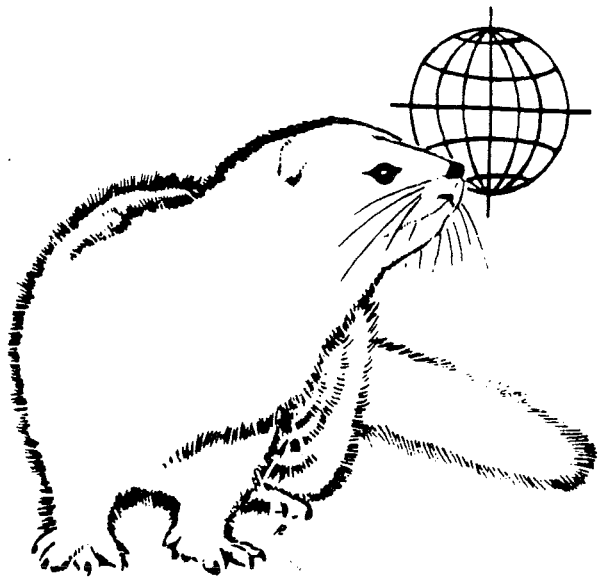

SCIENTIFUR
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The measurement of the contents of 13 minerals in brain, liver and kidney of mink with self-biting disease. *H.W. Gao. Maopi dongwu Siyang, No. 2, pp. 1-3, 1993. In CHIN. Code 2-3-14-M.*

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8. New books

New book

Evolutionary-genetic and genetic-physiological aspects of fur animal domestication - a collection of reports

Edited by

Ludmila N. Trut & Ludmila V. Osadchuk

Published by IFASA/SCIENTIFUR

See next issue of SCIENTIFUR

Distribution: IFASA/SCIENTIFUR, Oslo, Norway

Notes

SCIENTIFUR

Vol. 21. No. 2, 1997

Trees do not grow into the sky, and neither do skin prices. Hopefully, the "justification" of the skin prices during the latest months can be taken as a sign of a quicker market reaction to stabilize a healthy price level for all parties concerned.

It is not because of the reduced price level for skins that the invoices for membership of Ifasa and/or subscription to SCIENTIFUR have not yet been sent out. The reason is simply problems with the installation of a new system which even your editor can operate. Now the system is going to work and all you subscribers will find the invoice enclosed with this issue of SCIENTIFUR. All 1996 subscribers will therefore receive also Vol. 21 No. 2 before payment of the invoice, but it is our hope that you will all pay the bill as soon as possible, because the "water level" in our money tank is very low at the moment on account of the delay in sending out the invoices.

The prices for membership and subscription are - as earlier informed - the same in 1997 as in the years before, i.e. NOK 170.- for personal and NOK 1,700.- for Institutional membership of IFASA. The subscription rate of SCIENTIFUR is NOK 500.- for IFASA-members and NOK 600.- for others.

In Notes of No. 1 this year I underlined the importance of sending reports to SCIENTIFUR for abstracting as soon as possible in order not to delay important new information.

It is even more important to send in the announcement of scientific seminars or work shops within the field of fur animal production. We therefore regret that - too late - we can announce the following workshop arranged by the Division of Fur Animals of the Nordic Association of Agricultural Scientists (NJF):

STRESS AND REPRODUCTION

A two-day seminar and workshop in Oslo, 22-23 May 1997, organised by M. Bakken, A. Lund and V. Pedersen.

The preliminary agenda contains lectures by:

Prof. P.R. Wiepkema:
Stress, reproduction and welfare.
Prof. J. Ladewig:
Neuroendocrine aspects of stress and consequences for reproduction.
Prof. O. Vangen:
Biological limits to selection.
Prof. E. Røskaft:
Why do some animals choose not to reproduce in nature.
Dr. B. Braastad:
Effect of prenatal stress on behaviour and reproduction in mammals.

Furthermore, presentations will be given by participants, and the workshops will be organised around relevant topics.

For further information, contact Morten Bakken: e-mail: morten.bakken@ihf.nlh.no, phone: +47 64 94 80 03 or mail: Morten Bakken, Dept. of Animal Science, Agricultural University of Norway, P.O.Box 5025, N-1432 Ås, Norway.

As already announced in SCIENTIFUR Vol. 21 No. 1, the NJF Division for Fur Animals arranges a scientific meeting and in connection herewith a celebration of the 50th anniversary. All this will take place in the days from October 6 - 8, 1997.

Further information regarding programme, participation, prices etc. can be obtained from TUULA DAHLMANN, Finnish Fur Breeders Association, P.O.Box 5, FIN-01601 Vantaa, Finland. Tel. +358 9 8498441, fax +358 9 8498436.

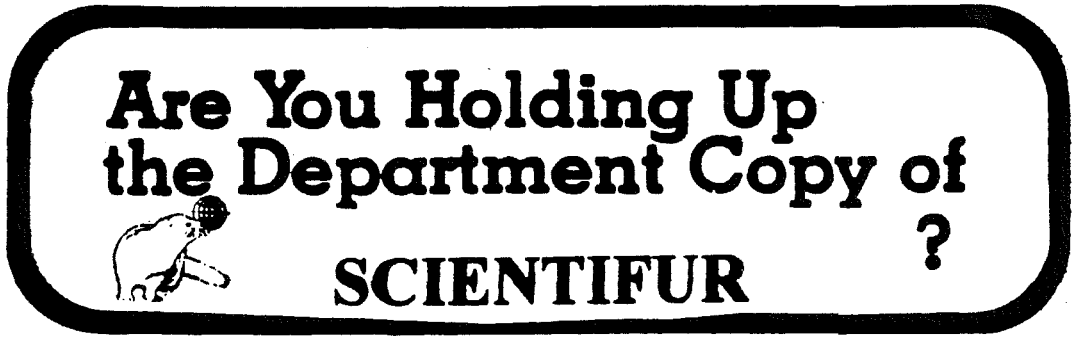
The new book: MINK - Biology, health and disease which was presented at the VIth IFASA congress in Warsaw in August 1996 is now ready for distribution. Further presentation, price, addresses etc. are given under "new books" in this issue of SCIENTIFUR.

Our language controllers have asked us to stress to the contributors of original reports that it is essential that the author(s) are very particular with their language before they send manuscripts to SCIENTIFUR. It has, in a few cases, been necessary for us to return manuscripts simply because it has been impossible for us to understand the meaning of the entire text or parts of the text, and this ought not to occur in a scientific journal. But apart from our evaluation, THE RESPONSIBILITY FOR THE SCIENTIFIC VALIDITY OF THE REPORT AS WELL AS FOR THE LANGUAGE RESTS WITH THE AUTHOR(S). If any of our readers have any difficulties in that direction, please do not hesitate to contact the author(s).

Hopefully the whelping season (Northern Hemisphere) is well over at the time when you receive this issue of SCIENTIFUR, and hereby we wish you a good midsummer.

Best regards,

Gunnar Jørgensen
Your Editor



Short communication

Platform use by farmed raccoon dogs (*Nyctereutes procyonoides*)

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Introduction

The Standing Committee of the European Convention on the Protection of Animals Kept for Farming Purposes has issued a recommendation whereby each weaned fox should be permanently provided with a secluded area, such as a suitable nest box or platform, on which it can rest and observe the environment (*European Convention, 1991*). These enrichments are considered to enhance animal welfare. The current recommendations obviously concern only farmed blue foxes (*Alopex lagopus*) and silver foxes (*Vulpes vulpes*) as they omit any mention of farmed raccoon dogs (*Nyctereutes procyonoides*). However, it is tempting to postulate that if the cages of farmed foxes are equipped with platforms, the same equipment could also be used for raccoon dogs. There is scanty scientific data in the literature concerning the need for platforms by raccoon dogs (*Korhonen, 1987; Harri et al., 1991*) and, therefore, more studies on this subject will be needed.

The aims of the present study were (1) to clarify the amount of platform use by raccoon dogs; and (2) to find out to what extent raccoon dogs use platforms as defecation sites.

Materials and methods

The experiments were carried out at the Siikasalmi Exp. Farm in eastern Finland (University of Joensuu) during July-November 1994. Two experimental groups were formed: (1) a control group, without platforms (25 males, 25 females), and (2) a platform group, raccoon dogs housed in cages with platforms (25 males, 25 females).

The experimental animals were all juveniles. Platforms were provided to them after weaning. The platforms were made of wood, measuring 105 cm long x 30 cm wide (Fig. 1), and were placed 25 cm below the cage roof. Platform use was recorded by daily scanning observations made 2-3 times a day (at 8 a.m., 12 a.m. and 3 p.m.) on workdays.

