure 3 shows a different pattern of change in the number of underfur per one pore and per one follicular group in the female melatonin treated mink.

The differences, the numbers and the rate of increase during the growth phase and the existence of a peak, were the same as in FC. Only the times at which these changes occured were different.

Generally, the number of underfur per one pore changed more noticeably than per one follicular group.

In M5D, M2D and FM, the number of undefur per one pore increased from late in July, reached a peak at the beginning of Sept. and achieved constant values (17-23) from early in Oct. (fig. 4). The results of M5D, M2D were not shown in Figure 5 because they were almost the same as FM.

In M1D, the number of underfur per one pore increased gradually from late in July and reached a plateu (20-22) in the middle of Sept. but did not show a peak (fig. 4). This result was similar to the pattern of change of the follicular groups in other melatonin treated minks.

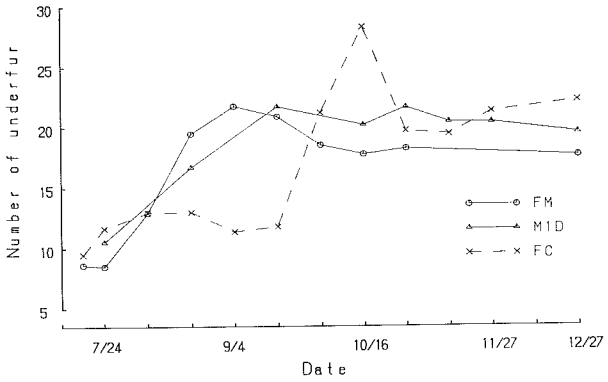

Fig. 4. Number of underfur at pore level in mink skin during autumn molt. The number of underfur per one pore of female melatonin treated mink (FM), 1 dose male melatonin treated mink (M1D) and female control mink (FC) are given.

The M5D, the M2D and the FM began to increase the number of underfur and reached the maximum 5-6 weeks earlier than the controls. The timing of the underfur increase corresponded to the increase of hair activity in all mink used in the experiment.

At the follicular group level, the number of underfur increased gradually until one week after hair activity achieved its peak.

In all mink used in the experiment, the winter coat had about twice the number of underfur as the summer coat (20-22/10-12).

3. Length of underfur follicles

The length of underfur follicle described here was the mean value of each follicle measured microscopically. For example, in the same section, some follicles in anagen were more than 2.0 mm long and some follicles in telogen were about 1.0 mm.

The length of follicle in FC shortened from late in July to the end of Aug., then it remained about 0.8-0.9 mm (fig. 5). From early Sept., the follicles began to elongate and showed a maximum length of 2.3 mm in the middle of Oct. Thereafter the length of the follicles shortened rapidly and reached a plateau (0.8-0.9 mm) late in Nov.

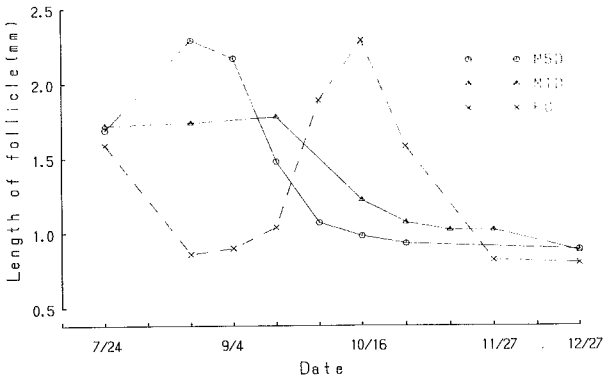

Fig. 5. Length of hair follicles in mink skin during autumn molt. Measuring was done on the sagittal section as described in MATERIALS and METHODS. M5D, 5 dose male melatonin treated mink; M1D, 1 dose male treated mink; C, female control mink.

There was no difference in the length of follicles between the summer coat and the winter coat. The male control mink exhibited almost the same pattern.

In M5D, MD and FM, the length of follicles increased slowly from late in July and exhibited a maximum length of 2.2-2.3 mm in late Aug. and early Sept. Afterward, the follicle length shortened quickly and by the middle of Oct. it was about 1.0 mm in M5D, M2D and 0.8 mm in FM. Thereafter the length of the follicles in M5D and M2D showed some shortening while FM kept a constant length. The results of M2D and FM were not shown in figure 5, because those were almost the same as M5D.

On the other hand, the length of follicles in M1D exhibited constant values of 1.7-1.8 mm from late in July to late in Sept. The length of follicles shortened from late in Sept. but were 1.1 mm late in Nov. Then the length of follicles shortened slightly and resulted in 0.85-0.9 mm at the end of Dec. similar to other mink.

The length of follicles of M5D, M2D and FM reached their maximums and minimums 5-6 weeks earlier than the controls. The patterns of change in follicular lengths of all the mink used in the experiment showed the same pattern of change in their hair activity. But the length of the follicles increased slightly before there was an increase in hair activity and decreased after there was a decline in hair activity. In the winter coat, there was no difference in the length of follicles between the melatonin treated mink and the control mink. In the controls, M5D, M2D and FM, the maximum length of follicle (anagen) was nearly three times longer than the minimum (telogen).

4. Thickness of skin

In mink middorsal skin, thickness of epidermis should not be compared with the dermis throughout the experimental period and the change of thickness of the dermis was regarded as the change of whole skin thickness.

4.1. Thickness of epidermis

In the male and female control mink, the thickness of the epidermis changed little until the middle of Sept. at which time it thickened slightly and then slowly thinned until the end of Oct. and then showed a constant thickness after that (fig. 6A,B).

In M5D and M2D, epidermis had thickened by late July and remained thick during Aug. to the middle Sep.

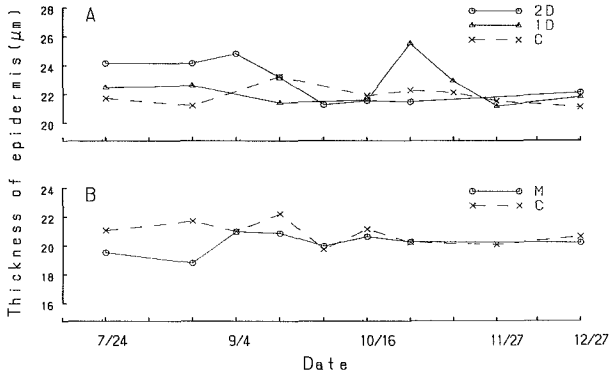

Fig. 6. Thickness of mink skin epidermis during autumn molt. Measuring method is the same as Fig. 5. In figure 6A, epidermal thickness of male control (C), 1 dose (1D) and 2 dose (2D) melatonin treated mink are given and female control (C) and melatonin treated mink (M) are given in figure 6B.

Then it became thinner and from early in Oct. it showed a constant thickness of about 22 μm (fig. 6A). The result of M5D was not shown because it was almost same as M2D. The thickness of the epidermis in FM, changed little until Sept., when it thickened slightly and then became somewhat thinner again (fig. 6B).

The epidermis of M1D thickened temporarily in late Oct. (fig. 6A). Although the thickness of the epidermis changed slightly, it was thicker when hair activity was high in each mink.

4.2. Thickness of dermis

The dermis in FC became thin from late in July and remained less than 1 mm until early in Sept. (fig. 7). From the middle of Sept. the dermis began to thicken and reached a maximum thickness (1.47 mm) in the middle of Oct. Afterwards, the thickness of the dermis decreased toward late in Nov. and from that time remained about 1.0 mm. The results of MC were almost the same as FC.

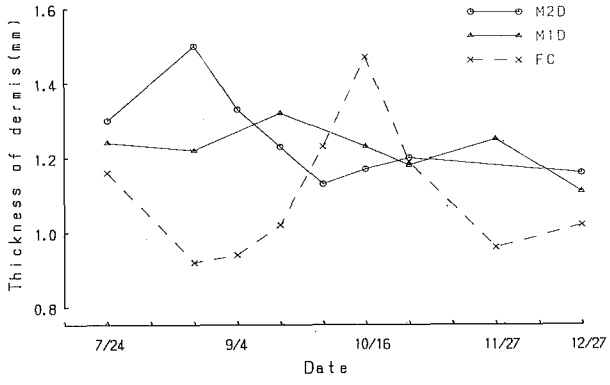

Fig. 7. Thickness of mink skin dermis during autumn molt. Measuring method is the same as the fig. 5. M2D, 2 dose male melatonin treated mink; M1D, 1 dose male treated mink; FC, female control mink.

On the other hand, in M5D, M2D and FM, the dermis began to thicken slowly from late in July and reached maximum thickness between late Aug. and early Sept. (fig. 7). After that the dermis became thinner and showed fairly constant values around 1 mm from early in Oct. In all experimental minks except M1D, the temporary change of dermal thickness coincided with that of hair activity and follicle length. The dermises of M5D, M2D and FM showed their maximum and constant skin thickness about 6-8 weeks earlier than the controls.

There was no difference in thickness of skin between melatonin treated minks and control minks after the autumn molt was completed, i.e. the point when hair activity was 0%. The maximum thickness of dermis (anagen) was about to 5 times as thick as the constantly thin dermis (telogen).

The thickness of skin in MID showed no significant temporary changes and did not undergo the same cyclic changes as the hair activity.

Discussion and conclusions

All five parameters presented in this study accompanied seasonal molting and corresponed with each other. This means that there is a correlation and/or interaction between individual parameters and the composition of the skin. There are few studies which have reported the quantitative histological changes in skin related to the molt in seasonal molting animals such as mink (*Blomstedt, 1988; Nishiumi et al., 1988*). In those, only hair growth or the number of underfur were measured (*Allain et al., 1981; Rougeot et al., 1984*). In contrast, the individual parameters measured in this study are a good index of the molting state and if summarized they will provide not only precise details of the molting stage but also the histological information on the molting process.

The general pattern of autumn molt in mink under natural conditions is that there is the catagen of the summer coat from the middle of July to early August, then the autumn molt begins after about one month quiescence (telogen). Each parameter reaches its maximum at the middle of October at which time the winter coat develops. Subsequently it shifts to catagen and the winter coat is completed between the end of November and early December (telogen).

On the other hand in the 5 dose male, the 2 dose male and female melatonin treated minks, there was evidently no telogen of the summer coat, and the hair activity increased from early in August and other parameters increased from the end of July. In the period from the end of August to early September, all five parameters exhibited maximum values and each parameter stayed high for 1-2 weeks. Thereafter catagen was confirmed by the decreased constant values of the parameters. The arrival of telogen and the complement of the autumn molt were in the middle of October. The changing pattern of each parameter was quite similar to the above pattern of control mink, but the timing of the autumn molt was different. So it could be said that the peak and completion of autumn molt in melaton in treated mink was hastened by 5-6 weeks, i.e. melatonin treatment shifted the whole aspect of the seasonal molting cycle, especially the autumn molts as was demonstrated by the examination of the five parameters. Pelting time of melatonin treated minks is also accelerated 5-6 weeks.

The reason why there was no catagen or telogen of summer coat is that the autumn molt was induced soon after the growth of summer coat by the implanted melatonin. It is confirmed that the dose of melatonin supressed the blood prolactin level (*Rose et al., 1985, 1987*), and a treatment of prolactin inhibitor also induces an early autumn molt (*Rose et al., 1987*). In the case of early autumn molt induced by artificial melatonin treatment, it seems that when the endogenous melatonin level is still low the implanted melatonin increases the blood melatonin level, supresses the prolactin level and autumn molt is induced. Although the 1 dose male treated mink showed no catagen and telogen of the summer coat, they did not show the accelerating effect of melatonin og the autumn molt as seen in other melatonin treated minks. Moreover pelting time was 1-2 weeks later than the controls.

The accerelating effect may be obtained by a 2 dose treatment in males and 1 dose treatment in females. To obtain the accerelated autumn molt by melatonin treatment, it is necessary to implant a definite amount of melatonin per unit body weight and keep the blood concentration of melatonin per unit body weight at some particular level. We cannot confirm its threshhold value in this study. The implant used contains about 2.5 mg of melatonin, so it may be necessary to implant more than 5 mg in males and 2.5 mg in females. Probably there are critical melatonin levels and periods, and the amount of melatonin is decided by the rate of release of the implant.

When the difference between each parameter was examined in detail, there were phenomena which explained the well known process of hair production molting. For instance, it is suggested by the fact that the increasing of follicular length started earlier than the increase of hair activity that proliferation of follicular cells and lengthening of follicles precede hair production. And the fact that old hair is gradually pushed upward by the newly synthesized hair growth when the summer coat and

the winter coat co-exist in the same pore for some period is reflected in the differences between pore level and follicle level of hair activity and underfur number. The use of histological parameters in the quantitative study was an advantageous method, but to know the detailed mechanism of hair production and the moulting process, ultrastructual and biochemical research are needed also.

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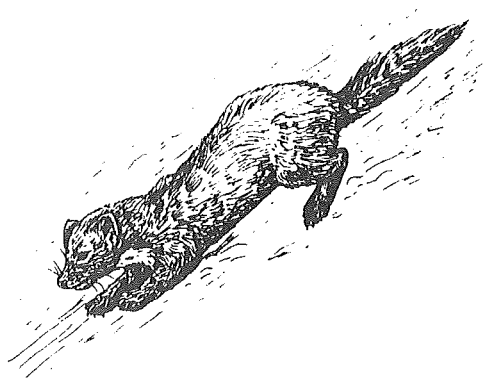

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Original Report

Changes in Connective Tissue Components in Mink Skin during the Hair Cycle and Growth

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Abstract

The content and solubility of collagen, elastin and uronic acid, the amino acid composition and the thermal denaturation temperature of skin were studied in order to elucidate the changes in the connective tissue components in mink skin during the hair cycle and the growth of the mink. There was a significant difference in amino acid composition of the skin between young and mature mink, which suggested the existence of considerable amounts of keratin and unidentified proteins in young mink skin. Although the newborn mink had a higher amount of elastin and uronic acid and a lower collagen content than that in mature mink, the high content of elastin and uronic acid was replaced with collagen by 10 weeks of age. That is in growing mink, skin collagen increased while the elastin and uronic acid content decreased. The content of non-collagenous protein such as keratin, elastin and unidentified proteins increased temporarily at the beginning of the autumn moult. Higher solubility of collagen in a neutral salt was recognized in the rapid skin thickening periods of skin growth between 18-20 weeks, while that in 4 M guanidine hydrochloride was notable in newborn mink. Thermal denaturation temperatures of the skin collagen ranged around 70°C from birth until 20 weeks old, and ranged between 75-80°C after 22 weeks old.

Introduction

Not only biological but biochemical and mechanical properties of skin are dependent on various interactions among collagen fibrils, elastic fibers and proteoglycans (*Matoltsy, 1986*). Generally, there is a decrease in solubility of collagen with aging, because of the formation of many kinds of crosslinks during aging (*Kohn & Schnider, 1989*). However, very little has been studied on the relationships between collagen content and the hair cycle or other connective tissue components in the skin.

It is also well known that elastic fibers composed of microfibrils and amorphous elastin play an important part in skin flexibility (*Uitto, 1986a*). Some studies using light or scanning electron microscopy reported an increase of elastic fibers (*Montagna & Carlisle, 1979; Tsuji & Hamada, 1981*), and the age-related decrease of the elasticity of the skin (*Vogel, 1978*). On the other hand, the relationship between elastin content and the hair cycle is suggested by the many elastic fibers attached to the hair follicles (*Meyer et al., 1981*).

Proteoglycans and glycosaminoglycans comprise less than 0.2% of the dry weight of the dermis, but have an extraordinary water holding capacity and occupy the bulk of the interfibrillar substance (*Hay, 1981*). The high content of glycosaminoglycan in newborn skin decreases rapidly with aging (*Prodi, 1964; Fleisch-majer et al., 1972; Nakamura et al., 1989*). This change coincides with the change of the moisture content of the skin and the proportion of glycosaminoglycan content (*Perlish et al., 1989*). In regard to the hair cycle, Moretti et al. (1967) and Cardo et al. (1981) reported the increase of glycosaminoglycan content from the end of telogen to the beginning of anagen when hair follicles begin to extend.

As mentioned above an important aspect of skin and hair growth concerns the intrinsic properties of dermal connective tissue, particularly collagen, elastin and proteoglycan. In a previous report, we suggested that the changes of collagen and non-collagenous protein contents and their solubility were correlated with the histological changes in mink skin during growth (*Nishiumi et al., 1989*).

In this study we investigated the amino acid composition of mink skin and the content of main connective tissue components, collagen, elastin and uronic acid as a marker of proteoglycan, to confirm the relationships between their contents and solubility and the hair cycle and growth. Furthermore, the age associated alterations in collagen crosslinking were discussed from the thermal denaturation temperature and solubility of the skin collagen.

Materials and methods

Animals and treatment of the skin
Male Sapphire mink, all sired by the same sire, born around May 8, 1985, and raised under identical conditions were selected. They were sacrificed at the rate of one animal per week until December 12, 1985. The animals were frozen immediately after sacrifice in order to prevent as much as possible changes in the structural elements of the skin that body temperature might cause. Skin samples were taken from the dorsal region after hair removal. Then samples were powdered in liquid nitrogen and dried and defatted in chloroform-ethanol mixture solution in a 2:1 ratio (dried defatted skin; DDS).

Extraction of collagen and proteoglycan
A part of the DDS was extracted in 100 times volume (w/v) with a neutral salt solution (1 M NaCl, 50 mM Tris; pH 7.2) for 24 hours at 4°C by shaking after overnight immersion and homogenization in a Polytron (KINEMATICA). The residue obtained by centrifugation at 10,000 rpm for 20 minutes was freeze-dried and then was supplied for amino acid analysis and quantitative analysis.

Another part of the DDS was extracted in 90 volume (w/v) with 4 M guanidine hydrochloride solution (4 M guanidine hydrochloride, 10 mM EDTA, 0.1 M 6-aminohexanoic acid, 5 mM benzamidine hydrochloride, 50 mM sodium acetate; pH 5.8) for 48 hours at 4°C after immersion and homogenization (*Breton et al., 1985*). The supernatant was obtained by centrifugation at 15,000 rpm for 30 minutes. The resulting residue was again extracted in 60 times volume (w/v) with the 4 M guanidin hydrochloride solution for 3 hours at 4°C and then the supernatant was obtained by centrifugation. The mixture of supernatants of the two extractions was dialysed against distilled water and the resulting substance was supplied for quantitative analysis of collagen and uronic acid (*Breton et al., 1985*).

Amino acid analysis
DDS and the residue by extraction with the neutral salt solution were hydrolysed with 6N HCl for 24 hours at 110°C, then dissolved in sodium citrate buffer, pH 2.2 after dechlorization. Amino acid analysis was performed using an Auto Amino Acid Analyzer (JFC-6AS, JEOL).

Quantitative analysis
Protein and collagen detection were achieved by using the method described previously (*Nishiumi et al., 1989*), i.e. protein content was determined by the Kjeldahl-Nessler method and Biuret reaction and hydroxyproline content determined by the method of Bergman & Loxley (1963) was converted to collagen content using the factor 7.46 (*Neuman & Logan, 1950*). The existence of collagen in DDS, 4 M guanidine hydrochlorode extract and neutral salt insoluble fraction was confirmed by SDS-PAGE and Western blotting using an anti-bovine type I collagen serum (*Nakamura et al., 1989*).

Uronic acid content, as an index of proteoglycan, was estimated by the method of Bitter & Muir (1962). The uronic acid content of DDS was determined after digestion of the protein contained in DDS with papain (*Sigma, type III*) according to the method of Alexander et al. (1986). Insoluble elastin was prepared as described by Jacob & Hornebeck (1985) with a modification.

DDS was treated overnight with 0.1 N NaOH at room temperature, then the soluble fraction was removed by centrifugation at 3,500 rpm for 15 minutes. The rinsed residue was immersed in distilled water and then autoclaved 2 times for 3 hours each at 110°C, then the hydroxyproline content of the resulting residue was determined. Amino acid composition of both DDS of 30 week old mink and standard elastin (Sigma) treated as mentioned above were the same as the reported amino acid composition of elastin (*Jacob & Hornebeck, 1985*) and the removal of collagen and

soluble proteins by this autoclave procedure was estimated. Hydroxyproline content was converted to elastin content using the factor 61.22 obtained from the amino acid composition of the elastin.

Thermal denaturation of the skin collagen
Thermal denaturation temperature of DDS was estimated using a differential scanning colorimeter (DSC-41, Shimazu) and a Shimazu thermal analysis data program.

Results

Amino acid composition of the skin
Amino acid composition of infant mink skin varied from that of mature mink (table 1). Amino acid compositions of DDS and neutral salt insoluble fraction were almost the same throughout the experimental period. Therefore the results of the neutral salt insoluble fraction are not shown. The skin from two week old mink was composed of smaller amounts of glycine, proline, hydroxyproline and hydroxylysine residues and larger amounts of glutamic acid, cystine, valine and histidine residues than in 30 week old mink. The quantity of glycine, proline, hydroxyproline and hydroxylysine residue increased gradually with mink growth, and the amino acid composition in 14-16 week olds was almost the same as in 30 week old mink.

It was also recognized that the amino acid composition of the skins when they were thick (10-12 weeks, 18-22 weeks) was different from the periods when the skin was thin (14-16 weeks, 26-30 weeks). To be more precise, the skin in anagen contained twice as much cystine residue and less glycine, proline and hydroxylysine residues than in telogen.

Table 1. Amino acid composition of dried defatted skin in various aged minks *

Week	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
Arg	53	51	50	51	49	47	49	48	51	53	51	52	49	50	51
Lys	42	39	42	35	32	40	31	28	37	38	37	34	33	36	34
Hyl	2	3	3	3	4	4	6	6	6	6	6	5	6	6	6
His	16	14	11	12	12	11	8	7	11	9	12	9	8	9	8
Phe	24	22	24	20	19	21	17	15	18	18	17	17	15	16	16
Tyr	20	17	15	13	3	11	8	7	7	6	8	9	6	5	7
Leu	62	55	50	49	44	44	34	28	41	42	41	39	33	34	36
Ileu	26	23	23	19	19	19	14	13	17	17	17	16	14	14	16
Met	10	9	10	10	9	9	8	8	8	8	8	8	7	7	7
Val	47	41	37	35	34	31	25	34	31	29	31	29	28	28	27
Cys	15	11	13	12	5	5	3	3	8	8	8	6	4	4	4
Ala	82	83	86	85	92	94	97	103	91	90	91	89	91	92	91
Gly	180	196	209	222	260	262	297	306	256	261	252	264	291	285	282
Pro	72	83	88	95	98	100	110	114	99	101	98	109	118	113	114
Glu	123	122	127	114	98	97	85	86	100	102	102	97	84	85	83
Ser	74	67	65	61	53	49	44	42	53	51	52	48	44	44	44
Thr	42	38	39	35	31	31	26	24	32	30	31	29	26	27	26
Asp	73	63	64	63	59	57	51	50	58	56	58	56	52	53	52
Hyp	39	57	44	65	79	66	88	89	78	77	78	86	92	93	96

* Values are expressed as amino acid residues/total 1,000 residues.