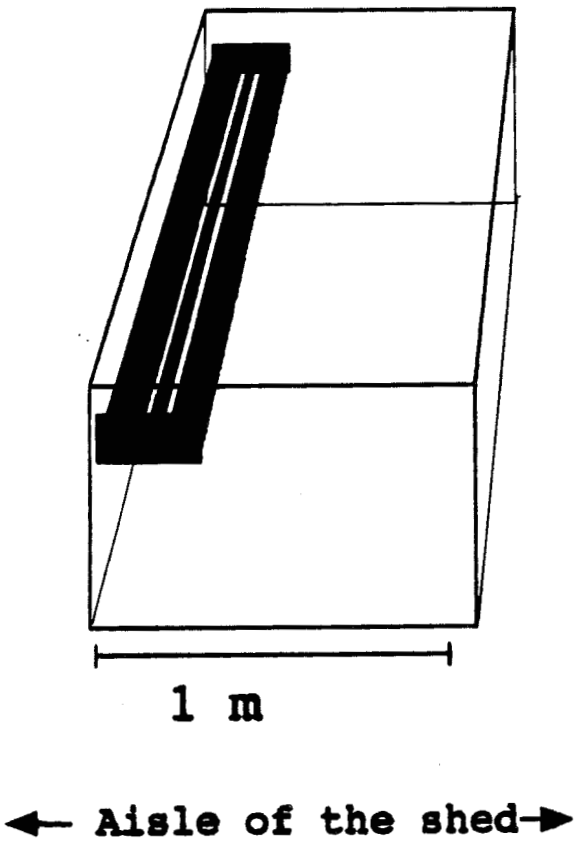

Fig. 1. Schematic picture of the platform type studied.

For the scan sampling observation, the experimenter walked quietly and slowly past the row of cages and manually recorded the location of the animal (on the platform or not) (*Korhonen et al., 1996*). Thus, when standing in front of cage No. 2, the location of the animal in cage No. 3 was recorded and so forth. If the animal fled from the experimenter, the location of the animal before it fled was recorded. The test animals were weighed at the beginning and end of the study. Platform dirtiness was evaluated according to the following scores: 1=clean, 2=slightly dirty, 3=moderately dirty, and 4=very dirty. Platforms were not cleaned of faeces or urine during the study period.

Results

Because platform use was very slight, the data for both sexes has been consolidated (Fig. 2). In July, platform use was lowest (4.8%). Thereafter, it slightly increased, and peaked in October (12.5%).

Initial body weights were almost the same in each group (control: males 3.2±0.5 kg and females 3.2±0.4 kg, and, platform group: males 2.8±0.3 kg and females 2.8±0.3 kg). Nor were there any differences in final body weights (control: males 10.6±0.8 kg, females 10.2±0.7 kg, and, platform group: males 10.7±0.8 kg and females 10.6±0.9 kg).

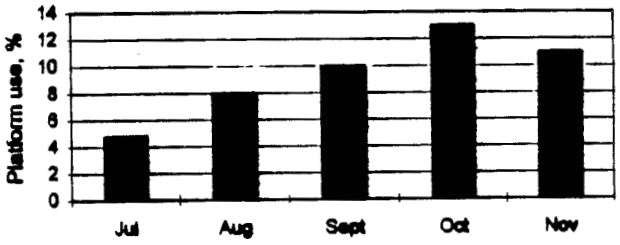

Fig. 2. Platform use (% of observations on platform) by raccoon dogs during July-November.

Platform dirtiness increased during the course of the study. In August, September and November 60, 44 and 36% of the platforms were completely clean, respectively (Table 1). On the other hand, the amount of very dirty platforms during August-September was only 4% and in November 12%.

Table 1. Platform dirtiness (% of total number) during the course of the study. Platforms were not cleaned at all.

	July	Aug	Sept	Nov
Clean	68	60	44	36
Slightly dirty	20	20	28	32
Moderately dirty	12	16	24	20
Very dirty	0	4	4	12

Conclusions

Because the platforms became dirty during the study period, they obviously serve as a kind of defecation site on which raccoon dogs can form latrines. Scent markings by latrines are known to be important message sites for raccoon dogs (*Korhonen et al., 1991*). In comparison to the quantities recorded for platform use in farmed foxes (*Korhonen et al., 1996; Korhonen & Niemelä, 1996*), the amount of platform use by our raccoon dogs was scanty. Quite similar low platform usage has also been documented in previous platform and sleeping plate observations carried out on raccoon dogs (*Korhonen, 1987; Harri et al., 1991*). Thus, if the amount of platform use is the main criterion when establishing the need for platforms, it is obvious that raccoon dogs do not need them. However, if the presence of a platform as such is considered an important enrichment, despite its low amount of use, then platforms can also be provided to raccoon dogs. Three reasons can be speculated as to why raccoon dogs do not use platforms: (1) the temperament of raccoon dogs is different from that of foxes. It is known that foxes typically like to survey the environment from higher places. Obviously this need is less pronounced in raccoon dogs. (2) The raccoon dog is a very tame animal and, therefore, does not need a platform as a refuge. Foxes, on the other hand, are considered to use platforms also as a hiding place. (3) The body type of the raccoon dog, i.e. short legs and an obese body, does not favour the use of higher places.

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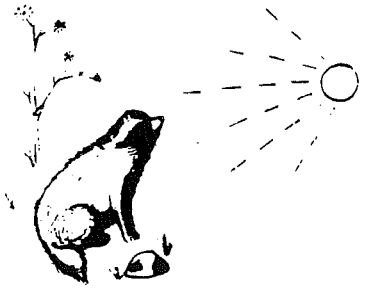

Resting platforms and nest boxes for farmed blue foxes (*Alopex lagopus*) and silver foxes (*Vulpes vulpes*)

The extent of use, reasons for use and welfare effects

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New doctor in the family. We congratulate Dr. Scient Jaakko Mononen with the new title and the fine work on which the dissertation is based.

Farmed blue foxes (*Alopex lagopus*) and silver foxes (*Vulpes vulpes*) are usually kept in open sided shed houses. Only breeding females have nest boxes for two to three months during the breeding season for giving birth and nursing the cubs. For the remainder of the year the farmed foxes live in unfurnished wire mesh cages. Year-round resting platforms and nest boxes have been suggested as one way to improve welfare of farmed foxes.

The extent of the use and the factors affecting the use of resting platforms and nest boxes outside the breeding season were studied in experiments where the cages of blue foxes and silver foxes were provided with these structures.

The average daily time spent on the platforms by the foxes in different studies ranged from 5 to 60%. The average daily use of the nest box interior ranged from 0 to 20%. The average percentage of daily time spent on the nest box roof (*i.e.* one type of platform) ranged from 20 to 70%.

The use of resting platforms and nest boxes was affected by several environmental factors and factors inherent to the animals. Individual differences in the preferences to use the platforms were substantial. The platforms were used more in the autumn than in the winter, whereas the nest box interiors were used to an equal extent in cold and warm seasons. The preference to use the platforms increased if the view from the platform was open and the view from the cage floor obstructed. There were differences between blue foxes and silver foxes in the use of the nest boxes.

Resting platforms may function as observation places or resting places with unrestricted view. Blue foxes and silver foxes did not use platforms or nest boxes as shelters against cold weather. The main results and conclusions are in agreement with the published literature.

Furthermore, a literature review revealed that here is sufficient knowledge available to permit the design of resting platforms which will be used by farmed blue foxes and silver foxes. There is also some knowledge of what features are important to the foxes so that they will use nest boxes. The suggested functions are important to the foxes so that they will use nest boxes. The suggested functions of resting platforms

(*e.g.* an observation place) and nest boxes (*e.g.* a hiding place) are closely related to the attempts of farmed foxes to control their environment. Therefore, these structures might be considered to help foxes in coping with farm conditions and, thereby, to improve their welfare. However, the benefits of platforms and nest boxes on the welfare of foxes have not been unambiguously proven, and further studies are required before it will be possible to design feasible housing systems that definitely improve the living conditions of farmed foxes.

Natural and Environmental Sciences, 52, 1996, 62 pp. 1 table, 4 figs., 134 refs. Author's abstract.

This dissertation includes the following papers referred to in the text by their Roman numerals:

I Harri M., Mononen J., Korhonen H., Haapanen K: A study of the use of resting platforms by farmbred blue foxes. Appl. Anim. Behav. Sci. 30: 125-139, 1991. Abstract in SCIENTIFUR, Vol. 17, No. 2, pp. 118, 1993.

II Mononen J., Harri M., Rouvinen K., Niemelä P: The use of resting platforms by young silver foxes (*Vulpes vulpes*). Appl. Anim. Behav. Sci. 38: 301-310, 1993. Abstract in this issue of SCIENTIFUR.

III Mononen J., Harri M., Rekilä T., Korhonen H., Niemelä P: Use of nest boxes by young farmed silver foxes (*Vulpes vulpes*) in autumn. Appl. Anim. Behav. Sci. 43: 213-221, 1995. Abstract in this issue of SCIENTIFUR.

IV Mononen J., Harri M., Rekilä T: Comparison of preferences of farmed silver and blue foxes for cages with and without a nest box. Acta Agric. Scand. Sect. A, Animal Sci. 46: 117-124, 1996. Abstract in this issue of SCIENTIFUR.

V Mononen J., Harri M., Ahola L: Effects of cage size and obstructed view from cage on use of resting platforms in farmed silver foxes (*Vulpes vulpes*), 1996 (manuscript). Abstract in this issue of SCIENTIFUR.

PAPER II

The use of resting platforms by young silver foxes (*Vulpes vulpes*)

Jaakko Mononen, Mikko Harri, Kirsti Rouvinen, Paavo Niemelä

According to the current European recommendation for animal protection regulations for fur animals, farmed foxes should have a resting platform in their cages. Therefore, the total time of use and factors affecting the use of resting platforms by 20 young silver foxes were studied on an experimental fur farm in western Finland.

Silver foxes used the platforms on average 70 min/day (median 24 min/day). The use declined over time from September/October (146 min/day) to January (9 min/day). Interindividual differences in platform use were marked especially in September/October. Platforms with an unobstructed view of the surroundings were preferred to platforms with a more restricted view. Platforms were used mostly during the working week, but outside the working hours. Neither daily temperature nor wind velocity had an effect on platform use.

It can be concluded that platforms function neither as protection against cold and draught nor as a hiding place. The role of the platforms as a resting place is not supported by the short and decreasing duration of their use as a function of time. They may have a role as a place for making observations, or simply as an environmental enrichment.

3 tables, 2 figs., 17 refs. Authors' abstract.

PAPER III

Use of nest boxes by young farmed silver foxes (*Vulpes vulpes*) in autumn

Jaakko Mononen, Mikko Harri, Teppo Rekilä, Hannu Korhonen, Paavo Niemelä

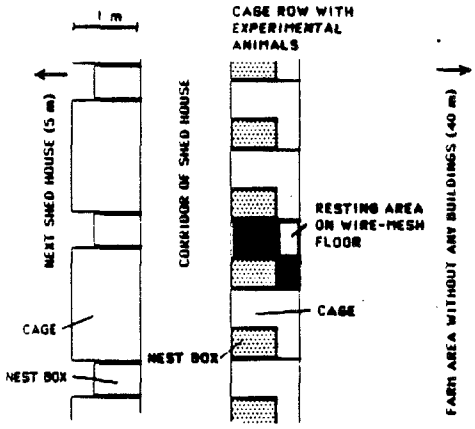

Fig. 2. A schematic drawing (as seen from above) of the experimental shed house. In both experiments animals totally refused to lie on the areas marked in black. If they rested on the net floor, this always took place on the area left white.

Traditionally farmed silver foxes are raised in their cages without nest boxes, with the exception of vixens in their breeding season. However, according to the European recommendations for keeping foxes, each weaned fox shall have available a secluded area, such as a resting platform or a nest box, for resting, hiding and observing. The aim of the work was to study a simple alternative to enrich the traditional housing system of juvenile foxes by providing a standard wire-mesh cage (length 112 cm x width 107 cm x height 70 cm) with a wooden nest box. The extent to which the nest boxes (dimensions of the main chamber 40 cm x 40 cm x 40 cm; or diameter 38 cm, height 32 cm) were used by silver foxes was assessed in two long-term experiments in practical farming situations, i.e. one or two juvenile foxes per standard cage. The nest boxes were situated in the wire-mesh cages where the animals were kept. Foxes (36 kept in pairs and eight kept singly) spent most of their time (>50%) on the roofs of the nest boxes and only 1-2% of their time inside the nest boxes. The wire-mesh floor was used very little for resting in August-October, but in November some foxes started to rest there sporadically. When resting on the floor, the animals always occupied a small area from which the view of the surroundings was best. Preference for the nest box roof with a good view may result from non-preference for the much worse cage floor view.

2 tables, 2 figs., 22 refs. Authors' abstract.

PAPER IV

Comparison of preferences of farmed silver and blue foxes for cages with and without a nest box

Jaakko Mononen, Mikko Harri, Teppo Rekilä

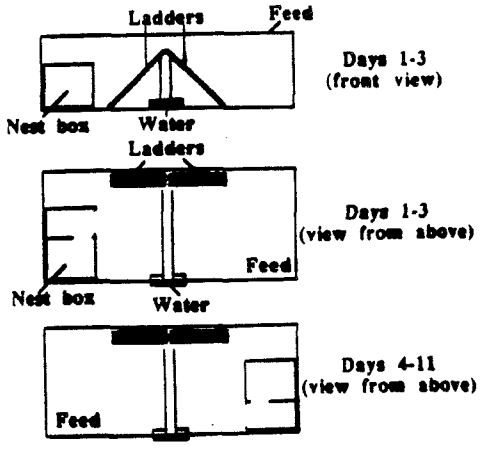

Fig. 1. Schematic drawings of the experimental double cage. During Day 9 (deprivation day) the opening between cages was closed and the fox shut in the left (empty) cage. At all other times, foxes had free access to both cages. See text for further details.

The preferences of juvenile farmed silver foxes (n=14) and blue foxes (n=12) for an empty cage (105L x 115W x 70H) and a cage of equal size with a wooden nest box were assessed in an 11-day preference test. The silver foxes spent a higher percentage of their time (86±8%) in the nest box cage than the blue foxes (66±21%). The silver foxes,

but not the blue foxes, had a strong preference for the nest box roof as a resting site (44% of total daily time). Assuming that greater use indicated a greater need, silver foxes may benefit more from the nest boxes than blue foxes.

1 table, 4 figs., 23 refs. Authors' abstract.

PAPER V

Effects of cage size and obstructed view from the cage on the use of resting platforms in farmed silver foxes (*Vulpes vulpes*)

Jaakko Mononen, Mikko Harri, Leena Ahola

The effects of cage size and an obstructed view from the cage on the use of wooden nonwalled resting platforms by juvenile male (n=10) and female (n=15) silver foxes were assessed in a ten week experiment. The degree of the obstructedness of the view and the free floor area of the cage varied between five types of cages used. Each animal lived for two weeks in each type of cage and their behaviour was videorecorded for a 24-h period in each two week period. The foxes spent 59±13% of their daily time on the platforms. The use declined from 72±13% in September to 35±21% in November. Males used the platforms more than females. In late October and early November, the platforms were used more for both active behaviours and resting in cages with an obstructed view from the cage floor than in the cages with an unobstructed view. The larger the free floor area of the cages was, the less the silver foxes used the platforms during activity in mid-September and mid-August. The most probable function of the platform is to offer the foxes an observation and resting place with an open view to all directions.

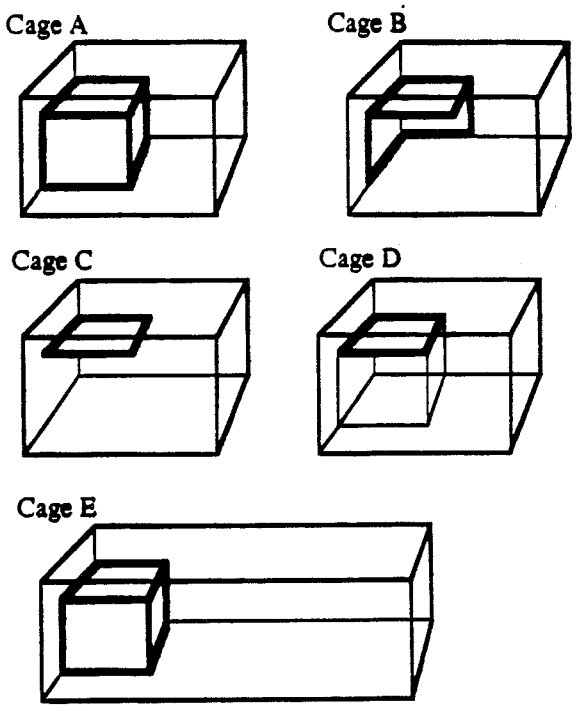

Figure 1. Schematic drawings of the five cage types. See text for details.

2 tables, 3 figs., 18 refs. Authors' abstract.

Investigation of methods to assess stress in farmed silver foxes (*Vulpes vulpes*)

A contribution to the scientific assessment of animal welfare

Randi Oppermann Moe
Norwegian College of Veterinary Medicine
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Norway

New doctor in the family. We welcome Dr. Randi Oppermann Moe in the family and congratulate with the title and the fine thesis.

The general aim of the present study was to increase our understanding of stress in the silver fox (*Vulpes vulpes*) by observing relevant physiological parameters. The presence of absence of stress is believed to provide a meaningful assessment of animal welfare. Thus, further knowledge of species-specific physiological indicators of stress and the recognition of environmental stressors should facilitate the assessment of welfare in this species. In particular, physiological variables related to acute stress need to be further investigated. Valid physiological indicators of stress will facilitate behavioural research when attempting to assess animal welfare. An important aim of the present study was therefore to combine expertise from relevant areas of veterinary medicine with behavioural research.