Protein and elastin contents
Newborn minks' skin had the highest content of whole protein, approximately 930 mg/g DDS, and its higher value was maintained until 6 weeks of age (fig. 1). The lowest value of whole protein, 520-550 mg/g DDS, was found between 14-16 weeks, then the whole protein content increased from 18 weeks when the autumn moult began and remained at a relatively high value, 700-770 mg/g DDS, until 30 weeks of age. Neutral salt insoluble protein content changed similarly to whole protein content thoughout the experimental period

(not shown). It showed a high value, approximately 650 mg/g DDS, in the newborn and dropped to a constant at 450-500 mg/g DDS (6-16 weeks old) and then went up to 600-700 mg/g DDS (18-30 weeks old).

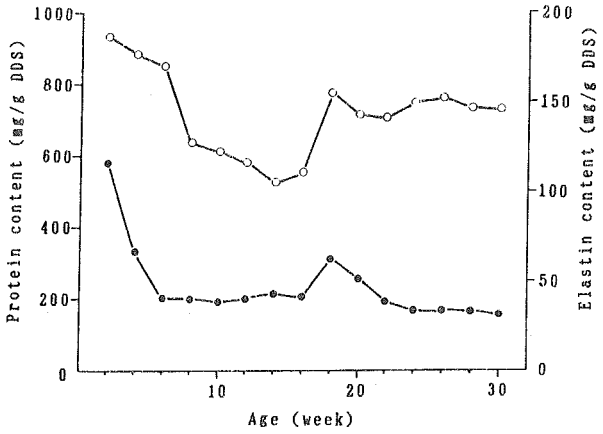

Fig. 1. Age-related changes of protein and elastin contents in mink skin. The contents of whole protein (O) and elastin (●) in 1 g of dried defatted skin (DDS) are given.

The highest elastin content was also observed in the mink just after birth (fig. 1), about 120 mg/g DDS, which was almost the same as the value of collagen content at that time (fig. 2). Then it decreased until the 6th week and kept a constant low value of 30-40 mg/g DDS throughout the experimental period except for the beginning of the autumn molt between 18 and 20 weeks when it was 50-60 mg/g DDS.

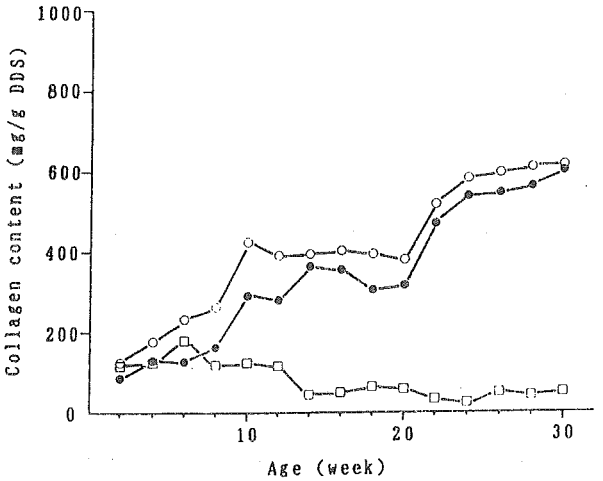

Fig. 2. Age-related changes of collagen content in mink skin. The contents of whole collagen (O), neutral salt insoluble collagen (●) and guanidine hydro chloride soluble collagen (□) in 1 g of DDS are given.

Content and solubility of collagen

The amount of whole collagen and neutral salt insoluble collagen in DDS were small immediately after birth (fig. 2). They increased until the 10th week and then continued on a plateau until the 20th week (whole collagen; 400 mg/g DDS, neutral salt insoluble collagen; 300-350 mg/g DDS). From the 24th week to the 30th week relatively high contents of whole collagen (~600 mg/g DDS) and neutral salt insoluble collagen (~550 mg/g DDS) were observed. Neutral salt soluble collagen content was constantly low, approximately 50 mg/g DDS, throughout the experimental period except for the period between 6-12 weeks and again at the age of 18 weeks, respectively 100-150 mg/g DDS and 80 mg/g DDS (not shown). In the newborn mink skin, about 120 mg/g DDS of collagen was extracted with 4 M guanidine hydrochloride (fig. 2). This relatively high value of soluble collagen, more than 110 mg/g DDS, continued until the 12th week, than it dropped to about 50 mg/g DDS. From the 8th week, the amount of 4 M guanidine hydrochloride soluble collagen agreed with that to neutral salt soluble collagen.

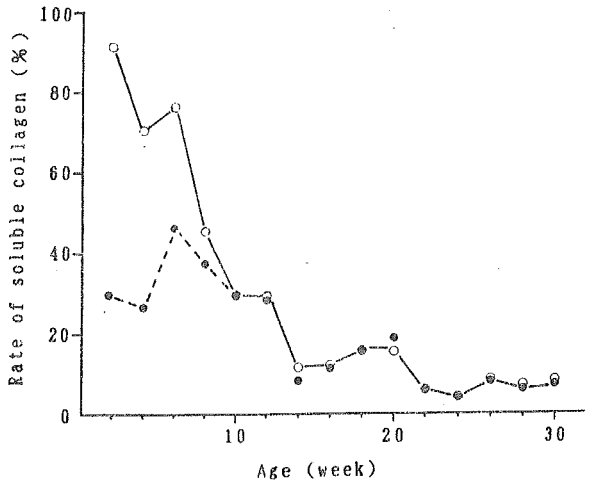

Fig. 3. Age-related changes of the solubility of collagen in mink skin. The rates of neutral salt soluble collagen (●) and guanidine hydrochloride soluble collagen (O) to whole collagen are given.

More than 20% of the skin collagen between birth and 12 weeks could be extracted with neutral salt solution (fig. 3). The solubility of collagen in this solution was less than 5% after the 14th week except between 18 and 20 weeks (about 20%). On the other hand, most of the collagen (more than 90%) in the newborn mink skin was extracted with 4 M guanidine hydrochloride solution, then

the collagen solubility in this solution successively decreased until the 10th week and was almost the same as results in the neutral salt solution after 10 weeks (fig. 3).

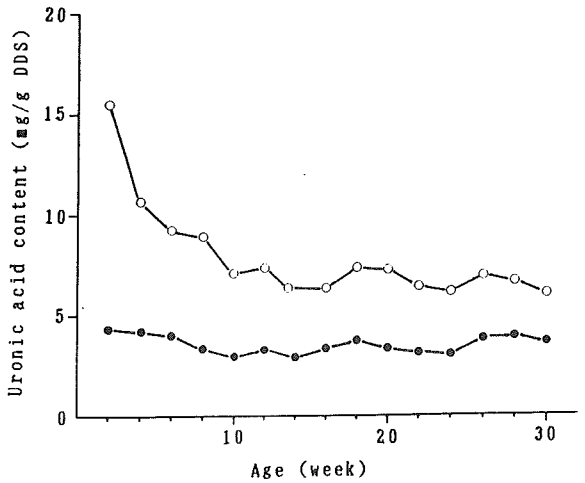

Fig. 4. Age-related changes of proteoglycan content in mink skin. The contents of whole uronic acid (O) and guanidine hydrochloride soluble uronic acid (●) in 1 g of DDS are given.

Proteoglycan content

The highest uronic acid content, about 15 mg/g DDS, was observed in mink kits just after birth, then the content decreased with mink growth and continued on a plateau, 6-7 mg/g DDS, from 10 weeks of age (fig. 4).

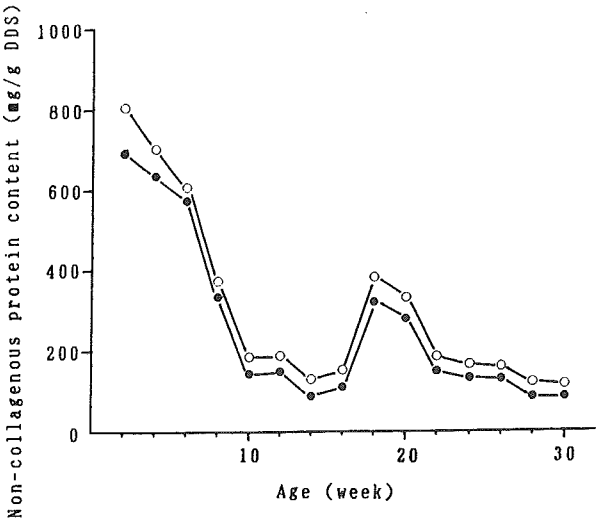

Fig. 5. Age-related changes of non-collagenous protein content in mink skin. The contents of whole non-collagenous protein (O) and non-collagenous protein after elastin content deduction (●) are given.

This changing pattern of uronic acid content looked like that of elastin (fig. 1) and showed good contrast to that of collagen (fig. 2). There were significant changes of uronic acid extracted with 4 M guanidine hydrochloride, the value of 3-4 mg/g DDS was constant throughout the experimental period (fig. 4).

Content of non-collagenous protein

There was a high content of non-collagenous protein in very young mink skin (fig. 5). It rapidly decreased until week 10 and continued on a plateau throughout the experimental period except for the beginning of the autumn moult between 18-20 weeks when the dermis was thick. The changing pattern of this non-collagenous protein content looked like that of elastin, but the elastin deducted non-collagenous protein was high in mink under 10 weeks old and between 18-20 weeks (fig. 4).

Relativity of components

The rate of collagen contained in the whole skin protein was only 15% at the age of 2 weeks, but increased rapidly until the 10th week (fig. 6). After that, collagen occupied most of the protein in the skin (more than 70%) except for the period between 18 and 20 weeks when it occupied about 50%. The highest ratio of elastin content to collagen content (about 1.0) was observed in mink skin just after the birth, then the ratio decreased rapidly until the 10th week and kept a constant low ratio (below 0.1) throughout the rest of the experimental period except for the beginning of the autumn moult between 18-20 weeks when it was about 0.2 (fig. 6). Although the ratio of uronic acid content to hydroxyproline content changed in the same manner as that of elastin to collagen (not shown), these two changes with aging showed a contrary pattern to that of collagen contained in whole protein.

Thermal denaturation of skin collagen

There are differences of peak temperature in thermal denaturation of mink DDS at various ages (fig. 7). But the range of denaturation temperatures was divided roughly into two. One ranged around the 70°C which was observed from birth to 20 weeks and the other ranged over 75°C which was observed on and after 22 weeks.

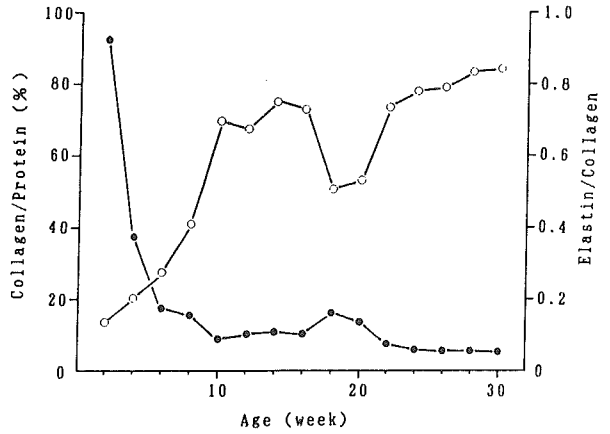

Fig. 6. Age-related changes of the ratio of collagen in mink skin. The rates of collagen to whole protein in DDS (O) and elastin to collagen (●) are given.

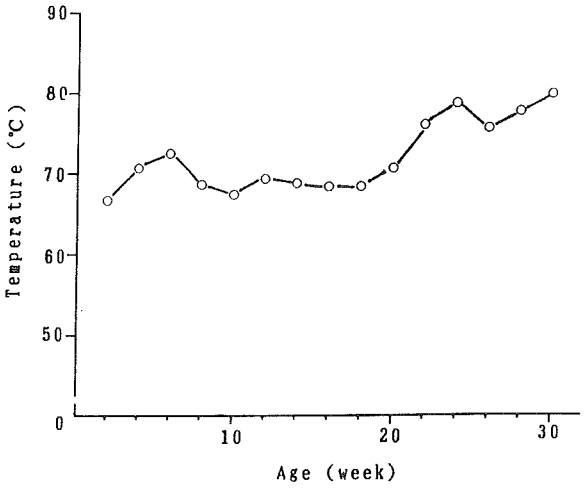

Fig. 7. Age-related changes of thermal denaturation temperature in mink skin. The peak temperatures in thermal denaturation of DDS are given.

Discussion

There was a significant difference in the amino acid composition of the skin between young mink and mature mink, which may be caused by the varing proportions of skin components. For instance, many animals have almost similar amino acid compositions of collagen which is characterized by a lot of glycine proline and hydroxyproline residues and the existence of a hydroxylysine residue (*Uitto, 1986b*), and hair keratins are generally characterized by a higher content of cystine and tyrosine residues (*Powell & Rogers, 1986*). In mink skin at the age of 2 weeks, there were less hydroxyproline and hydroxylysine residues which were peculiar to collagen, but more cystine and tyrosine which were peculiar to keratin. In addition, morphological observations indicated that the skin at that age was occupied predominantly by epidermis, hair follicles and hairs (*Nishiumi et al., 1986*) and the existence of keratin in those serum (unpublished). These results suggest that the young mink skin has a considerable amount of keratin but a smaller amount of collagen compared with the matured skin.

Mink skin just after birth abounded with uronic acid and elastin which was in direct contrast to collagen, but there was a large amount of non-collagenous protein even when the elastin content was deducted. The results of amino acid analysis indicated the existence of a considerable amount of keratin in young mink skin, but the cystine content also indicated that the keratin content was never over one half of the non-collagenous protein. The observations in this study suggest the existence of unidentified proteins in young mink skin.

A decrease in the content of elastin and uronic acid and an increase of collagen content were observed from birth until 10 weeks. After the 10th week the bulk of the mink skin protein, about 90%, was occupied by collagen, which was reflected in the amino acid composition of the skin. This quick increase of collagen in skin protein coincides with the steady gain of mink body weight and dermal thickness (*Nishiumi et al., 1986*), so that the rapid accumulation of collagen means the growth of mink skin. It is also considered that the good contrast between the rapid decline of the ratio of elastin and uronic acid to collagen and the quick accumulation of collagen suggest a functional relationship of those elements in young mink skin. Some part of the infant mink skin structure may be supported by the elastic fibers, proteoglycan and other non-collagenous protein in place of the few collagen fibrils and with the accumulation of collagen, a significant portion of the supporting system of the skin may turn to collagen.

There was a temporary increase of elastin, non-collagenous protein and keratin as indicated by amino acid composition at the beginning of the autumn moult around 18 weeks old when the most elongated hair follicles were observed. It is as

sumed that the elongation of hair follicles is accompanied by the synthesis of keratin and the construction of its supporting system in which elastin and non-collagenous proteins act as a supplier of sulfur to keratin in anagen (*Moretti et al., 1967*). But the changes of the proteoglycan content during the hair cycle were not confirmed in our present study.

Although the ratio of soluble collagen in guanidine hydrochloride, one of the strong protein denaturation reagents, was very high in newborn mink skin and decreased with aging, the skin collagen showed a relatively high solubility even in the neutral salt solution during the rapid skin thickening period such as in growing and moulting. There were no differences in the solubility of collagen in the above two solutions after the 10th week. Moreover, less than 10% of collagen could be solubilized after the 22nd week. In addition, the thermal denaturation temperature of the skin collagen increased from that time. Generally, it is said that both the solubility and denaturation temperature of collagen are affected by its crosslinking and that newly synthesized collagen has a high solubility. Consequently, the above phenomena firmly suggest the increasing of the crosslinks in skin collagen with aging (*Bentley, 1979*), and the high collagen synthesis and accumulation during the rapid skin thickening period. It is reported that the crosslinks like a hydrogen bond and Schiff's base which exist extensively in young skin collagen disappear with aging, and the Sciff's base crosslink, one of the reducible intermolecular crosslinks, is liable to solubilize the collagen in a neutral salt solution (*Bailey & Shimokomak, 1971*). As the differences between the collagen solubility in the neutral salt solution and the guanidine hydrochloride indicates the formation of the reducible crosslinks in young mink skin, it is suggested that newborn mink skin has a relatively steady structure of collagen, and probably this is reflected in the thermal denaturation temperature of young skin.

Non-reducible matured crosslinks such as aldol condensation, dehydroxylysiononorleusine, pyridionoline and desmosine are formed with aging. The increase of these crosslinks promotes the thermal, mechanical and chemical stability of the collagen, so that the insolubilization of collagen against the relatively strong reagent of protein denaturation and the rise of the thermal denaturation temperature of the skin is observed. It can be said that mink skin is mature by the age of 22 weeks.

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Original Report

Pelt quality and hair elements of reintroduced feral nutrias in Louisiana (U.S.A.)

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Summary

To observe the extremes of variation in feral nutria pelts within a single area, two groups of adults from brackish marsh were released into a depopulated, 5-ha area of freshwater marsh. Twenty-eight months after the first release and 14 months after the second release, nutrias were collected from the release area and a nearby control area. Hair elements and physical measurements were analyzed from swatches of venter pelt. Swatches from the release area had greater skin weight, a trait previously seen in brackish marsh. Females had longer underfur and lower hair zinc than males. Other variation included different hair concentrations of nickel and copper between the areas and high elemental concentrations in some individuals at both sites. There was further evidence that freshwater habitats increase the availability of elements like calcium and phosphorus.

Introduction

Pelt quality varies geographically in feral nutrias from coastal Louisiana (*Kinler et al., 1987*). Western pelts are more valuable than eastern pelts. Western pelts are darker and have longer underfur and thinner skins, greater numbers of dorsal hairs, and higher copper and phosphorus in the hair (*Ramsey and Maum, 1987*). Because pelt quality is affected by habitat and genetics, this economic problem may not be corrected by replacing eastern nutrias with western stock. Pelt traits are influenced by nutrition (*Aulerich et al., 1982*), and the range of dietary and genetic effects must be known before performing reintroductions. Therefore, we conducted a preliminary release-experiment to establish a protocol and data base for future studies of pelt quality in feral nutrias.

Materials and methods

Nutrias were taken from Marsh Island in February, 1987 (n=59 females, 33 males) and in April, 1988 (n=50, 1:1 sex ratio). The source habitat is brackish marsh with wiregrass (*Spartina patens*) and three-corner grass (*Scirpus olneyi*). Each group was released immediately into the same area of inland freshwater marsh; plant dominants were maidencane (*Panicum hemitomom*), bulltongue (*Sagittaria lancifolia*), alligatorweed (*Alternanthera philoxeroides*), and joint grass (*Paspalum dissectum*). A sample of adults was taken in mid-June, 1989 from the release site (5 males, 6 females) and a "control" area (8 males, 3 females). Because the release area contained no detectable nutrias before the first release, "controls" were taken about 2 km north of the release site where food items were similar. Released groups experienced high rates mortality and emigration, but nutrias in the release area are assumed to be descendants of released animals.

None of the released nutrias was recaptured. Five of the 6 females from the release site and 2 of the 3 from the control area were pregnant (fetus range 3-7).

Pelts were processed with the same methods and equipment used by Maum (1986). Skins were removed and frozen. A swatch (1 dm^2) of venter pelt was dried at 50°C and weighed. Underfur was measured to the beginning of heavy melanin deposition and to the hair tip. Swatches were shaved with small-animal electric shears and reweighed. One-half gram of hair (n=8, 5 males and 3 females from each area) was analyzed by Doctor's Data Inc. (West Chicago, Illinois) for 29 elemental concentrations by plasma argon torch. Contribution of minerals by the shears to the hair sample is minimized by a washing procedure prior to analysis.

Data summary, two-way analysis of variance (treatment x sex ANOVA), and correlation analysis were obtained from StatPac-Statistical Analysis Package (David S. Walonick, Version 6.0). Pelt characteristics at the release site were compared also with previous data from the source habitat (*Maum, 1986; Ramsey and Maum, 1987*). Log-transformation was applied to the data, but little difference in results was observed.

Results and discussion

Four significant differences were detected for the physical measurements (table 1): greater swatch weight at the release site ($\underline{P} = 0.024$), longer underfur ($\underline{P} = 0.022$) and pigment zone ($\underline{P} = 0036$) for females than for males, and one treatment x sex interaction effect, greater swatch skin weight ($\underline{P} = 0.031$) for release-site females. If the release-site nutrias were descendants of those taken from brackish marsh, skin weight, particularly in females, was maintained; nutrias from brackish marsh had thicker skins (*Maum, 1986*). Wild nutrias apparently have thicker (diameter) hairs and shorter underfur than penraised mutations (*see Niedzwiadek and Kowalski, 1987a*). Maum (1986) found no sexual dimorphism for pelt traits in feral nutrias. However, females had longer underfur in the present study, and male Amber Gold in Poland were reported to have heavier swatches (*Niedzwiadek and Kowalski, 1987b*).

Table 1. Physical measurements (mean and standard error) for pelts from the release and control areas. Asterisks indicate significant differences among subgroups from two-way analysis of variance ($\underline{P} < 0.05$).

Variable	ANOVA Main Effects					
	Treatment (n=11R, 11C)			Sex (n=13M, 9F)		
Swatch weight (g)	R	8.48 (0.32)	*	M	7.92 (0.19)	
	C	7.60 (0.24)	*	F	8.22 (0.47)	
Skin weight (g)	R	5.90 (0.31)		M	5.45 (0.14)	
	C	5.27 (0.24)		F	5.78 (0.46)	
Fur weight (g)[1]	R	2.59 (0.10)		M	2.47 (0.13)	
	C	2.32 (0.12)		F	2.43 (0.07)	
Total underfur length (mm)	R	9.42 (0.21)		M	8.91 (0.13)	*
	C	9.06 (0.24)		F	9.71 (0.29)	*
Fur length-to-melanin zone (mm)	R	6.67 (0.18)		M	6.36 (0.15)	*
	C	6.52 (0.18)		F	6.92 (0.18)	*

[1] Interaction effect (trt x sex) was significant ($\underline{P} = 0.031$); R-site females had greater fur weight than other subgroups.