The specific aims of the present study were:

1) to determine the short- and long-term effects of blood sampling on physiological indicators of stress (**Paper I**)

2) to develop methods for remotely obtaining physiological data related to stress in unrestrained silver foxes (**Paper II**)

3) to investigate the mechanisms involved in regulating a promising physiological indicator of stress (**Papers III, IV, V, VI**)

4) to apply this physiological indicator of stress as a tool for identifying acute environmental stressors as a supplement to behavioural observations (**Paper VII**).

The present study has identified physiological parameters that provide satisfactory indicators of short- and long-term stress in farmed silver foxes. In particular, increases in body temperature appear to reflect stress and an emotional state similar to fear or anxiety in this species. Radio telemetry, used to monitor deep body temperature, provides an elegant means of measuring acute stress and anxiety or fear in studies focusing on animal welfare without the confounding influence of man during sampling routines. It was possible to remotely obtain both physiological and behavioural data when the method was combined with video studies. Monitoring body temperature is therefore a promising new tool for observing an internal (physiological) stress response and may provide relevant data that supplement external (behavioural) observations.

Furthermore, virtually all the physiological parameters measured in the present study may be altered by handling and blood sampling routines which makes it difficult to assess true basal levels. Additionally, routine blood sampling techniques were

ERRATUM

SCIENTIFUR regret very much the linguistic mistakes made in the papers of the dissertation report of Dr. Randi Oppermann Moe in SCIENTIFUR VOL. 21, NO. 2, PP. 106-108.

You are therefore kindly asked to place this erratum in the actual issue of SCIENTIFUR, so the misunderstandings can be corrected. In the SCIENTIFUR index, the correct word "**hyperthermia**" will be used.

Paper III: Physiological, mechanisms involved in stress-induced **hyperthermia**. *Page 106, title and text line 2 and 3.*

Paper IV: Effect of indomethacin on LPS-induced fever and **hyperthermia** induced by physical restraint in the silver fox *(Vulpes vulpes). Page 106, title and text, point 1 line 2, and point 4 last line.*

Paper V: Effects of handling physical restraint on rectal temperature, cortisol, glucose and leukocyte counts in the silver fox (*Vulpes vulpes*). **Hyperthermia** on *Page 108, line 12 and 28.*

Paper VI: Anxiolytic drugs inhibit **hyperthermia** induced by handling in farmed silver foxes *(Vulpes vulpes). Page 108, title and text line 5.*

Paper VII: Effects of putative environmental stressors on deep body temperature and behaviour in silver fox vixens (*Vulpes vulpes*). **Hyperthermia** on *Page 109, line 20.*

Please correct these mistakes and keep thereby SCIENTIFUR as your "correct" partner in the fur animal science.

With excuses to the author and the readers,

The Editor

shown to affect several physiological parameters believed to be associated with chronic stress in foxes that have been sampled regularly over long periods. These findings have important implications for future research not only within the field of stress and welfare, but also where blood sampling and handling are components of the protocol. Thus, remote data sampling is recommended. This raises the need to develop further methods for remote data sampling, preferably for a wide range of physiological variables including blood parameters.

The advantages of using implanted transmitters in studies on other aspects of fox research are obvious. Ongoing metabolic studies in trapped, wild Arctic foxes are already benefiting from the ability of the transmitters used in the present study to measure heart rate, T_b and physical activity (Fuglei, personal communication; Haga, 1993; Haga & Mercer, manuscript in preparation a, b).

Joint Nordic studies on genetic selection for reduced fear of humans and early socialisation have been initiated. These studies aim to reduce fear and thereby achieve the goal of improved welfare in silver foxes. Within these studies, SIH may be applied as a tool to assess stress and fear responses. Furthermore, the present study indicates that leukocyte counts may be reduced during exposure to acute and chronic stressors in the silver fox. Whether or not these alterations are associated with a suppressed immune response will be a subject of subsequent research.

Thesis, 40 pp, 68 refs. Norw. College of Veterinary Medicine, 1996.

The thesis is based on 7 papers which are abstracted in the following:

PAPER I

Effect of repeated blood sampling on plasma concentrations of cortisol and testosterone and on leukocyte number in silver fox vixens (*Vulpes vulpes*)

Randi Oppermann Moe, Morten Bakken

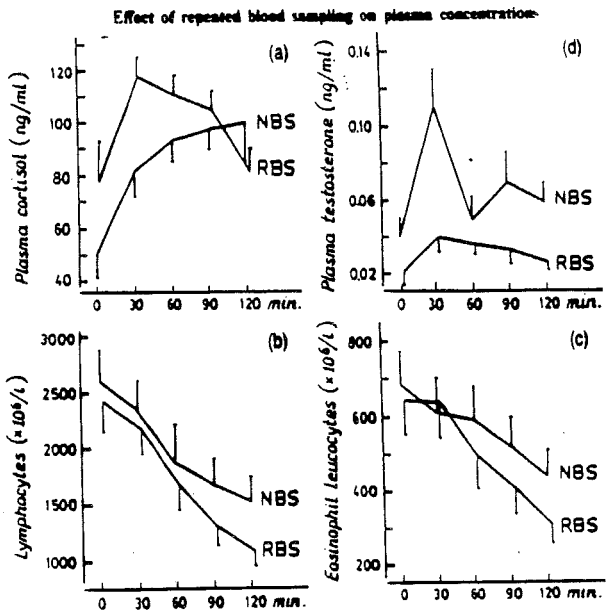


Fig. 1. Cortisol response (a), lymphocyte response (b), eosinophil leukocyte response (c), and testosterone response (d) to five blood samples taken at 30 minute intervals in two groups of silver fox vixens (means ± SE). RBS = repeatedly blood samples for one year; NBS = never blood sampled before.

It is of great importance to be able quantitatively to evaluate the stress to which captive fur animals are subjected to by various forms of management. A range of haematological and hormonal parameters have been shown to be good indicators of stress. However, blood sampling, which entails the presence of humans and handling of the animals, can itself be a stressor that influences the results of an experiment. The present study shows that a group of silver foxes (n=7) higher plasma concentrations of cortisol and lower concentrations of testosterone compared with an earlier non-blood-

sampled group (NBS-group) (n=7). The RBS-group also tended to have a lower number of lymphocytes. In addition, during a series of five blood samples taken at 30 min intervals, both groups showed an increase in plasma concentrations of cortisol, whereas numbers of lymphocytes and eosinophil leukocytes decreased. Plasma testosterone concentrations decreased after an initial increase. The study demonstrated that blood sampling, in both the long and short term, can profoundly affect hormone concentrations and leukocyte numbers.

Acta Agric. Scand. Sect. A, Animal Sci. 111-116, 1996. 1 fig., 27 refs. Authors' summary.

PAPER II

Techniques for surgical implantation of radio transmitters in the silver fox (*Vulpes vulpes*)

Randi Oppermann Moe, Morten Bakken, Øyvind Haga, Adrian Smith

Stress and behaviour research in captive furbearing animals such as the silver fox (*Vulpes vulpes*) is often based on ethological observations and physiological data. However, blood sampling, handling, and even the mere presence of humans have been shown to be severe stress factors for most farmed silver foxes. In an attempt to collect stress physiological data without disturbing the animals, radio transmitters, signalling heart rate, core temperature, and locomotory activity, were implanted in 18 silver fox vixens. All these parameters can change during stress, and can give valuable information to supplement behavioural observations. The present study describes the development of an implantation technique and potential problems when using the system in captive semidomesticated animals.

Journal of Zoo and Wildlife Medicine 26 (3), pp. 422-429, 1995. 2 tables, 1 fig., 30 refs. Authors' abstract.

PAPER III

Physiological mechanisms involved in stress-induced hypothermia

Randi Opperman Moe

Different physiological mechanisms in stress-induced hypothermia (SIH) are reviewed. Psychological stress induces hypothermia, and habituation occurs in several species. Increased motor activity seems to play a minor role in the development of SIH. Other possible mediators involved are adrenaline, noradrenaline, corticotrophin releasing hormone and cortisol. Also, some anxiolytics and endogenous opioids can modulate the SIH response. In addition to temperature increases caused by increased metabolism, it is discussed whether SIH partly is a regulated upward shift of the "set-point" temperature in the hypothalamus, since prostaglandin synthesis inhibitors can reduce SIH in rats. Cytokines might thus be involved in the development and regulation of SIH.

Norsk Veterinærtidsskrift 108, 3, pp.155-158. In NORG, Su. ENGL. 44 refs. Author's summary.