Table 2. Elements, mean ppm (standard error), in nutria venter hair from the experiment (1989) and the source population (1987). Separate group values indicate significant ANOVA effects. N's=8 release (R), 8 controls (C), 10 males (M), and 6 females (F); source N=6. (--) = no data.

Element[1]		Release Experiment		Source Population	
Lithium		0.09	(0.01)	--	--
Boron		3.22	(0.33)	2.7	(0.1)
Sodium		176.51	(16.57)	151.2	(15.3)
Magnesium		271.98	(15.13)	217.0	(12.6)
Aluminum		24.37	(9.44)	13.9	(2.6)
Silicon		6.40	(0.46)	10.2	(0.9)
Phosphorus		357.06	(14.23)	210.0	(12.1)
Sulfur		39,719.37	(1,040.13)	--	--
Potassium		101.73	(13.28)	89.2	(9.3)
Calcium		734.26	(31.74)	445.5	(18.9)
Vanadium		0.35	(0.03)	--	--
Chromium		0.82	(0.33)	--	--
Manganese		32.20	(2.70)	7.4	(0.8)
Iron		451.91	(60.68)	237.3	(30.2)
Cobalt		0.15	(0.03)	--	--
Nickel	C	1.35	(0.49)	--	--
	R	0.58	(0.49)		
Copper	C	6.95	(0.37)	4.5	(0.5)
	R	8.03	(0.31)		
Zinc	M	208.35	(11.58)	140.7	(4.7)
	F	170.66	(9.03)		
Arsenic		2.43	(0.93)	--	--
Selenium		0.10	(0.002)	0.09	(0.004)
Strontium		5.01	(0.37)	3.45	(0.13)
Zirconium		0.33	(0.02)	--	--
Silver		0.13	(0.01)	--	--
Cadmium		0.41	(0.04)	0.48	(0.12)
Tin		10.60	(0.52)	--	--
Barium		4.42	(0.42)	--	--
Gold		0.82	(0.04)	--	--
Mercury		0.66	(0.05)	1.02	(0.25)
Lead		3.04	(0.47)	--	--

[1] Elements are listed in order of increasing atomic weight.

Three minerals differed significantly by treatment or sex, and extreme values were observed in some animals for eight element (table 2). Nickel was higher in the hair of controls ($P = 0.020$), especially for females. Copper was greater in samples from the release site ($P = 0.035$), and zinc was higher in males ($P = 0.047$). Single individuals at the release site had extremely high values for arsenic (8x the mean), aluminum (5x), chromium (5x), vanadium (2x), and boron (2x). Single control-site individuals had elevated values for aluminum (5x), nickel (4x), and vanadium (x). Release-site females had about one-half the iron and were less variable than other subgroups, and one release-site male had 25% less sulfur than the overall mean value. Numerous site-specific conditions, as well as pregnancy and age of fetuses, could have affected the results.

Living conditions and season affect the availability of minerals. Jelinek et al. (1982) reported values from atomic absorption spectrophotometry for zinc, manganese, and copper in biological materials of the Standard variety. Their pen-raised nutria on summer rations had 10x higher zinc and 6x lower manganese than feral winter nutria in Louisiana. Compared with the 1987 values for nutria hair from three different habitats, release-site and control samples in 1989 had some characteristics of brackish/saline habitat: high mercury, cadmium, magnesium, and boron. Further, these 1989 freshwater-marsh samples had higher calcium, sodium, manganese, copper, zinc, iron, phosphorus, and strontium than any group in 1987 and were lower for silicon. The differing elemental profiles for 1987 and 1989 could be related to the different seasons when samples were taken. Seasonal effects on plant uptake and soil ingestion can decrease copper availability to ruminants by increased molybdenum, sulphur, or iron (Ag. Food Res. Comm., 1988).

Compared with the 1987 data from the source population at Marsh Island (table 2), the hair of release-site nutria had higher phosphorus, calcium, iron, and zinc. Freshwater habitats may increase the availability of minerals to nutria (*Ramsey et al., 1981*). Stomach contents of nutrias in brackish marsh have lower calcium and magnesium and higher copper than stomach contents from freshwater marsh. Also, nutrias from brakish habitat have greater hair concentration of elements such as manganese, boron, cadium and strontium (*Ramsey and Maum, 1987*). In the present trial, higher levels of hair phosphorus, zinc, and copper were associated with freshwater habitats. With attention to suitable controls and larger samples, we are continuing to study dietary effects on the nutria pelt by replicate reintroductions and feeding experiments with captive feral animals.

Except for swatch weight vs. skin weight ($r = 0.922$, $\underline{P} < 0.001$), pelt variables were independent. Fur weight was not dependent on underfur lengths ($r = 0.268$ and 0.057). The correlation for swatch weight and hair copper approached a significant value ($r = 0.468$, $\underline{P} = 0.065$). Weight of hair from a pelt swatch apparently is related to hair density, not to length or diameter of the underfur. Thus, with standardized procedures, hair weight can be used as an index of density. Lengths and densities of hair appear to be inversely related in Amber Gold skins *Niedzwiadek and Kowalski (1987b)*.

Acknowledgements

This work was supported by a contract between Louisiana Tech University and the Louisiana Department of Wildlife and Fisheries. R.M. Edmunds provided valuable assistance with processing and measuring swatches. The paper was written while the senior author was Fulbright grantee and visiting researcher at the Livestock Research Institute, Novi Sad, Yugoslavia.

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The optimum age of foxes at pelting.

Bente Lyngs.

The background for the experiment carried out on Research Farm North in 1989 was that in theory as well as in practice opinions differ with regard to the optimum pelting age of foxes. Pelting age affects the economic result in two ways: by the number of feeding days each animal requires and by the evaluation of the skin before it is sold.

On basis of this experiment it can be concluded that on average silver foxes ought to be pelted at the age of 210 days and blue foxes at the age of 180 days. In both types a better fur density can be obtained by pelting the animals at a higher age, but especially for blue foxes this will result in poor guard hair quality and a higher frequency of "woolly backs". In order to find the optimum pelting time, the experiment should be extended to comprise the time of birth of the animals as well as the influence of the feed and the feeding regime on the fur development.

Danish Fur Breeders Association, Technical Year Report 1990. 6 tables. In DANH. pp. 176-180. Author's summary.

Optimum control of growth of mink kits.

Carsten Riis Olesen.

Poor development of fur density in the hip area of mink (Mustela vison) has been proved to have a negative influence on fur quality (Olesen, 1988 and 1989F, Olesen & Clausen, 1990). The degree of fattening of mink kits affects the development of thin fur on hips and thereby also the fur quality (Olesen, 1989A).

The purpose of this experiment was to reveal which strategy of feeding control would be the best to prevent the occurrence of thin furred hips, in other words give the best fur quality. Furthermore, the purpose was - with joint sorting of skins from several institutions - to agree upon the conditions for evaluation of this defect on mink skins and to evaluate how accurately the defect can be judged on mink pelts.

The experimental period was divided into 3 subperiods: from July 17 until August 19, from August 20 until September 31, and from October 1 until pelting. Ad libitum feeding was practised in all groups until August 19. From August 20 until September 31 the daily amount of feed was adjusted to allow an increase of 8 grams in body weight per day. From October 1 the feeding was varied in different groups allowing a daily increase of 0, 4 or 8 grams in body weight, respectively. One group was fed ad libitum during this last period.

However, it was not possible to limit the amount of body fat so that differences in the number of pelts with thin furred hips had been achieved.

The best results were achieved by the following growth developments:

Date (period):	Growth:
04/07-20/08	approx 18 g/animal/day
20/08-01/10	approx 8 g/animal/day
01/10-01/11	approx 5 g/animal/day
01/11-pelting	no growth, perhaps even a modest loss of weight.

The results of repeated judgment of the defect on the same skins showed that it is difficult to achieve high correlation between judgements or to grade the defect in many degrees.

Danish Fur Breeders Association, Technical Year Report 1990. 8 tables, 2 figures, 4 references. pp. 222-233. In DANH. Author's summary.

The longitudinal and transverse changes of mink skins during the stretching process. The consequence for appearance and quality of the skin.

Carsten Riis Olesen, Bent Munkøe.

Previous investigations of the influence of stretching on mink skins showed:

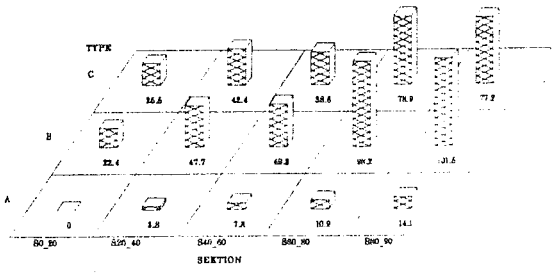
1) The individual sections of the back skin did not stretch equally.

2) The degree of fattening of the animals is very important to the stretching capacity of the skins.

3) If the skin from an animal which is too fat is stretched, there is a risk that the skin will get thin furred regions on the hips.

The purpose of this year's experiment was to increase the knowledge of the influence of skinning, fleshing and stretching on the appearance of a skin.

Totally 23 standard male mink were used. They were selected after killing according to body length and body weight. Body length immediately after killing was allowed to vary within 44-44.5 cm and was still considered constant. Within this body length two weight groups were selected: from 1860 to 1960 g and from 2130 to 2430 g, respectively.



A: Elongation at boarding the skin
B: Total elongation after finished pelting
C: Elongation during skinning and fleshing

Fig. 2. The elongation of different sections of mink skin caused by pelting. The elongation is measured in percentage of the body length of the corresponding section along the back bone line. Sections: The length of the body from nose to tail root is diided into 65 equal sections, each 20% of the body length.

The original body length of the mink plus the increase of length at skinning and fleshing constitutes the major part (92.8%) of the length of the skin after it has been stretched and dried. The increase in length at the stretching is therefore only 7.2% of the final skin length.

The degree of fattening has a special effect on the increase of the length of the lower part of the body and on the total abdominal extension.

The degree of fattening is important to the narrowing of the skin in the hip region. At the individual sections of the hip region (horizontally) the narrowing is very varied. The section closest to the back line narrows most, especially for animals with a high degree of fattening. The degree of fattening is of great importance to skin quality and the frequency of thin fur on hips. At a high degree of fattening the skin quali-ty decreases, and the degree of thin furred hips becomes more distinct.

Danish Fur Breeders Association, Technical Year Report 1990. 3 tables, 5 figures, 1 reference. pp. 256-263. In DANH. Author's summary.

Anal glands in the nest box environment of mink females before mating time.

Niels Therkildsen

The purpose of this experiment was to examine whether scent substances from anal glands could affect certain factors connected to the mating and/or the breeding result. All measurements were made on females, so only the possible effect on females was registered.

Immediately before mating time in 1990, ground anal glands from males killed after mating time in 1989 were rubbed into the nest box in an experimental group of 75 scanglow females. 67 not-treated scanglow females were the control group.

In both groups an average of 4 minutes passed from the time when female and male were put in the same cage until their interest aroused. The actual time of interest (sniffing at each other, mating games etc.) lasted 23.8 and 21.6 min. in the control and experimental groups, respectively. There are no statistically significant differences in these times.

The actual average mating time in both groups was a little more than 34 minutes. Especially in the control group the average mating time covers a large variation. The mating time of approx half of the females was a little less than 20 min. and of the other half of the females an average of 40-45 min.

The number of liveborn kits/mated female was the same in the two groups. Period of gestation, calculated from 1st and 2nd mating, was 53.5 and

a little less than 44.8 days, respectively, and not different in the two groups.

No statistically significant correlations were found between the time that elapsed after the two animals were put together until starting interest, length of mating and number of liveborn kits per mated female.

The experiment with addition of ground anal glands from male mink for female mink has not changed the conditions recorded about mating behaviour or the breeding result compared to a not-treated control group. The times recorded can be regarded as normal times in mating work with mink.

Danish Fur Breeders Association, Technical Year Report 1990. 6 tables, 1 figure, 1 reference. pp. 286-291. In DANH. Author's summary.

Early weight development of mink kits.

Henrik Falkenberg

Size is an important production parameter in mink breeding. The skin size is strongly correlated to the weight in May/June, and knowledge about the early weight development of the mink is therefore of great importance as regards the production economy.

The experiment included totally 398 kits of standard females mated the first time with standard males and remated 9 days later with pastel males. 158 kits were from litters where the females had been treated with hormone preparations and 240 from litters where the females were part of a not-treated control group.

The experiment confirmed that weight development depends on type and litter size and proved that the length of the gestation period also affects the weight development of the kits. Furthermore, it can be concluded that hormone treatment of the females immediately before and at the same time as 1st mating affects the weight development of the kits directly or through an influence on the length of the gestation period as well as on litter size.

Danish Fur Breeders Association, Technical Year Report 1990. 7 tables, 5 references. pp. 292-300. In DANH. Author's summary.

The effect of the stretching pressure on the size increase of the skin and on the occurrence of the defect thin furred hips.

Henrik Falkenberg

The aim of this experiment was to strain skins on a stretching machine at two different pressures and record the increase of skin length and relate it to the quality of the skin and the occurrence of the defect thin furred hips.

In November 1989 30 standard males and 30 pastel females were included in a pilot trial, the purpose of which was to examine the stretching pressure necessary to obtain a significant increase in length in per cent of the skin.

The skins were measured from nose to tail root in cm (no decimals) immediately before straining and again after they had been boarded. The 30 male skins as well as the 30 female skins were divided into 5 bundles, where each bundle was strained at a certain pressure.

At the same pressure female skins were stretched relatively more than male skins. An increase of 1 bar of the stretching pressure increased the length of male and female skins by 0.72 and 2.06%, respectively.

It is the general opinion that a strong increase of skin size by stretching reduces the fur quality. This could not be confirmed by this investigation.

A change of the stretching pressure from 4.5 to 7 bar resulted in a statistically significant increase in skin size but did not reduce the quality of the skins and provoked thin areas on hips only to a minimum extent.

Contrary to expectations, skins exposed to a stretching pressure of 7 bar had a better quality than skins stretched at 4.5 bar. This is probably due to the too small number of skins and/or lack of homogeneity among the lots in the basic material.

Danish Fur Breeders Association, Technical Year Report 1990. 3 tables, 1 reference. pp. 301-304. In DANH. Author's summary.

Storing dried pelts in nitrogen instead of air.

Niels Therkildsen

The experiment was carried out with 172 sacanblack male skins and 90 scanblack female skins were used. The animals were pelted at the beginning of December 1989. After drying the pelts were sorted as Saga Selected, Saga, Quality I and Quality II.

Both male and female skins were divided into an experimental and a control group. The control groups were stored traditionally in boxes at approx 12°C and 70% RH.

The experimental groups were stored in 35 by 112.5 cm plastic bags. Each bag contained up to 6 male or female skins. The bags were of the brand Riloten/X from Otto Nielsen Emballage A/S. The plastic film is especially suitable for packing of particularly oxygen-sensitive, chilled meat, delicatessen and cheese products. Welding temperature was mentioned to be 140-170°C.

After two and a half months the skins were regraded according to the quality. No clear difference could be seen in the general fur quality between the control and experimental groups. However, a general impression among the judges was that apparently skins stored in nitrogen had a more glossy appearance. This observation has, however, not been reflected in the general quality sorting.

Investigations of possible advantages of storing skins in a nitrogenous atmosphere require a more comprehensive examination.

Danish Fur Breeders Association. Technical Year Report 1990. 1 table. pp. 305-308. In DANH. Author's summary.

Effectiveness of different ways of establishing a mink farm free from plasmacytosis.

Mariann Chriél.

The mink farms which had in the period from 1981 till 1986 tested their animals for plasmacytosis were divided into 4 groups according to the strategy used. Their plasmacytosis status in 1987 and 1988 was recorded.

Method I: Farms established in the period with animals free of plasmacytosis, newly built houses on a ground that had not earlier been used for mink production.

Method S: Farms which had in the period replaced their entire stock of breeding animals, bought breeding animals free of plasmacytosis, and placed these in the old production houses.

Method G: Farms infected with plasmacytosis which have gradually tried to clean their farms by means of annual testings.

Method F: A-farms which have during the period had a severe outbreak of plasmacytosis and continue combating the disease by gradually testing the farm until it is free of plasmacytosis.

Farms established according to methods S, F, and G will all have vira in the ground, whereas farms established according to method I have earth free of plasmacytosis vira.

When there are plasmacytosis vira in the ground it is a great problem to become an A-farm, as vira are extremely stable and can remain infectious for many years.

This is seen as a long-term effect on old, infected farms which have difficulty in cleaning and disinfecting sufficiently. Therefore their chances of gaining gaining an A-status are weaker. It is very important to identify some of the factors necessary for "successful testing", so that it is possible to offer optimum advice to the farms if the traditional methods do not give results within 2 years.

Danish Fur Breeders Association, Technical Year Report 1990. 4 tables, 3 figures. pp. 331-336. In DANH. Author's summary.

Effects of light on fur animal production. Literature review.

K. Aarstrand.

The object of this literature study was to obtain an overview of the effect of light on fur animal

production. Artificial regulation of light affects both daylength and changes in daylength per day. Research has not established which of these factors has the most influence on the onset of heat and changes in fur. By the use of extended light heat in mink and fox can be accelerated. This fact is of particular interest in the cross-breeding of blue fox and silver fox. Use of extra light in order to shorten the pregnancy period of mink in the supposition that this will provide larger litters has not given significantly positive results. Shortening daylength from June/July accelerates fur ripening in fur animals. Artificial shortening of daylength requires that lightfree houses be built, giving rise to a substantial increase in production costs. Production methods using artificial light in fur animal production have not reached a level of development that can provide secure profit, although positive results have been achieved in some research programmes.

Norsk landbruksforskning (Norway); Norwegian Agricultural Research, Vol. 4(1): 39-49, 1990. 2 figs., 26 references. In NORG, Su. ENGL. ISSN 0801-5333. Author's summary.

Comparative studies of blood serum protein separated in polyacrylamide gel in silver and polar foxes.

K. Kostro, A. Brodacki.

Blood serum proteins from 23 mature silver foxes and 16 polar foxes were separated by horizontal polyacrylamide gel electrophoresis. In obtained electrophoregrams the following protein regions were differentiated: prealbumins (Pa), albumins (Alb), postalbumins (Poa), pretransferrins (Ptf), transferrins (Tf) and posttransferrings (Potf). It was demonstrated that the migration of proteins in the regions Pa_2, Alb, Poa_1, Ptf_2 and Tf was faster than the migration of proteins in the regions Pa_3 i Poa_3 in silver foxes in comparison with polar foxes. The differences let us suppose that it can be stated that proteins of those regions in tested species of breeding foxes reveal genetic polymorphism.

Medycyna Weterynaryjna, 45; 11-12, 626-627, 1989. 1 fig., 12 references. In POLH, Su. ENGL. Authors' summary.

Amino acid composition of hair protein of growing polar foxes.

Romuald Rajs.

The amino acid composition of hair proteins of growing blue polar foxes (2 weeks to 6 months old) was tested by high voltage electrophoresis and ascending paper chromatography method.

During winter hair synthesis, changes in the level of some amino acids were observed. The level of cystine with cysteine increases from 16% to 20%.

Zeszyty Naukowe Akademie Techniczno-Rolniczej w. Bydgoszczy, Poland, No. 153, 11-17, 1989. 2 tables, 10 references. In POLH, Su, ENGL, RUSS. Author's summary.

Monitoring heart rate and body temperature in red foxes (*Vulpes vulpes*).

T.J. Kreeger, D. Monson, V.B. Kuechle, U. S. Seal, J.R. Tester.

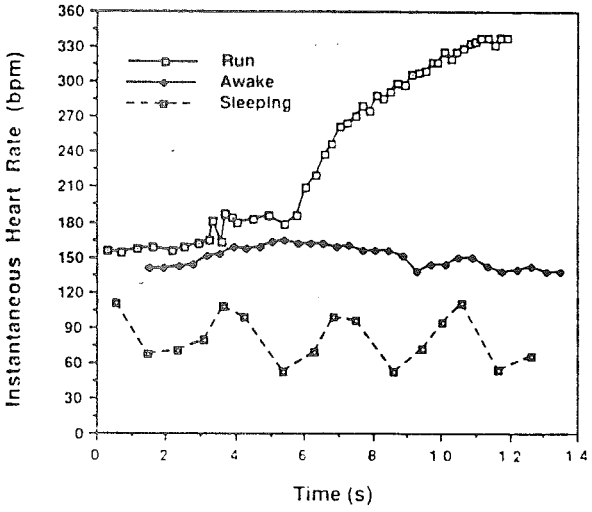


Fig. 2. Heart rate patterns of a single male red fox. Patterns were representative of levels of activity for all foxes studied. Sleeping pattern variances indicate respiratory sinus arrhythmia.

Twenty-four captive-raised red foxes were surgically implanted with radios that transmitted both heart rate and body temperature. Successive fox

pairs were placed in a 4.1-ha observation pen for 2 weeks and behavior was video recorded. The radio signal was recorded on the audio portion of the video tape for computer decoding. Heart rate and body temperature were measured for six behavior categories: sleeping, awake, hunting, feeding, running, and being chased. The heart rate for each of these categories was significantly different from any other (P = 0.0001). All body temperature categories were different from each other except for running and being chased (P = 0.0001). Both heart rate and body temperature increased with level of activity. The only significant difference in heart rate and body temperature between sexes was for the sleeping heart rate category, where females had higher values than males (P = 0.04). There was also a significant time of day effect showing that body temperature while awake was highest at night (P = 0.0005). Sleeping foxes displayed a pronounced sinus arrhythmia which disappeared when they became active.

Can. J. Zool. 67: 2455-2458, 1989. 4 figs., 17 references. Authors' summary.

Measurement of height of layers as an element of evaluation of blue fox coat.