PAPER IV

Effect of indomethacin on LPS-induced fever and on hypothermia induced by physical restraint in the silver fox (*Vulpes vulpes*)

Randi Oppermann Moe, Morten Bakken

1. The effects of indomethacin on LPS-induced fever, and on hypothermia induced by physical restraint, were investigated in the silver fox (*Vulpes vulpes*).
2. Base levels of deep body temperature (T_b) in undisturbed silver foxes measured with surgically implanted transmitters was 38.6°C (±0.1).
3. Rectal temperature (T_{re}) five hours after treatment with LPS was 40.1°C (±0.1), indicating a febrile response.

4. T_{re} in all foxes (LPS + indomethacin: 39.5°C ± 0.1; indomethacin + vehicle: 39.2°C ± 0.1, or vehicle alone: 39.4°C ± 0.1) was elevated compared with base levels of T_b. However, T_{re} was within the range of T_b in handled or physically restrained foxes (: 39.4°C ± 0.1 and 39.5°C ± 0.1, respectively), indicating that handling and restraint evoked a stress-induced hypothermia (SIH).
5. T_{re} in foxes treated with LPS was significantly reduced when they were pre-treated with indomethacin (39.5°C ± 0.1), and was within the range of T_{re} of the controls, indicating an antipyretic effect of indomethacin.
6. Indomethacin did not significantly attenuate the magnitude of SIH, indicating that SIH may nor, or to a minor extent, be mediated by prostaglandins in silver foxes.

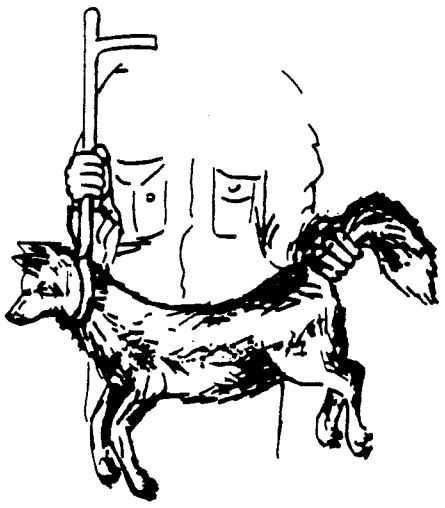


Figure 1.

Physical restraint of silver foxes with a neck tong for foxes.

J. therm. Biol. pp. 1-15 (accepted). 3 tables, 2 figs., 27 refs. Authors' abstract.

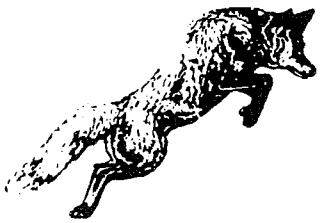
PAPER V

Effects of handling physical restraint on rectal temperature, cortisol, glucose and leukocyte counts in the silver fox (*Vulpes vulpes*)

Randi Oppermann Moe, Morten Bakken

Figure 1.

The present paper describes the effects of handling and one hour of physical restraint on rectal temperature (T_{rec}), plasma cortisol, plasma glucose an leukocyte counts in six 8-months old silver fox vixens (*Vulpes vulpes*). Mean T_{rec} in silver foxes 5 min. after capture was 40.1°C and increased during restraint,



showing a maximum of 40.8°C at 30 min. thereafter. Supplementary, deep body temperature (T_b) was recorded with surgically implanted biotelemetry devices in six adult silver fox vixens kept isolated from environmental disturbances in a barn. Mean T_b in these foxes ranged between 38.0-38.4°C, showing a diurnal variation and being at the lowest between 0700-1600h. When a person approached a fox and was present for 5 min., T_b increased rapidly. The results indicated that a stress-induced hypothermia (SIH) was evoked rapidly within the first registration at 5 min. after capture, and that this response continued during one hour of physical restraint. Plasma glucose and plasma cortisol levels increased during one hour of physical restraint, whereas numbers of lymphocytes, total white blood cell counts and total granulocytes decreased. Furthermore, previously reported base levels of plasma cortisol and plasma glucose were exceeded. The results indicate that the hypothalamic-pituitary-adrenal (HPA) axis and the sympathoadrenal medullary (SAM) system were activated within five minutes of handling and restraint. Furthermore, hypothermia is a promising indicator of acute stress in silver foxes.

Acta vet. scand (in press). 6 figs, 24 refs. Authors' abstract.

PAPER VI

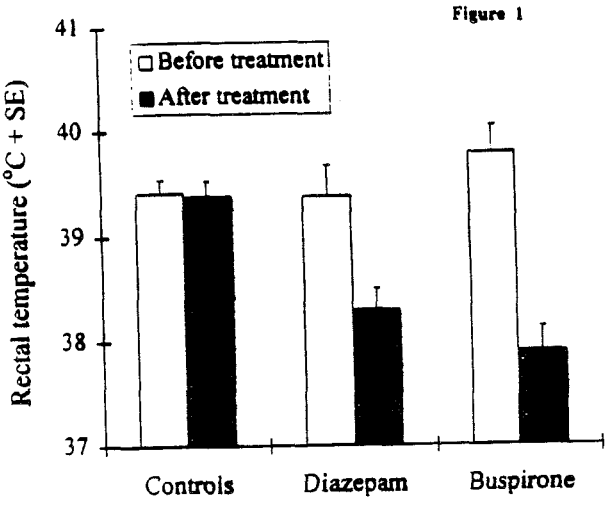
Anxiolytic drugs inhibit hypothermia induced by handling in farmed silver foxes (*Vulpes vulpes*)

Randi Oppermann Moe, Morten Bakken

As a contribution to the ongoing work aiming to assess and thereby improve animal welfare in farmed silver foxes, the present study attempted to investigate stress-induced hypothermia (SIH) as a physiological indicator of fear or anxiety. Measuring rectal temperature (T_{rec}) served as a stress paradigm and immediately elicited a SIH. Then, the foxes received anxiolytic drugs, diazepam, or buspirone, or sterile saline. 90 min. thereafter, T_{rec} in the foxes treated with diazepam and buspirone, but not T_{rec} in the controls, was significantly lower. The results indicate that SIH induced by handling was attenuated by anxiolytic drugs, which supports the hypothesis that anxiety pathways contribute to the development of SIH.

Mean rectal temperature (±SE) immediately after capture in silver foxes before, and 90 minutes after, injection with vehicle (NaCl), n=6; or anxiolytic drugs (diazepam, n=6; or buspirone, n=6).

Figure 1



Short communication, 10 pp. 1 fig. 12 refs. Authors' abstract.

PAPER VII

Effects of putative environmental stressors on deep body temperature and behaviour in silver fox vixens (*Vulpes vulpes*)

Morten Bakken, Randi Oppermann Moe, Adrian J. Smith, Gunn-Marit Eriksrød Selle

The present study was performed to investigate the effects of 20 different putative environmental stressors on deep body temperature (T_b), levels of physical activity and behaviour in six 2.5 year old silver fox vixens. All trials were performed six months after the reproductive season. Three of these vixens had lost all their cubs the past two reproductive seasons, whereas the other three had weaned litters unharmed. From

five days before the experiment started, the vixens were kept in an empty barn and isolated from environmental disturbances. Ten different experiments investigated effects of contact with humans, four experiments investigated effects of exposure to unfamiliar foxes, and six experiments investigated effects of various noise stimuli. T_b and activity levels were monitored with surgically implanted radio telemetry devices, whereas behaviour was recorded by video cameras. All registrations were performed during 90 min. after stimulus presentation. The present study demonstrates that the presence of humans and the presence of other silver foxes, but not the exposure to loud noise, result in increased T_b as well as a behavioural response. In the light of results from our previous studies, the increase in T_b was considered to reflect a stress-induced hypothermia (SIH). Comparison of the SIH and behavioural responses between the normally reproducing vixens and the previously infanticidal vixens revealed significant differences. The SIH response was most pronounced in the previously infanticidal vixens, whereas the levels of physical activity were lowest in this group. The present study indicates that important means to improve animal welfare in silver foxes should include an improvement of the general human-animal relationship and emphasizes the importance of a stable social environment.

2 table, 3 figs., 28 refs. Authors' abstract.

Purification and enzymatic peptide mapping of protein synthesis elongation factor-2 from mink and chicken livers

Bent Riis

Protein synthesis is a fundamental biological process aided by many enzymes and molecules. Although the process has been studied for many years, far from all the details are clear, and purification and test of the individual components are still very important. Fur production depends on optimal protein synthesis because hair and skin largely consist of proteins. In order to understand the protein synthesis process in mink and other fur animals, it is most important to study the individual components of the protein synthesis mechanism - not least in order to be able to optimize the synthesis and at the same time to minimize the input of nutrients.

Generally, the translation process is divided into the initiation step, the elongation step and the termination step. The elongation step is facilitated by two elongation factors, and both have been very well-conserved during evolution. The second elongation factor, eEF-2, catalyses the translocation of peptidyl-tRNA from the A-site to the P-site on the ribosome, and it is known to be involved in the regulation of protein synthesis via reversible phosphorylation.