J. Gedymin, R. Cholewa.

Searching for objective methods for evaluating blue fox coat, the authors carried out investigations in order to learn whether measuring coat height would contribute to more accurate evaluation. They measured height of both layers on 450 raw pelts on the back and at the tail base. The pelts were marked with the numbers of the animals from which they were obtained, which made possible a comparison of evaluations of live animals and of their pelts. The statistical characteristics of the dimensions and of the exterior evaluations of live animals and the correlations between them were calculated.
The score evaluation of coats of live animals was corrected using the measurements of height of underhair and of overcoat.

The coefficients of correlation of coat of live animals and the classification of their pelts were low. Their values increased when they were calculated with a correction of exterior evaluation based on the measurements.

Based on the results obtained, it was difficult to decide to what degree the measurements of hair height contributed to more accurate evaluation but it was found that measuring height of coat layers increased the objectivity of evaluation and improved comparability of evaluation of this trait.

Roczniki Akademii Rolniczej w. Poznanze - CCXX, 37-49, 1990. 5 tables, 5 references. In POLH, Su. ENGL, RUSS. Authors' summary.

Comparison of the results of evaluation of live polar foxes with those of evaluation of their raw skins.

R. Cholewa, J. Gedymin.

In the years 1981-1984 the authors evaluated 914 live blue polar foxes in their winter coat and the skins obtained from them and marked for each animal. In addition to organoleptic evaluation, the body length was measured in live foxes. The raw dried skins were evaluated by the sorters of the firm which bought them and prepared for export. These two evaluations were in little agreement, particularly as concerns colour and structure of coat. The values of measured traits of size coincided most but the coefficients of polar fox for improving coat quality cannot be effective. The main cause of this difficulty, according to the authors, is the subjectivity of both evaluations. This incompatibility could perhaps be avoided if the licenced judges and sorters evaluated the animals and their skins together.

It would be desirable to conduct investigations for finding more objective methods of evaluating coat in fur animals.

Poznanskie Towarzystwo Przyjaciol Nauk Wydzial Nauk Rolniczych i Lesnych Prace Komisji Nauk Rolniczych i Komisji Nauk Lesnych Tom LXV, 5-31, 1988. 3 tables, 7 references. IN POLH, Su. ENGL. Authors' summary.

Influence of age of polar fox puppies at weaning on their development and on reproductive performance of their dams.

R. Cholewa, J. Gedymin.

In order to learn about the effect of length of the

suckling period on the development of polar fox puppies, the authors investigated 3100 young foxes during 3 years. Their live weight was measured when they were 60 and 90 days old and in November, when the animals matured in body length and exterior traits were evaluated. The period of suckling ranged from 28 to 60 days in individual animals.

It was found that there was rather little connection between the suckling period and exterior traits. The live weight of 90 day old foxes was about 3% higher in the animals weaned at an older age (50-60 days). The exterior traits, particularly the size of mature animals, were better in those which were weaned at a younger age.

However, there were some differences depending on the time of birth, namely live weight and exterior traits were more advantageous in foxes which were born earlier in the season.

No statistically significant relation was found between the length of suckling of the female and her fecundity in the next season of reproduction.

Poznanskie Towarzystwo Przyjaciol Nauk Wydzial Nauk Rolniczych i Lesnych, Prace Komisji Nauk Rolniczych i Komisji Nauk Lesnych Tom LXV, 33-41, 1988. 6 tables, 8 references. In POLH, Su. ENGL. Authors' summary.

Observations on the histological structures of some internal organs in the mink.

Xiuying Pang, Lijun Wang.

Samples of various organs from adult female minks in good health were fixed in Bouin's solution, embedded in paraffin wax and stained with hematoxylin eosin. Then the histological structures of liver, pancreas, lungs, kidneys, testis, epididymis, spleen and adrenal glands were observed under optical microscope. Summarized in the following are results of the observations.

1) Numerous branches of lobule biliary ducts exist in confluent areolas of the liver, and there is a great number of unbounded cells in this areola.
2) Considerable numbers of pancreatic islands occupy the lobules over the pancreas.
3) Phrenocytes and dust cells in the lung are definitely clear, with profuse phagocytosed particles. Four to seven dust cells may be seen in the field of vision.
4) Great numbers of sustentacullar cells are found in the testis convoluted tubules, and are very clear when viewed. There can be up to 19 cells on one fracture surface of the tubules.
5) The multiform areolae are between spherical and arcuate. The cortex is light-stained and the medulla darkstained. Very few sympathetic neurons are found in medullary substances.
6) The splenic capsul is rich in smooth muscles which are entricular to each other. Well-developed sheathed arteries, typical structures of red pulp and white pulp are found.

The other fundamental structures are found to be similar to those of other species of mammals.

Journal of Hebei Agricultural University (China), Vol. 11 (3), 61-65, 1988. In CHIN, Su. CHIN, ENGL. Authors' abstract.

Effects of group and sex combination on productive performance of farmed polecats (*Mustela putorius*).

H. Korhonen, H. Tukiainen, M. Harri.

Effects of cage size, sex and social status on body growth and fur quality of juvenile, growing polecats (*Mustela putorius*) were studied under farm conditions. No significant differences in growth rate or fur quality parameters between various female groups were found. In males, animals housed by threes within a cage produced lowest final body mass and shortest pelt lengths. The best production result was found in the group where 2 males and 2 females were kept together in large-sized cages. In both sexes, social status did not produce any significant differences in body growth or fur quality parameters. The results support the conclusion that other than the conventional one-male and one-female combination can be used to produce animals of big body size and long pelts.

Z. Versuchstierkd: 33, 79-83, 1990. 2 tables, 16 references. Authors' summary.

The Vitamin-E and selenium status in mink.

Birthe M. Damgaard, Tove Nørgaard Clausen.

The effect of spiramycin and bacitracin in mink feed on the vitamin-E status and the activities of the enzymes (glutation-peroxidase (GSH-Px), creatin-kinase (CM), alanin-aminotransferase (ALAT), and aspartat-aminotransferase (ASAT)), in mink plasma was investigated in 4 groups of mink. One group was given feed from a feed kitchen, one group was fed the control diet, and two groups were fed the control diet added 20 ppm zinc bacitracin and 20 ppm spiramycin, respectively.

The effect of vitamin E and vitamin E/Tylan in mink feed on the vitamin E status and the activities of GSH-Px was investigated in 3 groups of mink. One group was fed the control diet, one was fed the control diet added vitamin E (100 mg/kg feed) and one was given the control diet added vitamin E (100 mg/kg feed) and tylan (50 ppm).

From the results it is concluded:

The activity of the enzymes ASAT, ALAT, CK and GSH-Px in plasma depends on the feed used. Spiramycin and zinc bacitracin in feed do not seem to affect the activity of enzymes in plasma. The concentration of vitamin E in plasma increases when vitamin E is added to the feed. The addition of vitamin E and vitamin E/tylan to feed may decrease the activity of CK. The concentration of vitamin E and the activity of GSH-Px in mink plasma was higher than the reference levels for pigs and chickens.

Danish Fur Breeders Association, Technical Year Report 1990. 6 tables, 7 references. pp. 54-60. In DANH. Author's summary.

Taste appeal trial: Popped barley versus ordinary, heat-treated barley for nursing mink females.

Bente Lyngs.

The idea of a taste appeal trial, where popped barley is compared to ordinary, heat-treated barley originated from a theory that popped barley is sweeter and should therefore appeal more to nursing females.

The taste appeal trial with popped barley for scanblack females in the nursing period (1-5 weeks after birth) was carried out on Research Farm North in 1990.

The conclusion of the trial was:

- the immediate reaction to feed containing popped barley was indifferent (measured as g wet feed, g dry matter, and kcal consumed).

- in weeks 2 and 3, where the animals had access to only one of the feed mixtures, the feed consumption was not different in the two groups. The animals ate the same amount of the two feed mixtures, as they had no choice.

- after 2 weeks of adaptation, where the animals had been offered only control feed or experimental feed, their choices were still indifferent (week 4).

- weight gain of the females was not different in the two groups and must be considered not to vary from corresponding animals not in experiment.

- the kits in the experimental group weighed more at the start and at the end than the kits of the control group, which must be a result of the smaller litter size in this group.

Danish Fur Breeders Association, Technical Year Report 1990. 5 tables. pp. 72-76. In DANH. Author's summary.

Taste appeal trial: Poultry offal for mink kits in the early growth period.

Bente Lyngs.

An accepted fact is that the early growth period is of great importance to the later development of mink kits. It is therefore obvious to examine the taste appeal of various feeds which can be used in this period.

Poultry offal is one of the interesting feeds to examine in this connection.

A taste appeal trial with warm Danish poultry offal for scanblack mink kits in the early growth period (age: 10-14 weeks) was carried out at Re-

search Farm North in 1990.

The conclusion of the trial was:

- the immediate reaction of the animals to feed containing 20% poultry offal was positive, as they ate significantly more of this feed than of the control feed without poultry offal (measured as g wet feed, g dry matter, and kcal).

- in weeks 2 and 3, where the animals had access to only one of the feed mixtures, the feed consumption was the same in the two groups, i.e. the animals ate the same amounts of the two feed mixtures, as they had no choice.

- after two weeks of adaptation, where the animals of the two groups had only been offered either control or experimental feed, they still (week 4) preferred the experimental feed containing 20% poultry offal ($P<0.05$).

- the growth of the animals was not different in the two groups but varied apparently somewhat from period to period. This variation seems to be parallel for males and females and for the two groups. A reduction of the growth in week 3 cannot be traced to a lower feed consumption in this period.

Danish Fur Breeders Associaton, Technical Year Report 1990. 5 tables. pp. 77-81. In DANH. Author's summary.

Taste appeal trial: Fish silage for mink kits in the growth period.

Bente Lyngs.

Fish silage is a nutritious and cheap feed used in mink feed mixtures at certain times of the year. In other connections several experiments with fish silage have shown that the feed consumption is often reduced when this ingredient is used. The reason may - among others - be a negative taste effect of the fish silage. To investigate this more thoroughly, a taste appeal trial was carried out comparing a feed mixture containing approx 15% fish silage with a feed mixture without this raw material.

The trial was carried out on Research Farm North in 1990 with scanblack mink kits in the growth period (age: 15-19 weeks).

The conclusion of the experiment was:

- the immediate reaction of the animals to feed containing approx 15% fish silage was negative, as they ate significantly less of this feed than of the control feed without fish silage (measured as g wet feed, g dry matter and kcal).

- in weeks 2 and 3, where the animals had access to only one of the feed mixtures, the feed consumption was the same for the two groups, i.e. the animals eat the same quantities of the two feed mixtures, if they have no choice.

- after 2 weeks of adaptation, where the animals in the two groups had been offered either the control feed or the experimental feed, they still (week 4) preferred the control feed not containing fish silage ($P<0.05$).

- the growth was not different in the two groups but apparently varied somewhat from week to week. This variation seems to be parallel for males and females and for the two groups. A reduction of the growth from week 1 to the other weeks can be traced back to a lower feed consumption that week.

Danish Fur Breeders Association, Technical Year Report. 5 tables, pp. 82-86. In DANH. Author's summary.

Taste appeal trial: Low pH in feed for mink kits in the growth period.

Bente Lyngs.

This trial is a continuation of the taste appeal trial with 15% fish silage for mink kits in the growth period. The experiment showed a significant, negative effect of fish silage on the taste of the feed. Fish silage is preserved with sulphuric acid, acetic acid, and etoxyquin. If added to the feed, the pH of the feed will fall. At the same time etoxyquin probably has an unpleasant taste. The negative effect on taste of fish silage may therefore be due either to a lower pH or to the added etoxyquin. The purpose of this experiment (and the following experiment) is to clarify the reason for the negative effect of fish silage on the taste of the feed.

A taste appeal trial with various pH levels of the feed was carried out at Research Farm North in

1990 with scanblack mink kits in the growth period (age: 19-23 weeks).

The conclusion of the experiment was:

- the immediate reaction of the animals to feed with pH = 5.5 was negative, as they ate significantly less of this feed than of the control feed with pH = 6.5 (measured as g weet feed, g dry matter and kcal).

- in weeks 2 and 3, where the animals had access to only one of the feed mixtures, the feed consumption was the same in the two groups, i.e. the animals eat the same amount of the two feed mixtures, if they have no choice.

- after 2 weeks of adaptation, where the animals in the two groups were offered either the control or the experimental feed, they still (week 4) preferred the control feed ($P<0.05$).

- the growth of the animals was not different in the two groups, but varied apparently somewhat from week to week. This variation seems to be parallel for males and females and for the two groups. A reduction of the growth in week 2 can be traced to a lower feed consumption that week.

Danish Fur Breeders Association, Technical Year Report 1990. 5 tables. pp. 87-91. In DANH. Author's summary.

Taste appeal trial: Etoxyquin in the feed for mink kits in the priming period.

Bente Lyngs.

This experiment is a continuation of the taste appeal experiment with 15% fish silage and the taste appeal experiment with a low feed pH for mink kits in the growth period. The two previous experiments have shown negative effects on the taste of the feed when fish silage was used as well as when the pH value of the feed was low. Etoxyquin is an additive in silage, and it was also included in the mixture of sulphuric acid and acetic acid, which was used to reduce pH in the preceding experiment. Probably etoxyquin has an unpleasant taste. It is therefore relevant to examine if this could be the reason for the negative effect on taste recorded in the two preceding experiments.

A taste appeal trial with etoxyquin in the feed for scanblack mink kits in the priming period (age: 23-27 weeks) was carried out on Research Farm North in 1990.

The conclusion of the trial was:

- the immediate reaction of the animals to feed with etoxyquin was negative - however, significant only for the control group.

- feed consumption was the same in the two groups in week 2 and week 3, where the animals had no possibility to choose another type of feed.

- after two weeks of adaptation where the animals had only been offered the control or the experimental feed, they showed no statistically significant preference towards one of the feed types in week 4.

- the growth of the animals was not different in the two groups but apparently varied somewhat from week to week.

The taste appeal trials with fish silage, pH and etoxyquin can now be compared, and it can be concluded that the negative taste effect of fish silage is a result of the lower pH of the feed and thus caused by the acids.

Danish Fur Breeders Association, Technical Year Report 1990. 5 tables. pp. 92-96. In DANH. Author's summary.

Meat- and-bone meal for mink.

Georg Hillemann.

In the summer of 1989 experiments with meat-and-bone meal were carried out on Research Farm North.

Meat-and-bone meal of ordinary quality as well as of low ash mink quality were tested with 5 and 10%, respectively. No unique differences were found in the development of the animals, the appearance of faeces, the changing of pelt or other relevant factors.

Pelt quality was affected negatively by large amounts of meat-and-bone meal. In pastel mink the difference is significant.

On the other hand, the effect on the colour of standard mink was positive.

Based on the general results of the experiment it can be concluded that both of the types of meat-and-bone meal tested can be used with approx 5% of the feed, but that 10% seems to exceed the acceptable level.

Danish Fur Breeders Association, Technical Year Report 1990. 11 tables. pp. 97-105. In DANH. Author's summary.

Duck offal for mink in the growth period.

Georg Hillemann.

In the summer of 1989 experiments with duck offal were carried out on Research Farm North.

No unique differences were found in the development of the animals, the appearance of faeces, the changing of pelt or other relevant factors.

The quality characteristics of standard type were influenced neither positively nor negatively, but there was a slightly negative effect in the colour.

In pastel there was a clearly positive effect on the quality.

It can be concluded that duck offal can well be included in the feed just like poultry offal in the quantity tested, but it seems that special attention must be given to the quality of fat.

Danish Fur Breeders Association, Technical Year Report 1990. 7 tables. pp. 106-111. In DANH. Author's summary.

Different energy distributions for mink in the breeding period and the frequency of greasy kits.

Georg Hillemann.

In the breeding period of 1989/90 experiments with different energy distributions for mink have been carried out on Research Farm North. Generally speaking, the experiment was a repetition of the experiments from the preceding breeding period. As regards breeding result, mortality etc. no significant differences were found between the various groups. It seems that good results can be obtained both with a low content of carbohydrates in the winter and a subsequent high content of carbohydrates in the nursing period and vice versa.

The frequency of greasy kits was highest in the groups that were fed 10% of the energy from carbohydrates which is the opposite of last year's result for pastel and partly also for standard. As far as wild mink are concerned, the result with the low number of animals last year coincides with this year's result. It does not seem that a feed with different energy distributions can always be expected to give different results in regard to the frequency of greasy kits and the degree of the problem. Pastel mink is still the most exposed type, especially young females.

The next factor to be examined thoroughly must be the protein fraction, including different protein ingredients.

Danish Fur Breeders Association. Technical Year Report 1990. 13 tables. pp. 112-123. In DANH. Author's summary.

Heat-treated peas and heat-treated rape seed for mink in the growth period.

Georg Hillemann, Bente Lyngs.

In the summer of 1989 experiments with addition of heat-treated peas and heat-treated rape seed to the mink feed have been carried out on Research Farm North.

The experiments showed that:

- there is a positive interaction of rape seed and peas on the growth of scanblack males. The growth of the females is affected positively by rape seed,

- rape seeds as well as peas affect the growth of pastel males and females negatively,

- the growth of scanbrown males and females is affected negatively by rape seed, whereas peas do not have any significant effect on growth,

- the fur quality of scanblack, pastel and scanbrown is not influenced significantly by peas,

- the fur quality of scanblack and pastel is af-

fected positively by rape seed, but this is not the case for scanbrown,

- in scanblack there is an interaction between rape seed and peas on skin quality,

- skin size is influenced negatively by the high level of peas (10%) in all three types.

- skin size is affected negatively by rape seed in all three types,

- the negative effect of rape seed on skin size is intensified by the simultaneous presence of peas in the feed mixture - and vice versa (interaction),

- the colour of scanblack and the clarity of pastel and scanbrown are not affected significantly by rape seed and/or peas,

- in pastel there is an interaction on clarity.

It can be concluded that rape seed and peas can be used in mink feed. However, special attention should be given to the negative effect of both of these raw materials on the skin size which applies to both scanblack, pastel and scanbrown, and to the fact that this effect is intensified by simultaneous presence of rape seed and peas in the feed. It has not been possible in this experiment to prove the positive effect of peas on silkiness discovered in earlier experiments with peas.

Danish Fur Breeders Association. Technical Year Report 1990. 11 tables, 3 references. pp. 124-134. In DANH. Author's summary.

Meat-and-bone meal of various qualities for foxes in the growth period.

Bente Lyngs, Georg Hillemann.

Several experiments were carried out in 1988 to reduce the price of feed for foxes. Among other things the experiments showed that meat-and-bone meal is a very good feed for silver as well as blue foxes. The meat-and-bone meal was of the so-called mink quality which is more expensive than the ordinary quality of meat-and-bone meal. Therefore the experiments in 1989 were based on a demand for further research of meat-and-bone meal in various qualities and quantities.

The conclusions of the experiments in 1989 with various qualities and quantities of meat-and-bone meal for foxes in the growth and priming season were:

SILVER FOXES
- a tendency towards poorer quality in all experimental groups compared to the control group.

- no unique results as regards quantity and quality of meat-and-bone meal, i.e. nothing seems to indicate that meat-and-bone meal of the so-called ordinary quality is different from meat-and-bone meal of mink quality. Nor does anything indicate that increasing quantities of meat-and-bone meal affect the fur properties of silver foxes (until the percentage of meat-and-bone meal in the mixture has reached 20).

BLUE FOXES
- none of the fur properties of blue foxes are affected by the qualities or quantities of meat-and-bone meal used here.

Based on these experiments it can be concluded that meat-and-bone meal of ordinary quality as well as meat-and-bone meal of mink quality can be used with up to 20% of the feed for silver and blue foxes in the growth and priming period, on the condition that the feed consistency can be controlled.

Danish Fur Breeders Association. Technical Year Report 1990. 4 tables. pp. 135-140. In DANH. Author's summary.

Rape concentrates for mink in the growth and priming period.

Georg Hillemann, Bente Lyngs.

Experiments of previous years have concurrently shown that the result of feeding mink a certain amount of rape is reduced growth and final weight and therefore also a smaller skin size, compared to mink which have not been given rape in their feed. Probably this effect of rape is caused by the content of glucosinolates which have a retarding effect on growth.

Experiments in 1987 (Hillemann, Jensen & Sørensen, 1989) with a rape product treated with en-

zymes showed that this product had a positive effect on the fur quality of mink but that the product has to be improved in regard to the effect on the growth of the animals.

This experiments in the summer of 1989 were carried out with the same rape product, a rape concentrate from NOVO, as in 1987. The experiment was carried out in cooperation with the pharmaceutical company NOVO and Hilmer Sørensen, Chemical Institute, the Royal Veterinary and Agricultural University in Copenhagen.

The experiments showed that:

- addition of 5% rape concentrates to the mink feed had no effect on growth and fur properties of scanblack and pastel males.

- addition of 10% rape concentrates to the mink feed had a positive effect on quality, silkiness and density of scanblack males. At the same time fewer skins with poor underfur, weak hips, and metallic were found.

- addition of 10% rape concentrates to the mink feed has no effect on the fur properties of pastel. However, there is a tendency towards more dense underfur and a reduced body weight with an increasing amount of rape concentrates.

The experiments showed that rape concentrates are extremely applicable in mink feed - on the condition that products low in glucosinolates are used, in other words which have been treated like the concentrate used for this experiment.

Danish Fur Breeders Association. Technical Year Report 1990. 8 tables, 2 references. pp. 141-147. In DANH. Author's summary.

Fish meal - is it necessary to buy mink quality?

Georg Hillemann.

In the summer of 1989 experiments with fish meal were carried out on Research Farm North. An ordinary commodity as well as a mink quality were tested with 5 and 10%, respectively.

No significant differences were found in the development of the animals, the appearance of the faeces, the change of pelt or other relevant factors.

The fur properties of standard and wild mink were influenced neither positively nor negatively.

The clarity of pastel was decreased significantly by the ordinary quality of fish meal. This is, however, not very important, as the degree of clarity is not of special importance to the price in the pastel colour type.

Based on this experiment it can therefore be concluded that in the summer period the use of an ordinary fish meal product, complying to a reasonable extent with the quality requirements of the Danish Feed Control, can be included in mink feed just like fish meal of mink quality in the quantities used in this experiment.

Danish Fur Breeders Association. Technical Year Report 1990. 9 tables. pp. 148-155. In DANH. Author's summary.

Different levels of protein, potatoe protein and l-tyrosin for mink in the growth period.

Georg Hillemann.

An experiment with various levels of protein in mink feed was carried out on Research Farm North in 1989. 7 groups were included in the experiment.