Because eEF-2 is important and involved in the regulation of protein synthesis, it is very important to find a readily available, cheap, abundant and reliable source for purifying the active form of this enzyme. Traditionally, purification of eEF-2 is done using rat liver tissue as starting material, but this approach is rather expensive. Alternative methods using pig and cattle livers have been tried, but these tissues are not suitable as starting material, probably due to high protease activity.

Based on these considerations, mink livers were tested and this tissue was shown to be of the same quality as rat livers as to use as starting material for purification of eEF-2. At the same time, chicken liver tissues were used for purification in order to see if this was also a possible source of eEF-2 purification and to compare the two species' elongation factor-2 by making specific peptide maps. Both sources were found to be

of excellent quality for purification purposes, and peptide-mapping indicated that the amino acid sequences in the two species are similar.

The perspectives of these experiments are several. Firstly, it is possible to purify large amounts of eEF-2 from mink livers. A cheap and good source of eEF-2 is important in order to be able to perform many types of experiments (i.e. MNR- and X-ray studies). Secondly, the mink liver eEF-2 seems to have the same amino acid sequence and carry the same post-translational modifications as eEF-2 from other species, including chickens and humans. Therefore it is reasonable to believe that the results obtained with mink liver eEF-2 also apply to other species. Thirdly, very little is known about protein synthesis in fur animals, including mink. It is therefore important to study all components involved in protein synthesis, including the key component eEF-2. Only by employing this strategy is it possible to learn more about protein synthesis - the biological basis of mink pelt production.

Biochemistry and Molecular Biology International 40(4), pp. 779-785, 1996. 2 tables, 2 figs., 9 refs. Authors summary.

Composting fur farm waste products

R.J. Aulerich, A.C. Napolitano, C.J. Flegal

The results of these studies on composting organic waste products of mink farming indicate that composting may be an economically feasible and environmentally acceptable process for converting casualty animals, pelted carcasses, manure, wasted feed, and/or used bedding into a useful end product. The system should fit into the routine management scheme of commercial mink farms. It can be adapted to various size operations and can be used throughout the year. The facilities required for composting are relatively inexpensive and easily constructed. The procedure is simple, requires minimal time and labour, and the equipment needed for handling the compost should be available on most mink farms.

2 tables, 8 figs., 2 refs. Michigan State University. Fur Animal Research, pp. 6-17, 1997. Authors' summary.

Bedding preferences of mink

R.J. Aulerich, C.R. Bush, A.C. Napolitano, P.B. Summer

Bedding is an important factor in mink production. It serves to keep mink warm, aids in grooming their fur, and provides security and comfort for the kits. Some of the more commonly used bedding materials for mink include marsh hay, wood shavings and shredded wood products, straw, crushed or chopped sugar cane, beet pulp, cotton seed hulls, and ground corn cobs. The results of this trial are of interest in that no clear preference for a particular type of bedding was shown by the mink at whelping or during lactation. Individual animals seemed to prefer different bedding materials, although some females moved their kits among two or three different nest boxes during the lactation period.

1 table, 3 refs. Michigan State University. Fur Animal Research, pp. 28-30, 1997. Summary: G. Jørgensen.

Ferret facts

R.J. Aulerich

Although ferrets were domesticated by the Chinese and Egyptians over 2000 years ago, they have only recently become popular in the U.S. as research animals and as pets. The "domestic ferret" (*Mustela putorius furo*) is a descendent of the wild European ferret or polecat. Since the 1930s it has become useful as a research animal in physiology, virology, pathology and toxicology. It is the species of choice for influenza research and has been

used extensively in the development of numerous vaccines. Research at MSU has shown the ferret to be a preferred mammalian model for studying the mechanisms involved in organophosphorus-induced delayed neurotoxicity. In 1992, ferret raising by private breeders was legalized in Michigan and has led to a marked increase in the number of these animals kept as pets. However, many ferret owners and caretakers are unaware of the basic biology of the ferret which can lead to management problems. The following is a compilation of some common normal biological values for ferrets that should be useful to ferret breeders, as well as others interested in this animal. These data were compiled from the scientific literature and from our 27 years of research experience with this species.

Ferret Biological Data
(Normal values)

Parameter	Values
Body weight	
Adult male	1400-2200 grams (record 3500g)
Adult female	700-1100 grams
Kits	
At birth	8-10 grams
At 3 wks	100 grams
At 6 wks	300 grams
At 9 wks	½ adult size
Life span	5-6 years (record 13 yrs.)
Age at sexual maturity	6-12 months
Length of breeding life	2-5 years
Chromosome number	40 (diploid)
Body temperature	101-102.5°F
Heart rate	210-242/minute
Respiration rate	33-36/minute
Dental formula	36 total teeth
	2 I 3/3, C 1/1, PM 4/3, M 1/2)
	Deciduous teeth erupt about day 14
	Permanent teeth erupt at 47-52 days
Vertebral formula	44-48 vertebra
	C = 7, T = 15, L = 6, S = 3, C = 14-18
Ribs	14 pair
Food consumption	
Males	42 g dry matter/kg b.w.
Females	49 g dry matter/kg b.w.
Rate of food passage	3 hours
Water intake	75-100ml/24 hours
Urine volume	20-25ml/24 hours
Urine pH	6.5-7.5
Gastrointestinal tract length	
Male	78 inches
Female	72 inches
	(no cecum or appendix)
Gestation	42 ±2 days
Litter size	8 (range 1-18)
Eyes open	30-34 days
Onset of hearing	32 days
Begin "solid" food consumption	21-24 days
Weaning	6 weeks

Michigan State University. Fur Animal Research, pp. 122-124, 1997. Reprinted in full length.

A multigenerational study of the effects of consumption of PCB-contaminated carp from Saginaw Bay, Lake Huron on mink. 1. Effects on mink reproduction, kit growth and survival, and selected biological parameters

J.C. Restum, S.J. Bursian, J.P. Giesy, J.A. Render, W.G. Helferich, E.B. Shipp, D.A. Verbrugge, R.J. Aulerich

This study was conducted to determine the multigenerational effects of consumption of PCB-contaminated carp (*Cyprinus carpio*) from Saginaw Bay (Lake Huron) on mink (*Mustela vison*) reproduction and health and to examine selected biomarkers as potential indicators of polyhalogenated hydrocarbon toxicity in mink. The mink were fed diets formulated to provide 0 (control), 0.25, 0.5 or 1.0 ppm polychlorinated biphenyls (PCBs) through substitution of Saginaw Bay carp for ocean fish in the diets. To determine whether the effects of PCB exposure were permanent, half of the parental (P_1) animals were switched from their respective treatment diets to the control diet after whelping the first of two F_1 generations. Effects of *in utero* and lactational exposure to PCBs on subsequent reproductive performance of the F_1 animals were examined by switching half of the first year F_1 offspring (kits) to the control diet at weaning, while the other half was continued on their parental diet (continuous exposure). Continuous exposure to 0.25 ppm, or more, PCBs delayed the onset of estrus (as determined by vulvar swelling and time of mating) and lessened the whelping rate. Litters whelped by females continually exposed to 0.5 ppm, or more, PCBs had greater mortality and lesser body weights than controls. Continuous exposure to 1.0 ppm PCBs resulted in lesser serum and liver vitamin A concentrations when compared to controls and had a variable effect on serum T_4 and T_3 concentrations. Compared to the controls, there were significant differences in kidney, liver, brain, spleen, heart, and thyroid gland weights of the mink exposed to the greater

concentrations of PCBs. There was an increase in the incidence of periportal and diffuse vacuolar hepatocellular lipidosis in the P_1 mink with exposure to greater concentrations of PCBs. Plasma and liver PCB concentrations of the adult and kit mink were, in general, directly related to the dietary concentration of PCBs and the duration and time of exposure. Short-term parental exposure to PCBs can have detrimental effects on subsequent generations of mink conceived months after the parents are placed on "clean" feed. The LOAEL for dietary PCBs in this study was 0.25 ppm.

Michigan State University. Fur Animal Research p. 132, 1997. Authors' summary.