The amount of energy deriving from protein varied from 20% to 35%. One of the 25% groups was given addition of the amino acid tyrosin.

In the groups with a low protein content, it was attempted to balance the amino acid content by means of potatoe protein which is considered to be a protein feed of high biological value.

The fur quality was influenced negatively - mostly in pastel - in the groups with a low protein content. The use of potatoe protein was not able to compensate for the low protein content, mainly because the amino acid content in the feed is still too low in comparison with the requirement of the animals.

The conclusion of the experiment must be that a feed composed according to existing guidelines can give a sufficient supply of amino acids in the growth and priming period with 30% of the energy from protein, but that an energy concentration considerably above the normal level, i.e. 180-190

kcal per 100 g requires special precautions with economic consequences in order to cover the amino acid requirement of the animals at this protein level.

The results also showed that the added tyrosin did not have any significant effect.

Danish Fur Breeders Association, Technical Year Report 1990. 9 tables. pp. 156-165. In DANH. Author's summary.

Tests of various antibiotics/probiotics for mink from February 1, 1989 until pelting.

Tove Nørgaard Clausen.

The addition of Flavomycin 4 ppm and 8 ppm, Zinc bazitracin 20 ppm and 100 ppm, Tylan 40 ppm, Cernivet LBC G35 1g/20 kg and Spiramycin 20 ppm to the mink feed in the lactation and growth periods had no statistically significant, positive effect on kit weight at weaning nor on fur properties at pelting.

Danish Fur Breeders Association, Technical Year Report 1990. 11 tables. pp. 184-195. In DANH. Author's summary.

The correlation between feeding and nursing disease in mink.

Tove Nørgaard Clausen, Carsten Riis Olesen.

Nursing disease is a serious problem which often affects up to 15% of all parturient mink females. Normally the best females are affected, so the loss from this disease can be very serious. Furthermore, it is often difficult to detect the females developing nursing disease before it is too late to cure the disease.

Supposing that the problems were to be found in the feeding, Research Farm West started an experiment with a large number of females. In this experiment the energy distribution of the feed was varied over a very large range. Especially the protein fraction of the feed energy covered the area from 35 to 65%.

In this investigation, the following relationships were found in the investigation between the feed and the frequency of nursing disease:

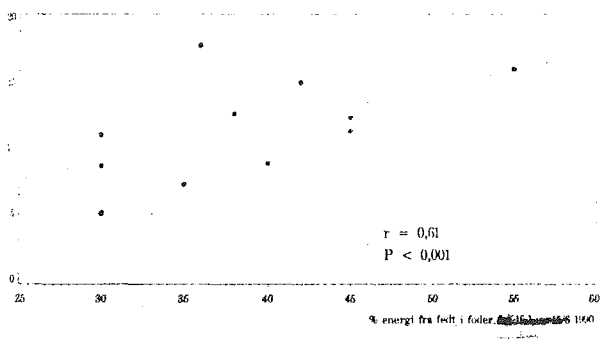
a) Less energy from protein in the feed (15/1 to 15/6) gives more females with nursing disease.

b) More energy from carbohydrates in the feed (15/1 to 15/6) gives more females with nursing disease.

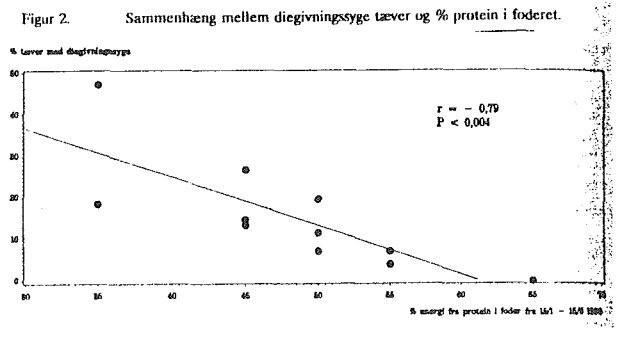
c) More dry matter (less water) in the feed (15/1 to 15/6) gives more females with nursing disease.

It is important to notice that the factors mentioned are to some extent interdependent. For instance you cannot change the protein level without at the same time changing the water content of the feed and most likely also the content of carbohydrates.

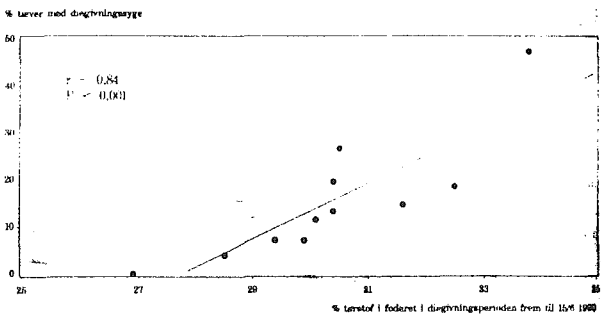
Figur 1. Sammenhæng mellem % energi fra fedt og frekvens af fedtede kuld.



Figur 2. Sammenhæng mellem diegivningssyge tæver og % protein i foderet.



Figur 3. Sammenhæng mellem diegivningssyge og foderets tørstofindhold.



Danish Fur Breeders Association, Technical Year Report 1990. 4 tables, 4 figures. pp. 204-213. In DANH. Author's summary.

Results from trials with the use of mash meal in the feed for mink kits.

Carsten Riis Olesen.

Mash is a byproduct from the brewing industry. During the brewing process, a lot of the accessible carbohydrates found in the malting barley has been utilized. The product left over contains large amounts of fibres. Wet mash has traditionally been sold as a cheap feed for cattle. New drying and fractioning processes have, however, made it interesting to offer a mash meal as a fibre supplement to feeds, and at the same time mash meal contributes with an essential amount of digestible protein and fat.

Apparently mash meal seemed to have a favourable influence on fur quality in general. After correction for a somewhat shorter skin length, the positive tendency still remained. It can be recommended to include up to 4-5% mash meal in ready-made mink feed.

Danish Fur Breeders Association, Technical Year Report 1990. 5 tables, 8 references. pp. 214-221. In DANH. Author's summary.

Suboptimally treated rape seeds used in mink feed.

Carsten Riis Olesen.

The purpose of this experiment was to test an average product of heat treated, ground rape seeds where no special requirements were made for the level of glucosinolates.

If rape seeds are used for mink feed, it is of vital importance that the product is heat treated optimally, so that valuable nutrients are kept while the myosinase enzymes are destroyed.

If the heat treatment is too extensive, the ability of the mink to digest protein and fat from the rape seeds decreases. High humidity during the heat treatment will keep the heat effect at optimum level and increase the inactivation of myosinase.

Mink react to rape seeds of poor quality by reducing their weight gain heavily. Analyses of the hormone production of the thyroid gland indicate that the metabolism is affected negatively. In the period of this experiment definite changes in the organs of the mink kits could not be detected.

In the present situation, where the Danish fur breeders are in search for low-priced alternative raw materials, it is important to spend time and resources to evaluate the quality of these raw materials.

Danish Fur Breeders Association, Technical Year Report 1990. 5 tables, 1 figure, 9 references. pp. 234-241. In DANH. Author's summary.

The protein requirement of mink for optimum body and pelt development.

Carsten Riis Olesen, Tove Nørgaard Clausen.

To determine exactly the actual amino acid requirements of fur animals is difficult, as special requirements are needed for the development of good quality. For hair growth access to sulphurous amino acids is required. If the protein level of the feed is reduced to a level around the physical maintenance level the share of sulphurous amino acids will probably be too low for the optimum development of fur. A supplement of methionine, based on requirement analyses (Glem-Hansen, 1980), may, at a low basic level of protein, permit an acceptable production.

With the ingredients used there have been no health problems when using protein levels down to 20% of the metabolizable energy.

Evidently, the best skin quality is developed in animals receiving up to 40% of the metabolizable energy from protein. However, only when the

protein level falls below 25% of ME we can with statistical significance see a poorer fur quality.

Artificial supplement of sulphurous amino acids seems to have a positive effect on fur quality when very low protein levels are used in the feed. It has, however, not been possible to improve fur quality significantly with supplements based on methionine alone.

The fur quality of the group fed a high level of carbohydrates (35% of the metabolizable energy) was very poor.

The feed used in group 23 (21:61:18 + methionine) and in group 24 (20:45:35 0 methionine) affected the metabolism of the mink to such an extent that changes in the colour and firmness of the liver could be seen. If yellow colour of the livers is judged = fatty degeneration of the liver, a correlation with an increased crude fat content in the livers can be seen. Animals with fatty livers (judged yellow) have higher blood values of the enzyme ALAT than animals with normal livers.

Danish Fur Breeders Association, Technical Year Report 1990. 8 tables, 10 references. pp. 242-255. In DANH. Author's summary.

Endogenous Zinc Excretion in Relation to Various Levels of Dietary Zinc Intake in the Mink (*Mustela vison*).

Heddie Mejborn.

Endogenous zinc excretion was studied in adult male mink fed experimental diets for 73 d, including a collection period from d 69 to 73. Dietary zinc levels were 2.8, 26 or 121 mg/kg wet weight. In accordance with the results of a methodological study, also reported here, the animals had an intramuscular injection of $^{65}ZnCl_2$ 12 d before the start of the collection period. Total fecal (endogenous + unabsorbed) zinc excretion for d 69-83 in the three groups was 2.3, 20.4 and 91.0 mg. The endogenous zinc excretion was 1.3, 2.0 and 6.4 mg, corresponding to 80.8, 10.6 and 6.4% of the zinc intake. Thus, the endogenous excretion was mainly important for the zinc homeostasis at low zinc intake, whereas at high intake the homeostasis was regulated via absorption from the digestive tract. The overall conclusion of the experiment was that mink are comparable to other species (including man) in regard to mechanisms controlling zinc homeostasis.

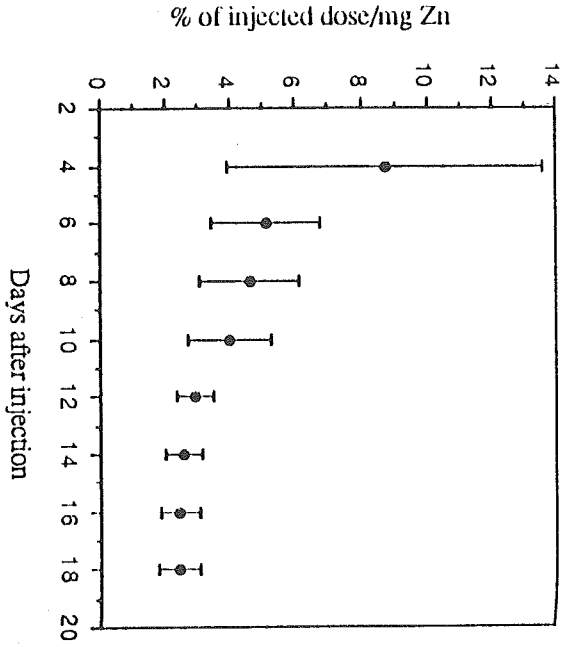


Fig. 1. Specific activity of Zinc (% of injected dose/mg Zn) in tissues from mink at different times after intramuscular $^{65}ZnCl_2$ injection (about 5.55 MBq). Points represent means of 7 tissues (heart, liver, pancreas, kidneys, spleen, proximal small intestine and skeletal muscle) from 3 or 6 animals (8,10 and 12 d after injection = 6 animals, other days = 3 animals). Vertical bars represent SD.

J. Nutr. 120, 862-868, 1990. 1 fig., 4 tables, 18 references. Author's summary.

Vitamin B_{12} level in blood plasma of blue and silver foxes.

R. Raja.

The level of vitamin B_{12} in blood plasma of full-grown (6 months old) blue and foxes was assayed by CPBA. The level of cobalamine was significantly higher in blue foxes than in silver foxes.

Zeszyty Naukowe Akademii Techniczno-Rolniczej w Bydgoszczy, Zootechnika (Poland), No. 153, p. 5-9, 1989. 1 table, 17 references. In POLH. Su ENGL, RUSS. Author's summary.

Activity of digestive enzymes in minks fed on dry pelleted feed.

W. A. Berestov, W. M. Oleinik, N. E. Kulikov.

Two groups of mink cubs were fed from 2 to 4 months old on 2 pelleted feeds with protein 40.5 and 38.6, fat 42.5 and 47.5 and carbohydrates 17 and 13.9%, respectively. Control minks were given a standard diet in paste form. Enzyme activities were estimated in homogenates of the stomach, jejunum and ileum mucosae and of the pancreas. With the first pelleted dry feed, the activities of amylase in jejunum and ileum and of protease in ileum were significantly less than with the standard diet. In the second pelleted feed the activity of pepsin in the stomach mucosa was significantly greater, amylase in the pancreas was significantly lower and in jejunum greater than on control diet. Other differences were not significant.

Doklady Vsesoyuznoi Ordena Lenina i Ordena Trudovogo Krasnogo Znameni Akademii Sel'skokhozyaistvennykh Nauk im V I Lenina, No 9, 41-42, 1988. 2 tables, 5 references. CAB-abstract.

An experiment with feeding mink crucian carp contaminated by mercury.

Zhongxian Zhao.

In the experiment described in the paper, the author fed mink with crucian carp living in water contaminated by a mercury reservoir. The mercury concentration of fish meal was 7.6120 mg per kg. Adult mink survived for 8-9 months and young mink for 4 months if the amount of the fish meal accounted for 70% of the total feed. They behaved normally and poisoning symptoms did not appear until death after one year if the ratio of the fish meal was reduced to 50%. The quality of furs coincided with standard of the first class in the second case. The result received would be profitable to utilization of contaminated aquatic products and elimination of secondary pollution.

Chinese Journal of Zoology (China), No. 4, p. 22-26, In CHIN. CAB-abstract.

New aspects on mink feeding.

R. Romiti, C. Bruscolini.

The trial took place between May and September. One hundred adult mink were divided into four groups according to the diet. The control group was fed the conventional mixed farm diet while the experimental groups received the same feed with frozen cod partially or totally replaced (30, 15, and 6% respectively) by fresh sardine and vitamin B_1 additive.

The evaluation of fur quality was made at slaughter, at the end of November. The results obtained for the experimental groups were as good as those of the controls as regards thickness, brightness and colour purity of fur. The replacement of cod by sardine had no negative effects on the parameters studied, despite the clearly higher thiaminase content of the sardine and was economically more advantageus, significantly riducing feed cost.

Tivista di Coniglicoltura, 26 (12), 77-78, 1989. 2 figs., 2 tables, 9 references. In ITAL. Su ENGL. Authors' summary.

An outbreak of a possible thiamine deficiency in farmed ferrets.

J. Gill.

A recent outbreak of deaths in young ferrets was ascribed to thiamine deficiency. The outbreak occurred on a large Otago commerical ferret farm, produced crippling losses and emphasises the importance of careful attention to the diets fed to ferrets.

No vitamins or mineral mixes had been added. The fish fed was a mixture of 25% red cod and 75% "blue nose" - a species of warehou. The warehou was fed for the first time on 20 December, a week before the first deaths were noted.

The affected kits showed a sudden onset of anorexia, depression, malaise, rapid loss of weight and greasy coats. No nervous signs were seen.

Death followed rapidly, generally 24 hours after the first signs were noted. Whole litters were dead within 3 days of first being affected.

This outbreak was unusual in that at no time were the CNS signs typical of thiamine deficiency seen in affected kits.

Surveillance (Wellington), 16 (4), 16-17, 1989. 1 fig., 1 table, 3 references. Summary (G. Jørgensen).

Influence of two protein levels in the diet on coat traits in Greenland nutria.

R. Cholewa.

The influence of different feeds (2 diets containing 12% or 17% protein without animal protein) on nutria coat quality was investigated in the Institute of Small Animals in Celle (GFR) in the program of Alexander von Humbolt grant. The experimental material consisted of 79 Greenland nutrias of both sexes. They were fed two diets "ad libitum". At the age of 210 days before slaughter their exterior was evaluated. The skins were dried, then measured, weighed, and coat quality estimated. In the laboratory measurements the coat traits were evaluated, namely hair composition, height and diameter of hair, SGM measurements and colour lightness.

The results obtained showed a positive effect of higher protein content in the diet on coat quality. This effect was more marked in males than females.

Roczniki Akademii Rolniczej w Poznaniu - CCXX, 9-16, 1990. 1 fig., 1 table, 2 references. In POLH. Su. ENGL, RUSS. Author's summary.

Indices of meat value of nutria fed a diet with different protein levels.

R. Cholewa.

The author studied the influence of feeding nutria two diets containing different percentages of crude protein (12 or 17%) without animal protein on meat values of the carcasses.

The investigations were carried out in the Institute of Small Animals in Celle (GFR) due to Alexander von Humboldt grant. Greenland nutria, males and females, were reared for 7 months and then weighed and evaluated before and after slaughter. Some parts of the body and some organs were then separated and weighed. It appeared that all dimensions were higher in males than in females. The animals fed rations containing more protein had higher weights. There were less pronounced differences between sexes in weights of the body parts and of organs depending on feeding groups.

Roczniki Akademii Rolniczej w Poznaniu - CCXX, 17-25, 1990. 2 tables, 6 references. In POLH, Su ENGL, RUSS. Author's summary.

Evaluation of the usefulness of some feeders for nutria.

R. Cholewa.

With a view to evaluation of the usefulness of different vessels for feeding nutria, six of them were tested in the Institute of Small Animals in Celle (FRG) within the framework of Alexander von Humbolt research grant. The experiment took place in the Experimental Station in Höfer from 20 April to 9 May 1985. The usefulness of individual feeders was estimated based on charateristic behaviour of the animals. It was found that feed intake was similar from all tested vessels but the amount of wasted feed was different, depending on the kind of feeder. The bipartite troughs appeared to be the best because the loss of complete feed was almost negligible compared to that with other feeders being used.

Rocz. Nauk. Zoot., T. 16. z. 2, 267-272, 1989. 1 fig., 1 table. In POLH, Su. ENGL, GERM, RUSS. Author's summary.

Blood values of silver fox females during the heat, gestation, and nursing periods.

Bente Lyngs, Grethe Møller, Niels Therkildsen.

The investigation was performed in 3 silver fox populations on females from the start of heat until weaning of the kits and is concentrated on the number of white and red blood cells, the size of the latter (mean cell volume) and the content of haemoglobin.

Based on the results of the investigation, the following conclusions have been reached:

- a certain variation between farms was found in the blood parameters included in this investigation. This variation in blood parameters must be expected to exist in silver fox populations in general. As far as some blood parameters are concerned, significant differences between the farms were found in certain periods. However, no systematic effects could be found in the differences.

- the level of the blood parameters at the beginning of heat affects the level of later measurements (until 4-5 weeks after birth),

- from the heat until the gestation period the number of red blood cells, haematokrit and mean cell volume decrease whereas the number of white blood cells increases,

- through the gestation period the number of red blood cells and the blood content of haemoglobin decrease,

- from the gestation period until the nursing period the number of white blood cells decreases,

- in period 3 barren females have a higher content of haemoglobin than females giving birth to kits,

- litter size has a negative correlation to the number of red blood cells and haemoglobin at the end of the gestation period and 4-5 weeks into the nursing period as well as to haematokrit in the latter period,

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- correlation between litter size and the number of white blood cells is negative in the heat period but positive at the first sampling in the gestation period.

Danish Fur Breeders Association, Technical Year Report 1990. 5 tables, 2 references. pp. 166-175. In DANH. Author's summary.

The effect of a prostaglandin analogous product or surgical removal of the ovaries of pregnant mink females.

Tove Nørgaard Clausen.

Surgical removal of the ovaries of 5 pregnant mink females resulted in a miscarriage in all 5 cases. A corresponding control group of 4 pregnant females, which had their abdominal cavity opened without removal of the ovaries, all gave birth normally.

Before and after surgery blood samples from all females were analyzed for progesteron. Removal of the ovaries resulted in a very fast and very large decrease in the concentration of progesteron in plasma. The ovaries of mink females must be regarded as the main organs for the production of progesteron.

3-5 treatments with a prostaglandin analogous product (Estrumat R. Vet) on 9 females from the middle to the end of the gestation period did not disturb the gestation. Progesteron measurements from 15/3 until 26/4 showed a clear cervix around April 1 followed by a decrease which was intensified strongly from 5-6 days before birth. The results indicate that treatment with a prostaglandin analogous product prevented a further increase in the progesteron concentration. In the given quantity the prostaglandin analogous cloprostenol therefore seems to have a certain luteolytic effect on the pregnant mink females. However, not sufficient to reduce the concentration of progesteron in the blood strongly and/or to cause a miscarriage.

In mink the ovaries must - in the entire gestation period - be considered essential to the normal

in alteration of gestation in mink; i.e. the prevention of prolactin secretion. Hyperprolactinaemia may inhibit embryo development in this species.

J. Reprod. Fert, 89, 423-429, 1990. 3 figs., 25 references. Authors' summary.

Dynamics of some biochemical indices in the blood of silver foxes before the onset of sexual activity.

J. Rafay, V. Parkanyi, I. Jakubicka.

Concentration of total proteins, total lipids, cholesterol, glucose, and activity of CK (E.C. 2.7.3.2), AST (E.C. 2.6.1.2), ALT (E.C. 2.6.1.2), GTP (E.C. 2.3.2.1), LD (E.C. 1.1.1.2.) was studied during three months preceding the onset of sexual activity in the blood of silver foxes (November, December, January). In most cases, highly significant differences were found in arithmetic means of blood plasma and biochemical components. A nonsignificant difference between sampling was observed in ALT.

Polnohospodárstvo 35 (11), 1023-1028, 1989. 3 tables, 10 references. Authors' summary.

Effects of multiple mating, multiple sire mating sequence on conception percentage and 24-hour litter size for three colors of farmed mink.

Robert L. Park, Dale O. Richards, Graham J. Carron.

Many mink ranchers use multiple matings, multiple sires unique mating sequences in an attempt to maximize litter size per female. The objective of this study was to compare 30 different breeding strategies involving these practices. Over 11,000 edited records collected during a four-year period, 1985 to 1988, representing three-colors, 5318 Blacks(B), 4491 Minnesota Wilds(MW) and 1233 Blue Iris(BI), were analyzed and compared as to conception percentages and 24-hours litter size. Breeding strategies compared included all combinations up to four matings and/or four sires per litter. Mating sequence patterns included day mating and eight days between matings.