Effect of prenatal stress on adrenal function in blue foxes (*Alopex lagopus*) during early postnatal development

M. Bakken, L. Osadchuk, B.O. Braastad

Earlier experiments indicate that daily handling of blue foxes is a stressor for the animals. Differences in adrenal gland weights, adrenal hormonal production and serum concentration of progesterone and cortisol were examined in 68 ten-days-old cubs (34 males and 34 females) produced by 12 multiparous blue fox vixens. Half of the vixens had been stressed by handling for one minute daily during the last 15 days of pregnancy (G1), the other half was treated in exactly the same way but without any stressful handling (G2). The cubs were sacrificed humanely 10 days after delivery and weighed, and the adrenal glands were removed, frozen or incubated for 3 hours at 37°C in Eagle's medium. The frozen adrenals were homogenised and analysed for cortisol and progesterone content with commercial RIA kits. The incubated adrenals were analysed for the production of the same hormones. The blood of the decapitated cubs was collected, centrifuged and the serum was analysed for the content of progesterone and cortisol. There was no treatment-related difference in cub weights [G1: 194.6 ± 8.4 (males, n=17), 179.9 ± 8.4 g (females, n=17); G2: 195.8 ± 8.4 (males, n=17), 188.11 ± 8.4 g (females, n=17)]. No significant differences were found in adrenal weight between the two sexes, however big differences were found between groups (G1: 29.1 ± 1.8 mg, G2: 47.1 ± 1.9 mg, $P<0.0001$). Differences between the experimental groups in the same direction were found in the cortisol and progesterone adrenal contents (cortisol G1: 28.7 ± 6.4, G2: 68.9 ± 6.5, $P<0.001$; progesterone G1: 71.6 ± 19.8, G2: 111.2 ± 19.8, NS). However, the smaller adrenals from the G1 cubs produced higher levels of progesterone and cortisol than the adrenals from the G2 cubs (progesterone: 0.59 ± 0.06 ng/adrenal/h versus 0.29 ± 0.06 ng/adrenal/h; $P<0.002$ cortisol: 19.2 ± 1.6 ng/adrenal/h versus 12.7 ± 1.6 ng/adrenal/h, $P<0.01$). These differences were to some extent reflected in the serum concentrations of progesterone and cortisol (progesterone: 162.6 ± 9.6 pg/ml versus 119.1 ± 9.5 pg/ml, $P<0.002$; cortisol 4.7 ± 0.6 ng/ml versus 4.4 ± 0.6 ng/ml, NS). The data obtained suggest that prenatal stress leads to increased adrenocortical function during early postnatal development.

3rd International Symposium on Reproduction of Dogs, Cats and Exotic Carnivores, September 12-14, 1996. Only abstract received.

Combined behavioural and physiological measurements as a basis of the assessment of animal welfare

V. Pedersen

During the welfare research of farmed foxes various indicators of impaired or improved welfare were examined. Behavioural and physiological measurements indicated that provisioning of whole-year shelters to farmed foxes would improve their welfare, as reflected in reduced fear responses and

low base levels of cortisol and eosinophil leucocytes. Behavioural and physiological measurements indicated that early experience with humans would improve the welfare of farmed foxes as reflected in reduced fear responses, reduced stress sensitivity, and improved reproduction.

The interpretation, validity, and generality of some of the used welfare indicators in domestic species are presented. In conclusion, the importance of using both behavioural and physiological measurements as a basis of assessing welfare of domestic animals is emphasized.

Acta Agric. Scand. Sect. A, Animal Sci. Suppl. 27, pp. 69-75, 1996. 48 refs. Authors' summary.

The effect of domestication on brain size and composition in the mink (*Mustela vison*)

Dieter Kruska

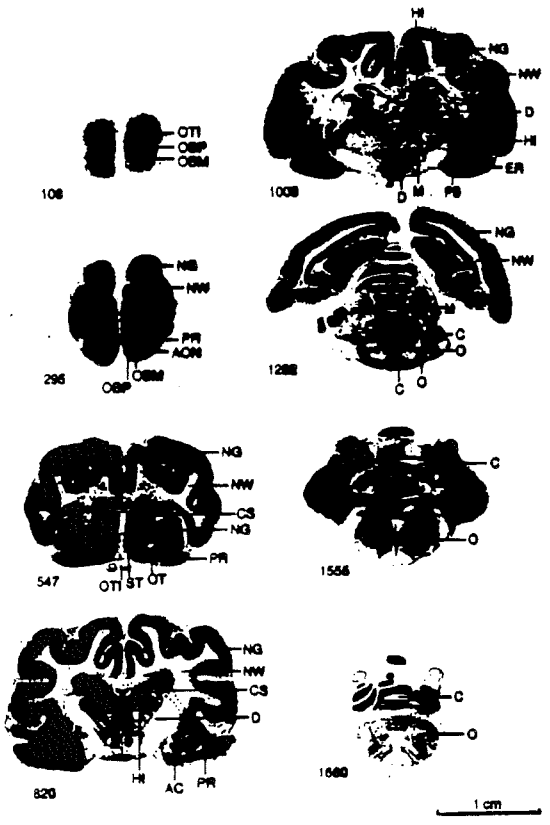


PLATE I Examples of delineation of measured brain parts (left brain side only) on the photographs (from the brains of a male wild mink (No. 16901). Eight 20 µm thick transverse Nissl-stained sections are presented with section numbers indicated. Abbreviations: AC = amygdaloid complex; AON = anterior olfactory nucleus; C = cerebellum; CS = corpus striatum; D = diencephalon; ER = entorhinal region; HI = hippocampus; M = mesencephalon; NG = neocortex grey matter; NW = neocortex white matter; O = medulla oblongata; OBM = olfactory bulb without plexiform layer; OBP = plexiform layer of olfactory bulb; OT = olfactory tubercle; OTI = other tissue; PS = pre- and parasubiculum; PR = prepiriform region; ST = septum telencephali.

The sizes of total brain, the five fundamental brain parts, and certain telencephalic structures were measured in wild mink (*Mustela vison energumenos*) and ranch mink of a Dark Standard strain of the same species. By means of intraspecific allometric methods for analysing the relationship between brain weight and body weight (net carcass weight), the volumes of the brain parts were compared in both groups. In general, total brain, as well as all the parts measured, were smaller in size in ranch mink independent of body size, age, and sex, indicating that domestication has led to a decrease in size. There were differences in the amount of decrease in the various brain parts. These are discussed in connection with domestication time, with comparable results obtained in other species, and with regard to the functional importance of the brain parts.

Journal of Zoology 239, 4, pp. 645-661, 1996. 6 tables, 2 figs., 47 refs. Author's summary.

Wild animal - domesticated - animal - experimental animal: changes in the brain during early ontogeny depend on environmental conditions

R. Apfelbach

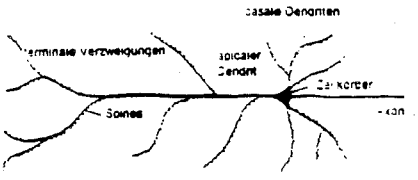


Abb. 1: Schematische Darstellung einer Pyramidenzelle mit dendritischen Spines (nach Bennett et al., 1964).

During the process of domestication, which has taken place over several thousand years, the brain weight of mammals has been reduced. In higher species this reduction has been more than 30%. The youngest area of the brain, phylogenetically the neocortex, has shown the greatest reduction. During

ontogeny, environmental and general husbandry conditions in captivity cause reductions in populations of specific nerve cell types. The dendrites and synaptic connections are most affected. In the ferret, the domesticated form of the European polecat, it is shown that an olfactory deprivation during ontogeny affects neural structures of the olfactory system resulting in behavioural changes.

Tierarzliche Umschau 51, 3, pp. 157-162, 1996. In GERM, Su. ENGL. 2 tables, 3 figs., 13 refs. Author's abstract.

The influence of fur farms on the condition of the ground water

M. Fic, H. Bis-Wencel, L. Saba, J. Slawon

Three farms of fur-bearing animals were chosen for investigation of the influence on ground water. These farms were located under three different hydrogeological conditions, characteristic for Niz Polski (Polish Lowland) i.e. river valley, sand, denudation, post glacial upland. Analyses of ground water samples collected from piezometers showed strong influence of farms on shallow ground water levels, especially high content of NH_4^+ and $N\text{-}NO_3^-$ was found, and high total salt content. But at the same time, on farms are the influence on ground water was very limited with depth. In none of the deep wells used on the farms was found a higher nutrient content.

Wasserwirtschaft, Wassertechnik (Germany), no. 3, pp. 34-36, 1995. In GERM. Only abstract received.

Habitat use of raccoon dogs, *Nyctereutes procyonoides*, in southern Finland

Kaarina Kauhala

Habitat use of raccoon dogs (*Nyctereutes procyonoides*) was studied in southern Finland during the snow-free seasons of 1990-1992 using radio tracking. Habitat selection within the study area and habitat use with the home range were examined. Raccoon dogs favoured shore areas especially during early summer. Shore areas with dense undergrowth provide food (e.g. frogs) and shelter, and raccoon dogs often escape into water when attacked. During autumn, raccoon dogs favoured moist heaths with abundant berries, which serve as an important food source before entering winter dormancy. The habitat use of raccoon dogs is thus affected by the availability of food, shelter and suitable den sites. Two features are common to dogs in all areas: 1) they are very often found near water and 2) during autumn they are more or less dependent on fruits and berries, which affects their habitat selection.