Differences among colors for conception percentages, B(93.3), MW(94.9), and BI(85.5), litter size per conceived female, B(5.4), MW(6.3) and BI(5.6) and litter size female, B(5.1), MW(5.9) and BI(4.8) were all significantly different (P<.01). Colors differed in conception percentages for one, two, three and four matings; B(72, 90, 96 and 95), MW(81, 92, 96 and 97) and BI(49, 71, 88 and 93). Number of matings did not affect litter size per conceived female for one, two, three and four matings (5.9, 5.9, 5.8 and 5.7) but did significantly (P<.05) affect per mated litter size (4.9, 5.2, 5.5 and 5.5). No significant differences were found using multiple sires versus a single sire when number of matings were equal. Mating females two times eight days apart versus consecutive increased conception percentage; 91.5, 83.9 (P<.05).

The practice of using more than two matings to increase 24-hour litter size per mated female is not routinely recommended for two of the three colors. Multiple versus single sire use to increase fertility is not necessary. Management practices which mate females twice at eight day intervals is preferred to consecutive day mating.

Proceedings, Western Section, American Society of Animal Science vol. 40, 27-30, 1989. 4 tables, 6 references. Authors' summary.

Number and activity of nipples in year-old females of Arctic fox and their effect on rearing performance.

Andrzej Frindt, Maria Bednarz, Marian Brzozowski, Tadeusz Kaleta, Roman Jaroszuk.

The number and activity of nipples of 152 females were analysed together with the number of cubs born and weaned. The correlation coefficients between the number of active nipples and rearing performance were low but significant statistically. There is evidence that the total number of nipples in Arctic fox females can be included in the selection index.

Annals of Warsaw Agricultural University - SGGW-AR Animal Science, No. 24, 41-44, 1989. 4 tables, 7 references. Authors' summary.

A survey on perinatal mortality in young mink.

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

The incidence of perinatal mortality in mink was

investigated in commercial farms in Argentina. Of a total of 2122 kits, 548 of those that were born alive died within the first four weeks of life (25.8% mortality) and there were also 62 stillborn kits. Death resulted from a variety of causes of which septicaemia, starvation and hypothermia were the most common conditions. The highest mortality occurred within the first day of life (61.9%). The lesions found in young kits at post-mortem examination are described and related to contributory factors such as weight, litter size and age at death.

Veterinary Research Communications, 14 (3), 199-205, 1989. 3 tables, 12 references. Authors' summary.

A survey on the reproductive statistics of silver fox raised in Korea.

K.D. Seo, K. Kwon, K.Y. Han, S.K. Kim.

The silver fox, a seasonal breeder of great economic importance, has a low reproductive efficiency in Korea. This study was carried out to obtain basic data about the reproductive physiology of silver fox raised in Korea.

A total of 135 litters in 1987, of which 83 were raised at Taekwanryung (N: 38,5°, E: 128.8°) and 52 at Yangsan (N: 35.5°, E: 129.0°), were used for this study. The vixens' breeding started on January 27 and continued until March 25. The mode and mean was March 5 with a standard deviation of 18 days for vixens raised at Taekwanryung, while the breeding of vixens raised at Yangsan began February 16 with a standard deviation of 11 days. The mean date for mating of yearlings was about a fortnight later than that of vixens of age two and more which were all raised in two areas. The linear model was used to measure the effect of raising region, parity and the date of mating on litter size.

The mean litter size was 4.78±0.14 kits. The difference in litter size among the 2 raising areas, 2 parrities and 4 dates of mating was not significant. However, the vixens raised in the southern area, having the first parity and mating between March 1 and March 15, had more kits per litter than in the other area, the 2nd parity and the other dates of mating.

Korean Journal of Animal Sciences (Korea R.), v. 31 (5), 281-283, 1989. 3 tables, 7 references. In ENGL. Su KORA. Authors' abstract.

Possible windborne transmission of plasmacytosis vira.

Mariann Chriél.

It has been known that plasmacytosis can be spread between farms especially if they are lying close together. In such cases it has been maintained that the cause has been windborne transmission of vira.

In this investigation the location of 4477 farms was marked on a map and their distance from the neighbouring farms was recorded. On the basis of the distance, neighbouring farms were divided into three groups: distance 0-500 meters, 500-1000 meters, and 1000-2000 meters, and based on the direction of location in four categories: North, east, south and west, which gives 12 classes altogether. In each class the total number of neighbouring animals plus the number of positive test results were used as a parameter for infection risk. In areas with colonies it is possible to have as many as 20 neighbouring farms within a radius of 2000 meters.

With the material available it has not been possible to prove statistically the windborne transmission of plasmacytosis vira. It may be because the material is too small but this is not likely as 4477 farms are included.

On the other hand a strongly significant effect of having neighbouring farms and plasmacytosis positive breeding animals on neighbouring farms was seen. This effect may be due to an indirect transmission of vira with the wild fauna.

Danish Fur Breeders Association, Technical Year Report 1990. 2 tables, 3 figures. pp. 337-340. In DANH. Author's summary.

Detection of Coronavirus-like Particles from Mink with Epizootic Catarrhal Gastroenteritis.

J.R.Gorham, J.F. Evermann, A. Ward, R. Pearson, D. Shen, G.R. Hartsough, C. Leathers.

Coronavirus-like particles have been detected by electron microscopy in fecal samples from naturally occurring cases of epizootic catarrhal gastroenteritis (ECG) of mink. Preliminary transmission trials with bacteria-free filtrates from mink with ECG suggested that a coronavirus plays a role in the disease syndrome.

Can J Vet Res, 54, 383-384, 1990. 1 fig., 12 references. Authors' abstract.

Pathogenicity of *Campylobacter jejuni* in Intraperitoneally or Intravenously Inoculated Ferrets.

Judith A. Bell, Dean D. Manning.

Ferret kits inoculated intravenously (IV) with *Campylobacter jejuni* after pretreatment with parenteral iron developed more severe systemic signs and more prolonged bacteremia than untreated inoculated controls. Watery diarrhea began in both groups 2-16 h after inoculation and lasted less than 48 h. *C. jejuni* was cultured from rectal swabs 2-8 h after inoculation, and gut colonization persisted up to 15 days, suggesting that colonization does not necessarily induce diarrhea. Gut colonization occurred as rapidly after IV inoculation of ferrets in which the common bile duct had been ligated as it did in unligated controls. *C. jejuni* apparently reached the intestinal lumen by mucosal invasion from the bloodsteam. Bacteremia following natural infection could thus result in repeated passages of *C. jejuni* across the gut wall, exposing the mucosa to both the bacterial cells and their metabolic products. Histological evidence of an inflammatory response in the mucosa, without severe epithelial damage, suggests a toxin-mediated secretory diarrhea.

Current Microbiology, Vol. 21, 47-51, 1900. 2 tables, 20 references. Authors' summary.

Spongy Degeneration of White Matter in the Central Nervous System of Silver Foxes (*Vulpes vulpes*).

G. Hagen, I. Bjerkås.

A disorder of central nervous white matter in Norwegian-bred silver foxes is described from the case histories of 21 clinically affected foxes. The main sign of this disorder was caudal limb ataxia, which appeared between 2½ and 4 months of age and progressed over the next 4-8 weeks. Only four affected foxes were allowed to live beyound this period, but they showed moderate to marked improvement.

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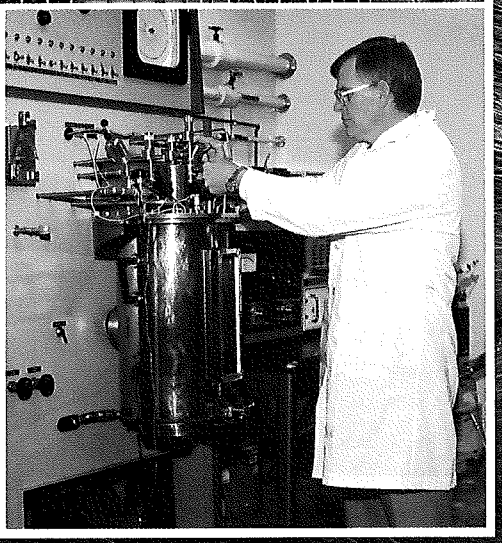

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Light microscopic examination of specimens from 16 affected foxes necropsied between 3½ and 6½ months of age revealed lesions that were restricted to the white matter of the brain and spinal cord. The lesions were characterized by a symmetrical spongy change with vacuoles of varying sizes and included significant myelin deficiency. There was a relative preservation of axons and nerve cells and no significant inflammation or vascular reaction. An astrocytic hypertrophy was usually associated with the spongy change.

Ultrastructural examination of central nervous tissue from two, perfusion-fixed, 6-month-old foxes showed intramyelin vacuoles resulting from splitting of the myelin lamellae at the intraperiod line and was interpreted as indicating myelin edema. Expanded extracellular spaces and watery astrocytic processes also contributed to the vacuolar appearance. Astrocytic processes in affected areas were hypertrophic and contained abundant filaments.

Although the 16 silver foxes had severe clinical signs, their lesions had features in common with the juvenile form of Canavan's disease in children and a spongy degeneration reported in Labrador Retrievers; however, the clinical course in the foxes was not uniformly progressive.

Vet. Pathol. 27, 187-193, 1990. 8 figs., 24 references. Authors' summary.

Fibrosis of the pancreas in American mink.

R. Sabocanec.

Chronic inflammation or fibrosis of the pancreas with parenchymal atrophy in American mink has not as yet been found in Yugoslavia, nor have any data on pancreas disorders in this kind of animal been found in the available literature. A comprehensive follow-up of the health condition of American mink allows the detection of some diseases that as such in wild animals are either unknown or unpublished. The author's own observations point to the nutritive agent as the etiological factor in the development of acute pancreatitis and subsequent chronic atrophic pancreatitis and fibrosis of the pancreas in American mink.

Vet. Stanica, 21 (2), 149-152, 1990. 1 fig., 11 references. In SRCR, Su. ENGL. Author's summary.

Aleutian Disease Parvovirus Infection of Mink and Ferrets Elicits an Antibody Response to a Second Nonstructural Viral Protein.

David D. Porter, Helen G. Porter, Austin E. Larsen.

A second nonstructural protein of the Aleutian disease parvovirus was predicted from nucleotide sequence analysis and a detailed transcription map. Western immunoblotting analysis showed that infected mink and ferrets show an antibody response to this predicted protein.

Journal of Virology, Vol. 64 (4), 1859-1860, 1990. 1 fig., 18 references. Authors' summary.

Nucleotide Sequence of the 5'-Terminal Palindrome of Aleutian Mink Disease Parvovirus and Construction of an Infectious Molecular Clone.

Marshall E. Bloom, Søren Alexandersen, Claude F. Garon, Shiro Mori, Wu Wei, Sylvia Perryman, James B. Wolfinbarger.

The 5'-terminal palindrome of the ADV-G strain of Aleutian mink disease parvovirus (ADV) was molecularly cloned and sequenced. A full-length molecular clone of ADV-G, denoted pXVB, was then constructed. When this clone was transfected into cell cultures, infectious ADV could be rescued. Virus derived from pXVB was nonpathoge nic in adult mink, as is the parent ADV-G strain.

Journal of Virology, Vol. 64 (7), 3551-3556, 1990. 5 figs., 2 tables, 35 references. Authors' summary.

Mechanisms Contributing to the Virus Persistence in Aleutian Disease.

O.-R. Kaaden, E. Bartel, L. Haas, D. Kierek-Jaczszuk, M. Löchelt, F. Müller, R. Neth, S. Roth, B. Stolze, S. van Dawen, G. Voss, K. Willwand.

In this review published results and further studies concerning the persistence of Aleutian disease virus (ADV) isolate SL3 are presented. By Southern blot and in situ hybridization with strand-specific RNA probes focal replication of ADV-DNA was demonstrated in spleen, mesenteric lymph nodes, sporadically in mononuclear cells of the peripheral blood and bone marrow cells.

These findings further support the concept of the lymphotropism of ADV.

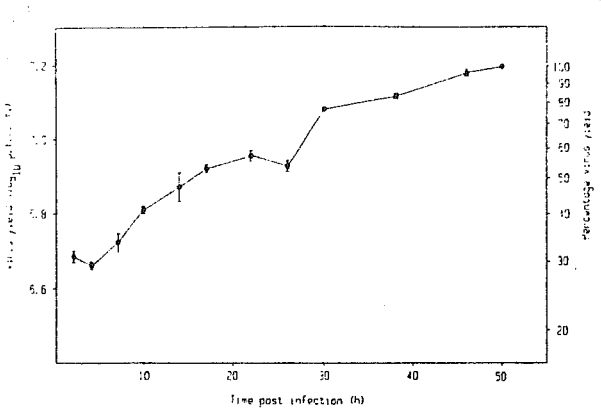


Fig. 2. Effect of temperature shifts from 32 to 37°C on the production of infectious virus in ADV-infected clone 81 cells. Cultures were shifted at the indicated times and maintained at 37°C until 50 h post infection. Virus yields were determinated by FFA at 32°C. Bars represent the standard deviation calculated from the measurement of duplicate samples.

All cell culture-adapted ADV strains appear to have a ts-defect. Our in vitro studies indicate that the ADV isolate G(orham) induced the synthesis of comparable amounts of viral replicative DNA and viral proteins VP1 and VP2 at 37°C. However, the viral progeny DNA synthesis was about threefold less at 37°C compared to the permissive temperature of 32°C. These findings suggest that the reduced level of viral progeny DNA at 37°C accounts for the reduced production of infectious ADV. Finally, we provided experimental evidence that the apparent lack of neutralizing antibodies in AD is due to the masking of critical viral epitopes by cellular phospholipids.

Dtsch. tierärztl. Wschr 97, Heft 2, 96-99, 1990. 3 figs., 1 table, 17 references. Authors' summary.

Aleutian disease of mink: The role of endogenous deoxyribonuclease as a possible factor of virus control.

G.A. Kovalenko, N.A. Popova, D.K. Tsertsvadze, R.I. Salganik.

The deoxyribonuclease (DNAse) activity in the blood serum of minks infected with Aleutian disease virus (ADV) was studied.

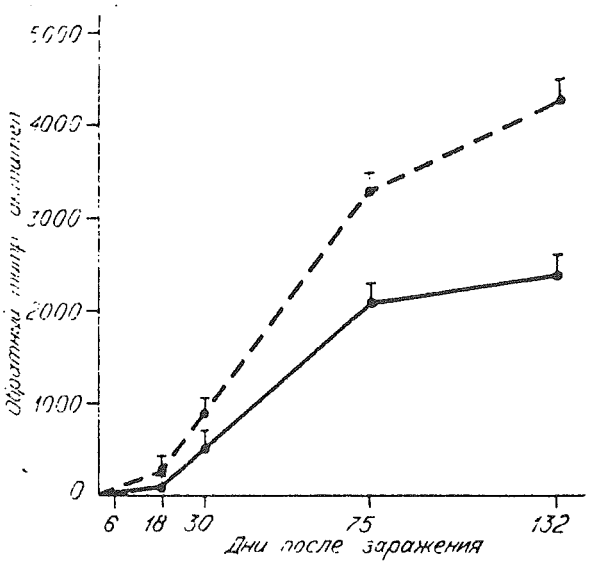


Рис. 1. Динамика нарастания титра противовирусных антител у норок стандартной и сапфировой окрасок после заражения вирусом алеутской болезни.

Здесь и на рис. 2, 3 сплошная линия — норки стандартной окраски, штриховая — норки сапфировой окраски.

It was found that in the blood serum of disease-resistant standard minks surviving the infection, a sharp and long-lasting increase in the blood serum DNAse activity occurs, while in the ADV-sensitive sapphire minks, most of which die after infection, there is only a low and short lasting increase in the DNAse activity. At the same time, the titer of the anti-ADV antibodies after infection was higher in the blood serum of the ADV-sensitive sapphire minks, than in the ADV-resistant standard ones. It is suggested that the increase in the DNAse activity but not the level of the anti-ADV antibodies is responsible for the resistance to ADV.

Izvestiya Sibirskogo otd-niya AN SSSR. Seriya Biologicheskikh nauk (USSR), No. 2, 107-112, 1989. 3 figs., 24 references. In RUSS, Su. ENGL. Authors' summary.

Close relationship between mink influenza (H10N4) and concomitantly circulating avian influenza viruses.

M. Berg, Lena Englund, Izzeldin A. Abusugra, B. Klingeborn, T. Linné.

Strains of an influenza H10N4 virus have been isolated during an outbreak of a respiratory di

sease in mink on the south-east coast of Sweden. This was the first example of a disease in mammals caused by the H10 subtype. We compared the A/mink/Sweden/84 strain with two recent avian H10N4 isolates, one from fowl and another from a mallard, both isolated in Great Britain in 1985 as well as the prototype A/chicken/Germany/N/49 (H10N7). The comparison was carried out by genomic analysis of the strains by oligonucleotide fingerprinting and in bioassys on mink. The oligonucleotide fingerprint analysis revealed a high degree of genomic homology of around 98% between the viruses from mink, mallard and fowl. Only the recent avian isolates, that from the mallard and fowl could infect mink by contact, causing similar pathological and clinical signs and inducing seroconversion as did the mink virus. However, the susceptibility of mink to the fowl and mallard viruses by contact was less pronounced than that to the mink virus. Both the genomic homology and the similarities from the infectivity and pathogenicity studies between the mink virus and the recent avian isolates point to a direct invasion of the mink population by an avian H10N4 virus.

Arch Virol 113, 61-71, 1990. 2 figs., 7 tables, 19 references. Authors' summary.

Is the cardiopulmonary insufficiency syndrome of foxes a distemper virus infection?

J. Jasso.

A cardiopulmonary insufficiency syndrome, characterized by cough, dyspnoea, a haemorrhagic foamy discharge from the nostrils, depression and death, with lung and heart lesions, has occurred on fox farms in Czechoslovakia since 1985. It has mainly affected young silver foxes of 35 or more days of age, but also arctic foxes, with morbidities of 50 and 5%, respectively, and mortalities of 25-30%. Two outbreaks are described. The disease has not occurred in foxes vaccinated against canine distemper.

Veterinarstvi, 40 (1), 34-35, 1990. In CZEC. CAB-abstract.

Haematological and immunologic indices in blue foxes infected naturally with distemper virus.

Wieslaw Deptula, Jerzy Gorski.

The statistically significant increase in number of leucocytes, the phagocytic index and an ability to reduce nitrotetrazole blue were shown in blue foxes infected naturally with distemper virus. On the other hand, the indices of the humoral immunity, i.e. G, M, and A immunoglobulin concentrations and total serum globulin content were lower than those determined in healthy animals. Number of erythrocytes and total protein content in the sera of healthy and sick foxes did not differ from normal values.

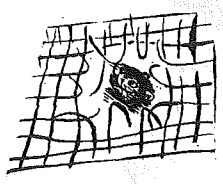
Bull. vet. Inst. Pulawy, Vol. 30-31, No. 1-4, 17-20, 1987-88. 1 table, 24 references. Authors' summary.

Lack of detectable blood groups in domestic ferrets: Implications for transfusion.

Dean D. Manning, Judith A Bell.

Evidence of blood groups in domestic ferrets was sought by testing serum samples for naturally acquired or experimentally induced erythrocyte antibodies. All sera were tested for ability to cause direct agglutination, antiglobulin-enhanced (Coombs test) agglutination, or lysis.

Examination of 212 randomly paired combinations of ferret serum and erythrocytes produced no evidence of naturally acquired blood group antibodies. Six pairs of ferrets were reciprocally transfused twice, 34 days apart, with 6-ml quantities of anticoagulated blood. All were tested 21 days after the first transfusion, as well as 10 and 30 days after the second transfusion; erythrocyte antibodies were not detected. Four additional pairs of ferrets were reciprocally inoculated SC with a series of six 1.25-ml quantities of blood in Alsever solution, administered over a 3-week period, and tested 8 days after the last injection; again, erythrocyte antibodies could not be detected.



These observations suggest that blood groups of the kind in human beings and other mammals either do not exist in domestic ferrets or represent antigen systems too weak to elicit measurable responses under the reported conditions. It appears, therefore, that transfusion in this species poses little clinical risk, even without cross-matching.

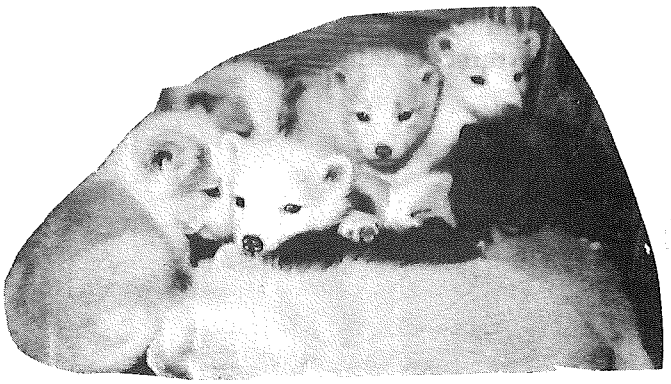
JAVMA, Vol. 197, No. 1, 84-86, 1990. 1 fig., 1 table, 6 references. Authors' summary.

Klebsiella pneumoniae infection in chinchillas.

M. Bartoszcze, J. Matras, S. Palec, J. Roszkowski, E. Wystrup.

An outbreak of acute disease which affected breeding chinchillas during August and September is reported. Affected animals displayed loss of appetite, depression, respiratory distress and diarrhoea; death occurred 5 days after the onset of clinical signs. PM examination revealed congestion and consolidation of the lungs, hydrothorax, enlargement of the heart, gastroenteritis and subcapsular petechial haemorrhages on the kidneys. Histologically, the lungs showed congestion of alveolar capillaries, distension of veins and alveoli filled with serous cellular exudate. There was congestion and extravasations in the kidney medulla and tubular necrosis. K. pneumoniea was isolated from visceral organs. The isolates were pathogenic for guinea pigs. The chinchillas with clinical signs were treated with gentamycin; about half the treated animals recovered. Apparently healthy animals were immunised twice, with a 5 day interval, using a vaccine prepared from formalin or heat-killed culture of the isolated strain. The disease subsequently disappeared from the flock.

Veterinary Record, 127 (5), 119, 1990. CAB-abstract.



Therapeutic value of immunostimulation with Propionibacterium acnes in the treatment of listeriosis in chinchilla.

A.J. Furowicz, D. Broda, P. Loczewski, D. Czernomysy-Furowicz.

The investigations were performed on 72 chinchilla suffering from various forms of listeriosis.

The disease was caused by Listeria monocytogenes type 4. Within two weeks 54.2% of the animals died. The animals were treated with antibiotics i.e. with penicillin or erythromycin, later with oxytetracycline and at last with gentamycin or tobramycin. Two weeks after the beginning of the therapy all chinchilla were given a formalinized preparation of Propionibacterium acnes CN5936 (20 x 10^8 cells/ml) subcutaneously. It was found that the antibiotics administered did not give a considerable clinical effect. On the contrary P.acnes proved to be a good immunostimulant: the signs of the disease disappeared within 1-2 weeks after its administration.

Medycyna Weterynaryjna, 45 (5), 289-291. 1 table, 17 references. In POLH, Su. RUSS, ENGL. Authors' summary.

Epidemiology of coccidiosis in nutria.

P. Zourliiski.

The article offers the results of epitozoological studies on the coccidiosis in nutria. It is found that invasion in nutria depends on the following:

- Season values being 62% in summer, 55.1% in autumn, 31.1% in spring, and 7.5% in winter.

- Age: the maximum is up to three months - 56.9%, up to six months - 31.7%, up to one month - 26.5%, and over six months - 18.8%.

Veterinarna Sbirka, 86 (5), 44-45, 1988. 3 tables. Author's summary.

Pasteurellosis in nutria: epidemiology, treatment and prophylaxis.

R.A. Kadymov, E.M. Agaeva, M.A. Kurbanova, N.M. Kulibekova.

Pasteurellosis of nutrias has occurred in the form of enzootia, more frequently in spring, striking mostly young animals aged from 2-8 months. The disease appears in superacute, acute and chronic forms.

Pasteurella received from pathological material of pasteurellosis dead nutrias did not vary from pasteurellosis agents of other animals on the general biological properties. They concern, in general, A and B serovars. Therefore, in making a vaccine against pasteurellosis of nutrias, it is desirable to include these serovars in the vaccine.

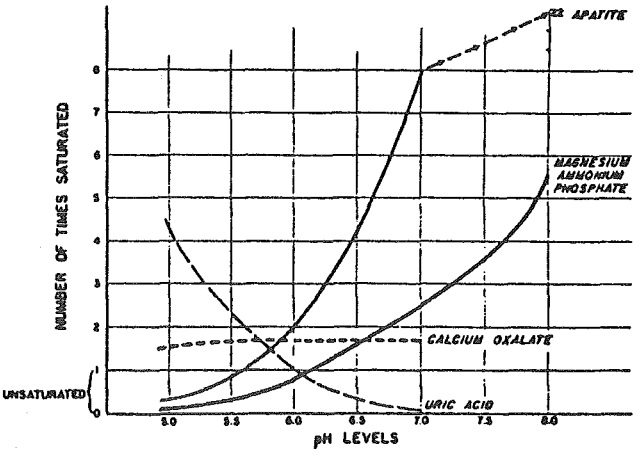
Antipasteurellosis serum, used in association with bicillin-3, has a high medical effect on pasteurellosis of nutrias.

Veterinariya (Moskva), No. 5, 34-36, 1990. In RUSS, Su. ENGL. Authors' summary.

Infections of the urinary tract in ranch-bred mink: inflammatory changes, bacterial colonization and therapeutic approaches.

G. Luehrs.

1) Infections of the urinary tract are frequently causes of death in adult and young mink.
2) In young mink only males die at the age of 8-16 weeks. Females die only after birth. Adult males fall ill, too.
3) In young animals infections of the urinary tract occur as haemorrhagic-purulent cystitis with gravel while chronic cystitis with bladder stones is found in adult females.
4) Uroliths are composed of magnesium-ammoniumphosphatehexahydrate and calciumphosphate.
5) Urea-splitting staphylococcus intermedius is isolated from inflamed bladders, straw of cages before mating and in the time of breeding, and the upper respiratory tract, throat and prepuce of healthy mink. Urea-splitting changes the normal acid urine pH into the alkaline level. Thereby stones of magnesiumammoniumphosphatehexahydrate and calciumphosphate can develop in the urinary tract.
6) In mink, diseases of the urinary tract develop from ascending infections.
7) There is no connection between infections of the urinary tract and Aleutian disease.
8) The quantity of calcium in the water has no influence on formation of uroliths.
9) Improvement of hygiene is a very important factor for prevention of such a disease. This can be completed by an antibiotic treatment, which has to begin in May.



(Nach PRIEN 1955)

Review article (Thesis): Tierärzliche Hochschule Hannover (Germany, F.R.), Universitätsbibliothek, 107 pp, 81 references. In GERM, Su. GERM, ENGL.

3. INTERNATIONAL SYMPOSIUM ON FUR ANIMALS

(3. Internationales Pelztiersymposium, Leipzig, 4-5 April 1990)

PROCEEDINGS

Publisher: Sektion Tierproduktion und Veterinär medizin der Karl-Marx-Universität Leipzig, Johannisallee 21, Germany.

Editors: Prof. Dr. sc. H. Pingel and Doz. Dr. sc. H. Hattenhauer, DAI Monika Stübs.

195 pages with total 27 reports, 22 in German and 5 in English.

On the following pages we have the pleasure of presenting abstracts of the reports in English.

Actual problems in the breeding and production of mink.

H. Pingel, R. Krieg.

Mink breeding has a certain future if the productivity of mink in reproduction and fur quality increases by breeding methods. Under consideration of animal protection the production must become more ecological and more efficient. An effective selection involves registerting the fertility, viability, body mean and fur quality. A lower remounting rate and in this way a higher selection difference directly affects the breeding success. The elite breeders are selected intensively (25%). The other animals of the stock (75%) belong to the reproduction group for pelting.

In GERM, pp 8-16, 2 figs, 2 tables.

A new grading system for live standard mink - results and conclusions.

K. Neumann.

The relations between the quality values of live mink evaluation and mink skins have been determined by a marketing firm. Close relationships exist between evenness and density of guard hairs and the total fur quality, and between skin colour and total quality. The author wishes to enhance in particular the trait "nap". More and central evaluation exercises are necessary because farmers and judgers evaluate in a different manner.

In GERM, pp. 17-22, 2 tables.

Results of mink-farm-checking in the FRG as voluntary self-assessment.

Dr. Scheelje.

The mink farms were checked in 1988 and 1989. The results from 1989 were statistically analysed. According to a checklist the traits were scored from 1 - 5. Correlations were found between total assessment scores and "farm size", "farm ground", "sheds", "boxes" and "education" of the farmers.

In GERM, pp. 23-43, 6 figs., 10 tables.

A crossbreeding program in mink breeding.

E. Børsting.

A commercial hybrid program for a Danish mink farm with about 4000 female breeders is set up with one male line and two female lines. Pure line breeding includes 18 percent of all female breeders, grandparents 26 percent, and parent breeders 56 percent of the breeders. The program can utilize heterosis and the breeding programs can be seperated in male and female line programs.

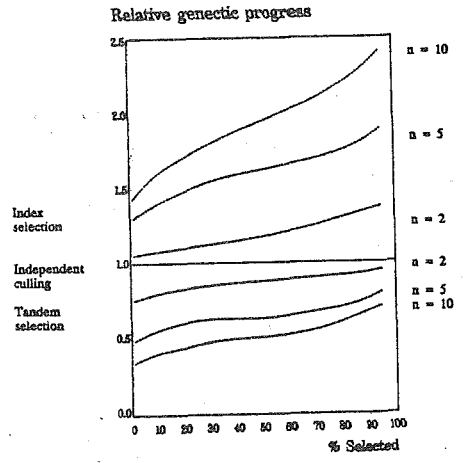
In ENGL, pp 44-49, 1 fig, 1 table.

The use of personal computers in mink breeding.

J. Clausen.

During the 3 years the system has been in use, we have succeeded in producing a breeding program for use by the individual breeder on his own PC. The best proof that the program is user friendly is the fact that only 1 man is employed in supporting the approx 350,000 breeding animals and 400 farms that are today using the program. In addition we have started to receive very positive feedbacks from the breeders who have now used the program for three years. Both immediately and from the annual statistics from Danish Fur Sales, the breeders can see the effect of the higher efficiency of the breeding work. Furthermore there is a breeder who started as a mink breeder three years ago, who worked himself up on the list of the best Danish breeders by means of Dan-Mink in just those three years.

Fig. 1. Relative comparison of 3 selection methods, when the traits are uncorrelated and of equal importance. Independent culling is valued as 1.



In ENGL, pp 50-54, 3 figs, 5 references.

Influence of litter size on hair characteristics of blue fox females.

R. Cholewa.

Backhairs were taken from 48 four year-old fox females. Relations were found between the litter size and the fur quality. Blue fox females with greater littter size had lower fur quality.

In GERM, pp. 55-58, 2 tables.

The body weight of young foxes and the quality of winter skin.

R. Cholewa.

230 blue foxes born from 26.4 to 13.5. were weighed at their 2nd and 3rd live months of age. After pelting the pelts were graded. There exists a relation between 3 month body weight, the weight gain (2nd to 3rd month) and the pelt size. No important relations have been found between body weight at 2nd and 3rd months of age and fur quality.

In GERM, pp. 59-63, 1 table.

Factors influencing reproduction performances of female mink.

H. Hattenhauer.

The speech dealed with factors affecting reproduction performances in mink - particularly factors which could be applied in every mink farm without higher expense. In detail they concern the role of flushing, feeding and some feed restriction methods during the preparation for the mating period. Some flushing methods as well as a feeding programme which restricts the daily feed consumption of females by about 90% of the standard feeding programme are able to increase litter size and gestation rates. In general, the experimental results emphasized the role of mating condition of the female. With regard to the influence of the mating date, gestation duration, whelping date and litter size some mink populations have been analysed. It was found that young females mated 1 + 7 during the first half of March and old females mated 1 + 1 during the second half of March lead to superior reproduction performances, that late mating dates shortened the gestation period and increased the litter size, that litter size and mating dates are always slightly negative correlated, and that the litter size at whelping and litter size at 1. 6. are highly positive correlated.

In GERM, pp 64-74, 10 tables.

Influence of different mating methods on reproduction performance in mink females.

S. Müller.

The following mating models have been compared:

1 + 8 + 1	(young females)
1 + 9 + 1	(young females)
1 + 1 + 8	(young and old females)
1 + 1	(old females)

The number of females mated in the experiment was 1637 and those used as control animals 261. Three times mated females showed no better fertility rate and no larger litter size. Old females mated 1 + 1 showed a good reproduction performance.

In GERM, pp 75-83, 6 tables.

Experiences with mating of mink.

Dr. J. Hartung.

A stepped mating season according to the model 1 + 8 + 1 and a wider mating ratio (1 : 5 - 6) led to higher breeding results and lower mating expenses for the farmers.

In GERM, pp 84-89, 1 fig., 3 tables.

Increased mating ratio in mink with biotechnica.

R. Krieg, H. Hattenhauer.

The experiments concerning problems to improve the breeding progress in mink showed that once mated females supported by a Gn-RH injection close to mating time (1 h after copulation) represents a suitable method to enlarge the mating ratio in mink. Females once mated without Gn-RH injection had a reduced gestation rate and litter size. It was shown that with once mated and Gn-RH treated females 1 male could mate to about 13 females with 64 live whelps per male. This means a distinct enlargement of the mating ratio and selection basis compared to common mating methods.

In GERM, pp 90-98, 4 tables.

Possible use of melatonin in fur animal production.

M. Valtonen.

The results of the present study confirm that the testicular activity and the hormonal changes related to breeding season in silver fox can be induced by exogenous melatonin. The suitable doses for this purpose seem to be 12 to 24 mg. Higher doses may have a negative effect on the animals' health. The suitable timing for melatonin implantation to produce semen in autumn is the two first weeks in July. This advances the breeding season by about two months. However, the great variation between individual males should be considered when planning the practical use of melatonin.

In ENGL, pp 99-106, 3 tables, 14 references.

Experiences in sanitation of plasmacytosis in mink.

Dr. A. Tohtz.

The sanitation was made by a selection principle. 3 times a year the mink were controlled with "agar test". If a positive result was shown, the mink was pelted. The negative reagents must be saved from reinfection by a strict hygienic regime. In 1986 there existed 18.4% minks with plasmacytosis. After three years (1989) the farm had no positive reagents (0.0%).

In GERM, pp 107-109.

Results and experiences in sanitation of plasmacytosis in the farm "Bölkow".

Dipl. Landwirt B. Pischel.

The author describe a way to sanitate plasmacytosis in the farm practically. The pelt production takes place in the farm by steps to meet the hygienic demands more effectively. The so called principle "All in all out" and wet cleaning in the frost free months to make the desinfection effective are accomplished.

In GERM, pp 110-116, 3 tables.

Reasons for female deathsin the peripartal period.

Dr. U.D. Wenzel.

The main reasons for death in the peripartal period are mistakes in breeding and management, morphological reasons, functional reasons and infections.

In GERM, pp 117-119.

Reasons for whelp death in the first 4 days of life.

Dr. U.D. Wenzel.

The main reason for whelp death in the first 4 days of life is the keeping method of the mother. The author proposes whelping boxes with narrow entrance-holes, narrow entrance tubes into the whelping box, whelping charge with plastic wales, and bottoms in the cages.

In GERM, pp 120-125, 1 table.

Problems of flea control in the perinatal period of mink.

Dr. H. Zimmermann.

The first peak in the flea invasion appears in the perinatal period. "Vioxan" powder with 5% carbaryl was used with 22 g per box on the 20th of April. The results showed an embryotoxic effect. The author concluded that the first treatment with "Vioxan" must be carried out in autumn. If the whelps have reached an age where they cannot fall through the mesh then a first treatment with "Vioxan" is indicated.

In GERM, pp 126-129, 2 tables, 4 references.

Trichophytis in nutria and possibities of therapy.

Yassin Alyssino.

Trichophytis gives lower prices for pelts and the danger for anthropozoono to the farmers. That's why prophylaxis and therapy are of big importance! In two farms the vaccine "Mentavak" from SU was tried in 1987 and 1988. Farm A has 15000 standard animals kept on bottoms and in cages while whelping. In farm B there were kept 400 - 500 Greenland nutrias in small families on bottom. The application of "Mentavac" was successful in the smaller farm. A vaccine like "Mentavac" must be developed in the administerting country because the germ is territorially specific. The day of application must be earlier (35 day of hiring). An application before infection is impossible.

In GERM, pp 130-137, 2 tables.

Pathomorphological researches on sexual organs in females pelted after unsuccessful mating.

Dr. U.D. Wenzel.

217 unsuccessfully mated females were examined. After macroscopal research histological preparates were made from one ovary and one cornus uteri. The thickness of uteri varied.

With the help of uterus mucous membrane a hint of an active cycle was given. About 45% of the females lacked an active cycle. An inactive cycle was found in 1/3 of females. The farmers did not observe a successful mating in 26.3% of the females. Only a very small number of females (3.7%) suffered from pathological changes and therefore this fact is unimportant.

In GERM, pp 138-141, 1 table.

Treatment and prophylaxis of hypogalacty in mink.

Prof. Dr. Berestov.

Hypogalacty in the first days of young mink often has a neurogenic origin. From 7th to 21st day of lactation the females were given DL-Tryptophan at 100 mg per animal. The segregation of milk increased hich was controlled by weighing the whelps before and after suckling. The treatment of females with DL-Tryptophan and vitamin B6 also has a positive effect on the growing whelps. The applied preparates were "orap" and "frisedil".

In GERM, pp 142-144.

Prognosis of reproductive activity of males and their use in mink breeding.

T.M. Djemina.

Analysed results showed a realized polygamy of 1:4. The traditional selection of males following body weight at 2nd to 20th day and the quality of testicles at evaluation time must be considered. Using this method the farmer can realise a polygamy result of 1:6. One-time mating using artifical synchronization increases the polygamy result (1:8). The breeding season was shorter (40%) and the number of females per male increased (47%).

In GERM, pp 145-149.

Optimization of physiological state in fur animals as a basis for their increasing productivity.

Dr. N.N. Tyutyunnik.

To optimize the physiological state of mink the breeding and feeding conditions have to become better and detrimental influences in cage keeping have to be diminished. The farmer must use the reproductive functions and methods of biochemical monitoring must be introduced. With the help of "mebicar", stress factors shown as blood serum enzymes became lower. The experiment was made on 300 mink which received 250 mg/kg body weight "mebicar" one day before weaning. The same dosis was given the mink females the ten following days. The treatment had an antistress effect, also when transporting the mink. To stimulate the reproductive system, mating sounds were played for the minks with a power of 60 - 80 decibel for 20 - 25 minutes 20 - 25 days before mating. The reproductive performance in this group was better than in the control group. All diseases in fur animals take place with an increasing of serum transaminase and alcali-phosphatase-activity. The length of increasing or decreasing enzyme activity is important. Enzymatic indices are not useful for evaluating the healthy state of the stock.

In GERM, pp 150-153.

Preliminary studies on the biochemical composition of Polar fox semen obtained by masturbation and elektroejaculation.

O. Szeleszczuk.

An experiment was carried out on 10 young male Polar foxes from which semen was collected according to the following design:

1st day - semen collection by masturbation technique
2nd day - semen collection by EE method

followed by a 4-day interval after which time semen was again collected according to the above design. The plasma protein level in fox semen obtained by masturbation was ave. 127 mg/100 ml and exceeded that in semen obtained by EE method (114 mg/11 ml). No differences were observed in fructose content with respect to the method used. The levels were 146.01 and 149.77 mg/100 ml respectively. The experiments hitherto conducted by the authors have shown a lower GPC level in plasma obtained by masturbation (23.5 mg/100 ml) and a higher one following the EE method (32.3 mg/100 ml). Statistically significant differences with respect to the method of semen collection were observed by authors only in

the activities of saparagine and alanine aminotranspherases. The activities of both enzymes were lower in semn obtained by masturbation technique (1.54 and 3.86 i.u.) and higher ones were obtained by EE method (2.59 and 4.49 i.u.) respectively.

In ENGL, pp 154-160, 4 tables.

The effect of feeding practice on reproduction and fur quality in mink under Danish conditions.

N. Glem-Hansen.

The feeding practice and its influence on reproduction and pelt characteristics has been investigated in several experiments in Denmark and in Sweden also. In this report the experience from these experiments are surveyed for the reproduction and the growth periods separately.
In ENGL, pp 161-164, 1 fig., 2 tables.

The use of sodiumm glutamate in mink feed.

N.A. Balakirew.

The authors analysed the influence of sodiumglutamate on growth, size and quality of pelts, state of amino acids in liver, reproduction performance, morphological and exchange profile of blood and the hormone state of mink. Young animals were fed once a day, breeder females twice a day with sodiumglutamate at a dosis of 50 - 300 mg per animal per day, young breeder animals only 50 - 200 mg/kg body weight. Once a month the young animals were weighed. In every experiment there was analysed the morphological and biochemical state of blood and the hormon state twice. In November the animals were pelted, the pelts and the livers were analysed. As the results show, natriumglutama increases the animal growth and the amino acid state of the liver, length and quality of pelts and did not negatively affect the morphological and exchange profile of blood and the physiological state of the animals. Sodiumglutamate stabilizes the reproduction performance. The number of whelps per female was elevated. 200 mg/animal per day, respectively 100 mg/kg body weight represents an effective dosis for pelters, respectively breeders.

In GERM, pp 165-170, 2 tables.

The influence of antioxidants on mink performance.

E.A. Tinajewa.

The experiment was made with 3 groups each of 42 males. All animals received the basis ration. During the experiment period of 61 days (from 18.07) the animals received 50 mg/mink "diludin" in the first group and 100 mg/mink "ionol" in the second group. The third group served as a control group. The basic feed was mixed with plant oil at a dosis of 100 mg/animal. No significant difference was found in feed intake 95.5 - 96.4%. The body weight was taken once a month. The results show a positive effect of mink performances. An effective dosis of "ionol" is 100 mg/animal and of "diludin" 50 mg/animal to stabilize the feed ration during the summer time and to increase the growth intensity and fur quality.

In GERM, pp 171-176, 2 tables.

Results of "bisergon" treatment on mink (growth, losses in breeding, fur quality).

P. Zunft.

The experiment was started on the 22nd of June with 174 animals as a control group and 182 animals in the experimental group in Thalborn farm.

In Dassau farm the experimental group involved 300 animals and 300 in the control group beginning on the 4th of July. With regard to weight gain and pelt length the experimental animals were superior to the control animals, especially in male minks. The number of animals with wet belly and fur biters was reduced in the experimental group.

In GERM, pp 177-180, 2 tables.

Criteries of species conforme keeping andcarring of fur animals and rabbits for animal protectionally assesment of accomodation and care.

H.Ch. Löliger.

Species specific husbandry of fur animals is reflected the healthy development of young growing animals without complications, by the mainte-

nance of necessary reproduction and growth of the offspring, and by the lack of injury to the animal. The healthy state of the animal is the decisive criterion for the evaluation of a farm whether the animal husbandry methods are species specific. The healthy state of an animal can be estimated by objective methods which were discussed in detail. Moreover the author gave many references in all respects to the assessment of keeping and caring methods with regard to animal protection. The speech was concluded with numerous judgement criterions of the healthy state and possible changes to adverse management methods.

In GERM, pp 181-197, 5 tables.

688 Beretning fra
Statens Husdyrbrugsforsøg
Report from the National Institute of Animal Science, Denmark

Steen H. Møller, Steffen W. Hansen,
Outi Lohi, Asbjørn Brandt, Palle V. Rasmussen
Department of Research in Fur Animals

Lone Vejgaard Jensen
Biotechnical Institute

Production of Mink

The influence of various management, environment and nutritional elements on behaviour, physiology and production in mink

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1. MANAGEMENT AND ENVIRONMENT IN MINK PRODUCTION

by Steen Møller

Summary

In this part of the project "Management and Environment" experiments were conducted concerning light, temperature of drinking water, water supply, visual isolation, scent communication, reaction to repeated weighings, and the correlation between time of birth, litter size, weight development, body length, skin size, and pelt quality.

A method for evaluation of light conditions in mink sheds was developed and tested. This method measures the quantity of light in the shed in relation to the quantity of light outside, and the difference expresses the light reducing effect of the shed. The light reduction is connected with the number of light panels in the roof and the cleanliness of these panels. The method gives the same results under different weather conditions. The method is therefore found to be applicable in practice. The significance of the light reduction is discussed, and it is found that mink can be kept under very dark conditions without any negative consequences as regards production. Negative consequences are more likely to occur when moving animals between varying light conditions or when using artificial light.

The intake of 40°C warm water by mink in comparison to water from the tap has been examined with adult males, with kits, and with pregnant and nursing females. In all cases the warm water was drunk in the same quantities as the cold wa-

ter. If the adult males were offered one temperature at a time, they drank more warm water. If both temperatures were offered at the same time, they drank the same quantities, or in one case more cold water. The mink drank more frequently but less per session of cold water if both temperatures were available. If there was only one temperature at a time, no difference in the intake pattern was seen. In all cases a higher quantity of cold water was spilled, both totally and per drinking session. Mink kits drank equal amounts of warm and cold water, but wasted more cold water. Before giving birth the females preferred warm water, but after birth they drank mostly cold water. The physiological significance of the temperature of drinking water is discussed. It is concluded that mink like to drink water up to 40°C. The waste of water is lowest if the water is warm.

In the latter part of the lactation period a supplement to the ordinary supply of drinking water is often used. A drip watering system was tested throughout two lactation periods, and the weight development, drinking behaviour and activity of the animals were recorded. In the cold and wet lactation period of the first year the system had no effect. In the warm and dry lactation period of the second year, the weight loss of the females was reduced, and the weight gain of the kits was faster in the group with drip watering system. Kits with drip water supply take in water earlier than the control group, by licking water from the tongue of the valve. However, they do not learn to release the valve earlier. Saliva licking occurred most frequently in the group without drip water supply. A difference of approx 2 weeks was observed from the kits start eating and until they start drinking. It is concluded that the opportunity of the kits to take in water early improves with drip watering. In warm and dry lactation periods this will increase gain and reduce the stress on the females.

Previous experiments with visual isolation of mink females in the gestation and lactation periods have indicated a positive effect on the whelping result. The experimental groups have, however, been too small to demonstrate any reliable differences in reproduction results. Therefore, four experiments with visual screening of mink females were carried out. The females were isolated before mating or before whelping. The separation consisted of an empty cage or a cage filled with straw. Whelping results, weight development, and activity were recorded. No systematic differences in whelping results were found that could be related to the screening, and kit gain was not affected. The females in the control group were more active than the separated groups. The whelping results are discussed. They conflict with previous results, but are confirmed by later investigations. It is concluded that visual isolation of mink females does not influence whelping result or kit gain but reduces the activity of the females in the lactation period.

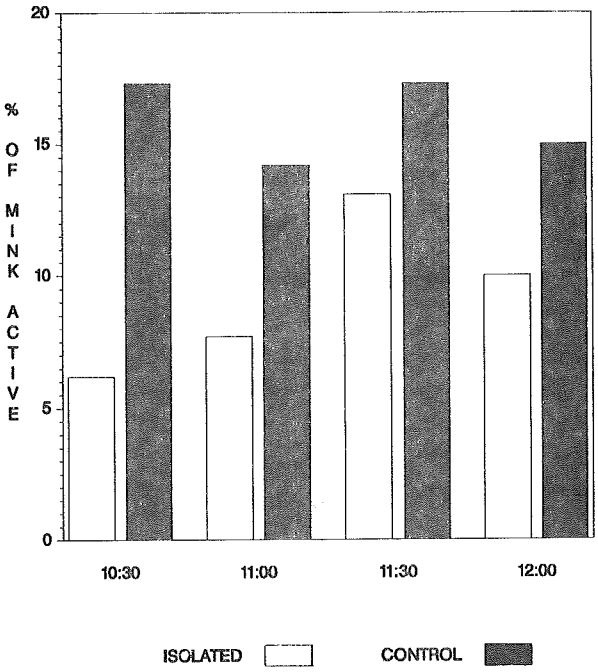


Fig. 1.7. Percentage of mink females active in the cage during the morning in isolated and not isolated cages. Observations from experiment IV the week after birth.

The significance of scent communication between males and females was investigated by spraying male urine on the cages of the females before mating. The period of latency from the time animals are put together until mating starts, was 4 minutes shorter in the group stimulated by scent, but no difference was found in mating success or whelping result. It is concluded that scent stimulation is of no practical importance as regards the way in which males and females are placed before mating.

The reaction of mink kits to repeated weighings was examined by means of a stick test on 17 farms distributed all over Denmark. In general, the weighed animals reacted more timidly than the not-weighed animals. Females reacted in ge-

neral more timidly than males. On a few farms the weighed animals were less timid, which shows that handling can be regarded as a positive experience.

The correlation between weight development, body length, skin size, and pelt quality was examined on scanblack males. Already at the age of 9 days weight is correlated to body length, skin length and weight at pelting. After weaning, the correlations are increasing until pelting. The correlations between size measurements and quality of the skins show that weight is responsible for the decrease in quality, whereas body length plays a secondary role. It is concluded that a long skin from a long mink is of better quality than a long skin from a fat mink. The body length can therefore with advantage be included in the breeding work, instead of body weight.

Body length and weight development were examined in relation to time of birth and litter size. The importance of time of birth decreased quickly and had almost been balanced out in August-September. Litter size was significant for both body length and weight all the time until pelting, and the biggest kits came from litters of 3-7 kits. Kits from large litters do catch up somewhat in size after weaning, whereas kits from small litters have no compensatory gain.

12 figs., 13 tables, 29 references. Author's summary. In ENGL. Scientific report No. 688. Production of mink, pp 13-62. natl. Inst. of Animal Science, Dept. of Fur Animals, P.O.B. 39, DK-8830 Tjele.

2. BEHAVIOUR AND ENVIRONMENT OF MINK

by Steffen W. Hansen

Summary

In the project section behaviour and environment, investigations have been carried out regarding the development, weaning age, cage environment, activity and temperament of mink kits.

The ontogenetic investigations have dated important periods in the development of mink kits. Thereby possible correlations be-tween the development stage of mink kits and the suboptimal adaptation to the production environment have been determined.

Weaning age, varying from 6 to 12 weeks, when the kits are taken away from the female and placed in pairs, male and female, is of no importance to their later reproduction capacity. The examinations of the optimum weaning age have included the welfare of the female as well as of the kits.

Individual parameters regarding the physical cage environment have shown that the nest box is important to the welfare of farmed mink and to the fur quality. A 4-time increase of the cage size area as compared to the conventional cage size did not result in a better welfare.

The installation of water trays for lactating females had no improving effect on the welfare of the females or the kits, neither on the ontogenetic development of the kits. The water trays do, however, probably have an occupational function. It was found that a place of refuge for lactating females reduced the frequency of stereotypic behaviour - a behaviour which is very energy-consuming.

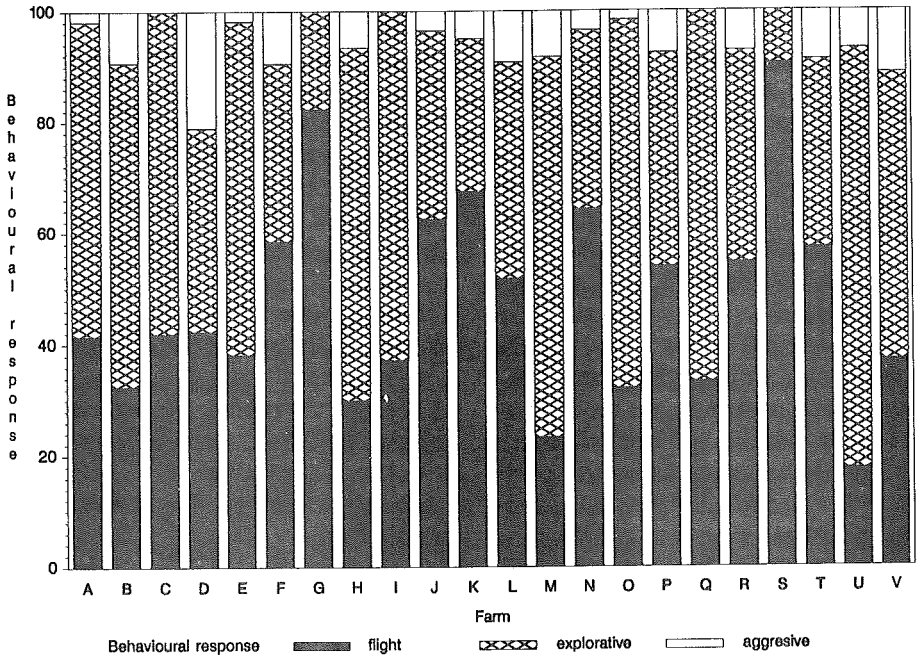


Figure 2.2. Per cent distribution of behavioural response per farm.

The activity pattern of lactating females has been described. As for other periods of the production cycle of farmed mink, also the activity of lactating females to a considerable extent seems to be controlled by the feeding routine.

A simple and fast test (the stick test) of the temperament of mink has been developed. The test is a practical tool for identification of farmed mink with reduced adaptability to the production environment, i.e. animals with a timid temperament.

Behavioural, physiological, haematological and physical-chemical variables are included in this project section for evaluation of the welfare of farmed mink.

2 figs., 10 tables, 27 references. In ENGL. Author's summary. Scientific Report No. 688. Production mink, pp 63-96. Natl. Inst. of Animal Science, Dept. of Fur Animals, P.O.B. 39, DK-8830 Tjele.

3. MINERAL CONTENT OF FEED AND HAIR AND MICROSCOPIC STUDIES ON HAIR.

by Outi Lohi, Palle Vistisen Rasmussen and Lone Vejgaard Jensen

Summary

A special part of this project was to investigate the mineral content of mink hair and its relation to minerals in feed. The pelt material collected for mineral analyses was also used for microscopic studies on hair in order to get a detailed description of variation of hair size and shape and to study possible relationships between mineral content and hair morphology.

The mineral content of mink feed was analysed in weekly samples from five feed kitchens in the period from August 15th until December. The daily fluctuation was studied within two weeks. Feed values were compared with pelt characteristics and with the mineral content in hair of scanblack male pelts from customer farms. Furthermore objective measure of fur weight and morpho-

metric characteristics of guard hairs were compared with the mineral content in hair. There was a clear correlation between the amount of Ca, Mg, Na and Se in feed and in hair.

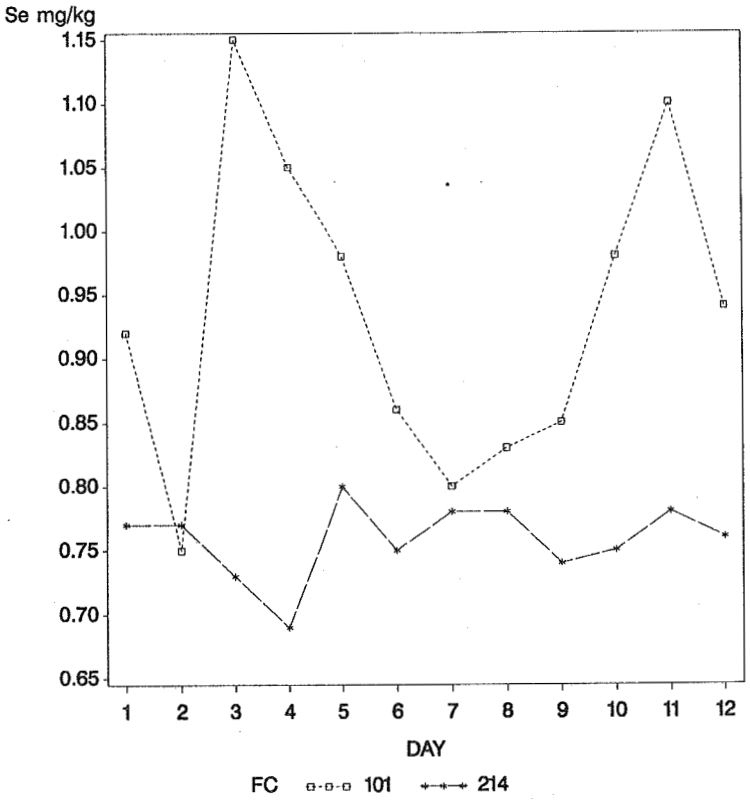


Figure 3.2 **Day to day fluctuation in Se content of feed on two feed kitchens (dry matter basis).**

The levels of Zn, Cu and P in feed were not reflected in the hair. Pelt quality was not related to minerals in feed or hair but hair colour showed significant correlation to the content of Ca, Mg and P in hair. Interactions between minerals play an important role in mineral metabolism and in organ concentrations.

Great variation could be shown in guard hair types on pelts from different farm populations.

Of single minerals only Ca showed correlation to morphometric characters of hair. Hair samples from the hip region expressed more clearly differences in pelt quality than samples from the center of the back.

14 figs., 11 tables, 15 references. In ENGL. Authors' summary. Scientific report No 688. Production of mink, pp 97-130. Natl. Inst. of Animal Science, Dept. of Fur Animals, P.O.B. 39, DK-8830 Tjele.

4. PHYSIOLOGICAL, GENETIC AND ENVIRONMENTAL VARIATIONS IN HAEMATOLOGICAL AND CLINICO-CHEMICAL PARAMETERS IN MINK;

- THEIR APPLICATION IN HEALTH SURVEILLANCE IN MINK POPULATIONS.

by Asbjørn Brandt

Summary

The investigations were divided into 3 areas:

1) Initially a comprehensive study of variance concerning the effect of physiological, genetic and environmental factors on haematological and clinico-chemical variables in mink was done.

Thus reference values were determined for a major part of haematological and clinico-chemical blood parameters in mink. Age variation was shown to be particularly important. Interesting representatives of this were the number of erythrocytes, the mean erythrocyte volume, haemoglobin and haematocrit, mean cell haemoglobin concentration and the plasma activity of alkaline phosphatase.

Heritability of the measured parameters has been analysed provisionally and significant environmental and genetic variations in both haematological and clinico-chemical variables were found. Together with mink production data, further analysis of these data will be performed as an intergral part of a PhD thesis.

Different analytical methods were developed and applied to mink parallel to these analytical investigations. The most significant methods developed were:

a) Plasma protein agarose gel electrophoresis with densitometry/quantification of plasma protein classes (alpha-1-2, betha-1-2 and immunoglobulins).

b) Quantification of lipoproteins (HDL, LDL, VLDL and chylomicrones).

c) Isolation and quantification of creatine-kinase isoenzymes MB and MM).

d) Rocket immunoelectrophoresis and quantification of immunoglobulin A, G and M in plasma and milk.

Plasma and milk immunoglobulin G and A concentrations were found to vary dramatically during the lactation. This was also the case for the concurrent change in the mink kit plasma values and the variation found between litters and farms. The significance of these new findings in neonatal kit disease resistance and mortality was discussed.

2) In the work concerning the applicability of clinical pathology, clinical biochemistry and haematology in health surveillance in mink populations it was demonstrated that haematological and clinico-chemical analyses are of great diagnostic and prognostic value and useful in monitoring the nutritional and disease status in mink populations.

Thus clinical and haematological profiles were suggested for the nutritional myocardial degeneration syndrome and nursing disease.

Certain clinico-pathological parameters were evaluated as disease predictors in mink populations on problem farms and in outbreaks and cases of greasy mink kits (early and late type), nursing disease, cystitis, nephritis, urolithiasis, and sudden death syndromes.

Based on this part of the project a general mink Health/production-Check-Profile (HCP) was suggested. It should include parameters of haematology (erythrocyte and leucocyte indices), enzymology (ASAT, ALAT, alkaline phosphatase and CK) and urology (density, blood and pH).

The general HCP could be applicable in a health surveillance programme for screening a given population for sub-clinical symptoms concerning both environmental/nutritional, hereditary or systemic diseases in mink.

3) In the experimental part of the study significant effects of dietary iron, copper and zinc on haematological and enzymological development, on fur growth and on mineral balance and turnover were demonstrated.

It was suggested that the present investigations should be followed by a statistical analysis of haematological and clinico-chemical blood data together with environmental and pelt data. This should include a test of the predictive value and validity of the proposed mink HCP in a larger scale and evaluated as a service function for the mink farmer.

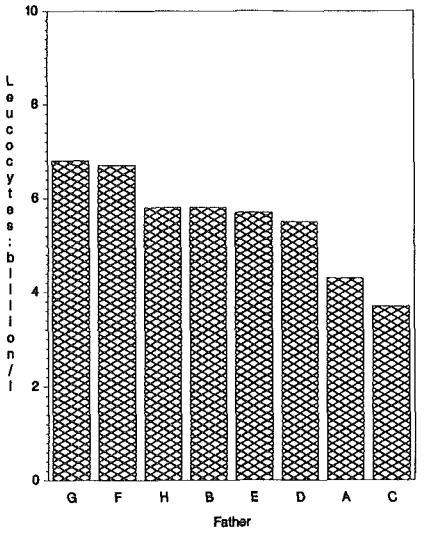
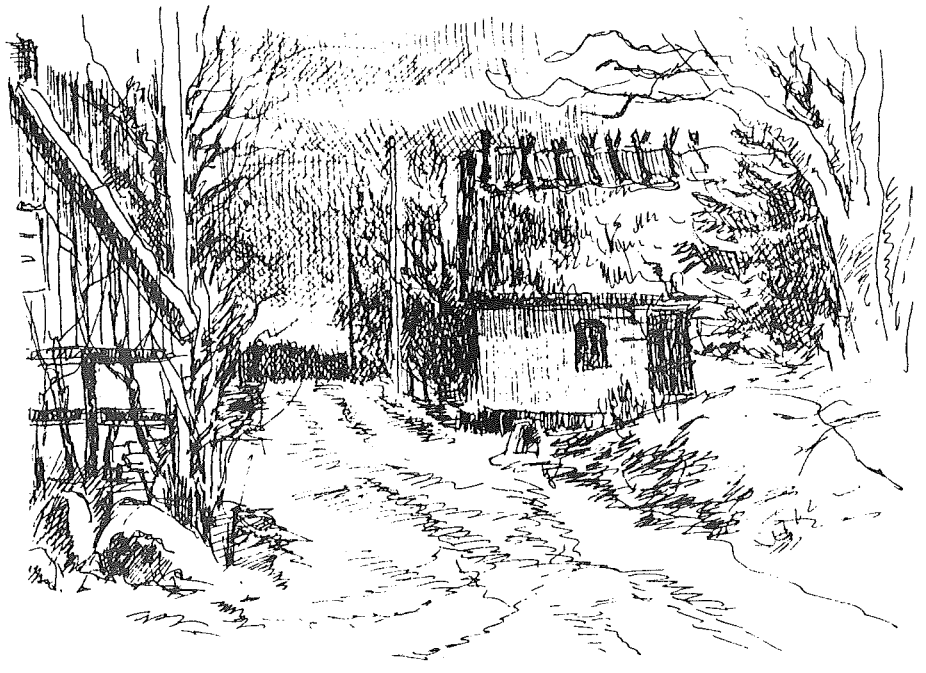


Figure 4.8 Genetic strain difference in leucocyte count.

8 figs., 8 tables, 48 references. In ENGL. Author's summary. Scientific report No. 688. Production of mink, pp 131-171. Natl. Inst. of Animal Science, Dept. of Fur Animals, P.O.B. 39, DK-8830 Tjele.



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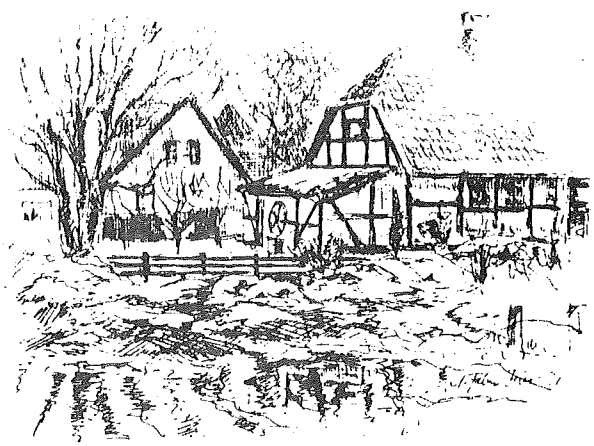

Beautiful Fur Animals – and their colour genetics

By Norodd Nes, Einar J. Einarsson and Outi Lohi
with contribution from S. Jarosz and R. Scheelje

Published by SCIENTIFUR

BEAUTIFUL FUR ANIMALS - and their colour genetics,
ISBN 87-981959-5-6, 271 pages, incl. more than 300
colour photos, Price DKK 320.- + postage. (Also
available in Danish, Norwegian, Swedish and Japanese).

Beautiful Fur Animals – and their colour genetics is intended as a reference book for fur farmers and fur merchants and a textbook or manual of studies about qualitative genetics.

The book is a result of an age-long collaboration between the authors Norodd Nes and Einar Einarsson from Norway and Outi Lohi from Finland/Denmark. Stanislaw Jarosz from Poland and Reinhard Scheelje from West Germany have both contributed to the chapters concerning nutria and chinchilla.

The authors have done a great deal of research into qualitative genetics of fur bearing animals. They have also worked closely with practical fur breeding. The book is therefore written especially for people in praxis but it will also be a useful textbook and inspiration for additional reading into qualitative genetics or fur animals in general for most levels.

"Beautiful Fur Animals – and their colour genetics" is illustrated with about 300 unique colour pictures of mutants in different species of farmed fur animals, combinations of mutants and inter specific hybrids. As a result of a thorough investigation of previous literature it even includes historical documentation of the origins of the mutants.

As an illustration of the multiplicity of natural fur colours, this book is outstanding in documenting the enormous potential of applied qualitative genetics which can be used to renew and enrich life for the pleasure of fur producers and consumers alike.

Because of the thorough description of primary mutant types, their combinations and the effect of colour genes in inter specific hybrids, the book can be used in education and in private studies and it is also a wonderful picture book for animal lovers.

The book is published by SCIENTIFUR, the information service of the Fur Aimal Division of Scandinavian Association of Agricultural Scientists and the first Norwegian edition was presented at the 40th anniversary of the association in September 1987.

Besides the Nordic languages, Norwegian, Finnish, Swedish and Danish the book is translated into English to express the desire of the fur breeders' organizations of the four Nordic countries to support international collaboration between people working with fur animals.

The Scandinavian Board of Fur Farm Organizations has made this work possible with pre-publication orders.

The book can be ordered at: SCIENTIFUR
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