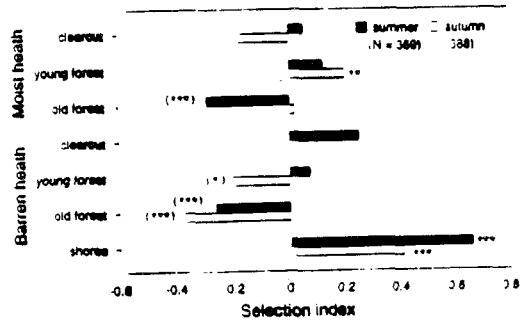


Fig. 2. Habitat use of raccoon dogs in Evo research area, southern Finland, during early summer and autumn of 1990–1992. The selection index is calculated according to Strauch et al. (1990). A positive selection index means that the habitat is favoured, negative values indicate that the habitat is used less frequently than expected. Habitat use is compared with the availability of each habitat which is estimated on the basis of the distribution of 532 random fixes from the Evo area. The statistical significance is indicated by asterisks (t-test: * $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$). If the habitat was used less frequently than expected the significance is in parentheses (see text).

Z. Säugetierkunde 61, pp. 269-275, 1996. 1 table, 3 figs., 14 refs. Author's abstract.

Distributional history of the American mink (*Mustela vison*) in Finland with special reference to the trends in otter (*Lutra lutra*) populations

Kaarina Kauhala

The distributional history of the American mink (*Mustela vison*) in Finland in 1951-93 was studied by means of game inquiries and compared to the trends in otter (*Lutra lutra*) populations. Mink were brought to fur

farms in the late 1920s and the first mink were observed in the wild in 1932. In the early 1950s mink occurred mainly in the western and southwestern coast of Finland, but two decades later mink were found in most parts of the country. Today mink are found almost everywhere in Finland; only few observers report that mink are not found in their area. The relative density of mink is now highest in eastern Finland, rather high in southern Finland and quite low in Lapland. The data from the archipelago are, however, sparse. Otter density declined in the 1970s, but increased again in some areas in the 1980s, is now highest in the provinces of Kymi, Mikkeli and Central Finland, and almost lacking from SW Finland, especially from the coast. Among the reasons behind the decline in the otter populations may have been environmental pollutants, like dieldrin in inland areas and PCBs in the coast and archipelago. Human disturbance may also have had an effect, especially in the archipelago. The role of mink is not clear; it seems probable that if there is competition between these species, the otter is the stronger one.

Ann. Zool. Fennici 33, pp. 283-291, 1996. 1 table, 8 figs., 43 refs. Author's summary.

Open field behaviour and latency to eat as indicators of temperament in blue fox

Teppo Rekilä, Jaakko Mononen, Mikko Harri

Use of open field behaviour and latency to eat as a indicator of temperament is based on evolution theory; survival in the wild depends on predictability of the environment. A hungry rat in an unfamiliar environment cannot eat before it has found where the food, enemies, hiding place and etc. are. Differences between three groups (blue fox): 1) successfully reproduced females, 2) barren females and 3) males, were studied with i) open field activity, ii) latency to eat in the open field arena (LEOF) and iii) latency to eat in the home cage in the presence of man (LEC). Barren females were most active and reproduced females were least active in the open field. Latency to each was shortest for males and longest for barren females in both tests. Assuming that the high latency to eat indicates fearfulness, then the barren females were more fearful than the other two groups. If the activity in the open field indicates exploravity, the barren females were as explorative as males and more explorative than successfully reproduced females. Thus, high activity may also indicate fearfulness.

Suomen Elainlaakarilehti 100, 2, pp. 130, 1994. 2 tables. Only abstract received.

Assessing preference for cages with or without a standard nest box in young silver fox (*Vulpes vulpes*)

Jaakko Mononen, Päivi Pyyvaara, Teppo Rekilä, Mikko Harri

According to the current European recommendations for keeping fur animals, each weaned fox shall have available a secluded area, such as a nest box or a platform, which gives to the animal the possibility for resting on a solid floor, observing the environment and hiding.

The preference of seven individually caged young (age 12-18 weeks) silver foxes for two identical cages, one containing a standard wooden nest box in the cage and the other being empty, was assessed during an 11-day experimental procedure. During days 1-3 the animals had free access to both cages. On day 4, the nest box was transferred to the other cage, and the animals had free access to both cages during days 4-8. As an attempt to measure the effect of nest box deprivation, the animals were shut in the empty cage during day 9, and had free ac-

cess to both cages during days 10-11. The behaviour of the animals was recorded continuously with a time lapse video recorder. The percentages of passive and active behaviour in each of the cages was calculated from days 3, 8 and 10 (separately for working hours and evening & night) using the period occurrence method with 5 min sampling period. Friedman Two-way ANOVA was used for statistical analyses.

The silver foxes spent 68±9, 72±12 and 65±20 % (mean ± SD, NS) of their time in the cage with the nest box during days 3, 8 and 10, respectively. The respective percentages for the empty cage were 5±8, 7±11 and 9±17 % (NS). The percentages of the 5 min. periods including activities in both cages were 27±6, 21±3 and 25±7 % (NS), respectively. The deprivation did not induce any change in the cage preference. After the deprivation animals were more active, but only during the working hours. The roof of the nest box was the most popular as a resting place (about 67-75% of total daily resting time). Some individuals rested a part of their resting time in the nest box. All animals totally refused to rest on the net floor of the next box cage. Two foxes; i.e. the first and last in the cage row, rested also on the net floor of the empty cage. These animals had better view of the surroundings while lying there than the other five animals.

The silver foxes showed a clear preference for the cage with the nest box, especially as a resting place. The empty cage was used mainly as an extra space during activity. However, the two animals with a good view of the surroundings from the empty cage also accepted the floor of this cage as a resting place. Thus, it may be that the strong preference for the nest box roof in the remaining five animals was solely due to the lack of other acceptable resting places in this experimental set-up.

Suomen Eläinlää Kärilehti 100, 2, pp. 124, 1994. 1 table. Only abstract received.

Mortality of blue fox cubs. Preliminary report

H.A. Kulbotten

An account is given of some recent and current investigations on cub mortality in silver and blue foxes in Norway. Based on preliminary results, it is suggested that mortality is lower in litters from blue fox than from silver fox females and in litters from adult than from young females. Mortality tended to be slightly higher on farms with <20 breeding females than on larger farms. The effects of body length and restricted feeding of dam, food hygiene and feeding of cubs on mortality are considered.

Norsk Pelsdyrblad 69, 12, pp. 6-8, 1995. In NORG. 2 tables. CAB-abstract.

Population of fur bearers in 1996

P. Clausen

In 1996 there were 1,902,000 mink and 18,700 fox breeding females in Denmark, representing increases of 4 and 11% respectively over 1995. Of the mink females, 1,151,000, 400,000, 101,000 and 66,000 respectively were of the Scanbrown, Scanblack, Mahogany and Pearl colour types. There were 12 100 blue and 5000 silver fox females. Data are tabulated by farm size. There were 186 polecats, 124 raccoon dogs and 4928 chinchillas.

Dansk Pelsdyravl 59, 6, pp. 270-271, 1996. In DANH. 6 tables, 3 figs. CAB-abstract.

Pelt production in different local breeding associations in 1994-95

Anonymous

In 1994-95, in Finland, the production of mink pelts totalled 1,588,673 (representing an increase of 1.4% over the previous year),

that of fox pelts was 1,561,139 (+35.8%), that of raccoon dog pelts 83,010 (+12,000) and that of polecat pelts 50,671 (vs. 92,820 the previous year). Data are presented in 22 tables by colour type, district, farm size and pelt size, and economic aspects are considered.

Finsk Pälstidskrift 29, 12, pp. 323-237, 1995. In SWED. 23 tables. CAB-abstract.

Breeding of furbearing animals in Estonia

O.A. Eldoy

At 8 of the 14 fur farms in Estonia, 50,000 blue fox, 13,0000 silver fox and 14,000 mink pelts were produced in 1995. Details are given of breeding stock, housing management, reproduction and pelt quality and marketing.

Norsk Pelsdyrblad 70, 6, pp. 4-6, 1996. In NORG. 3 photos. CAB-abstract.

Selection for behavioural traits in farm mink

Steffen Werner Hansen

Over a period of 6 years, more than 3000 farm mink were tested for their behavioural response to human contact. Using a simple test (the stick test) five times per generation, the mink were characterized and classified with regard to their response to human contact. Behavioural response that might be caused by genetic factors was found to occur in three lines selected for explorative, fearful, and aggressive temperament. Over six generations, a considerable quantitative difference in behavioural response between the three selection lines developed. Selection for fearful behaviour caused the normal habituation towards man to disappear, and 90% of the mink selected for fearfulness responded consistently with fear to human contact. A less distinct effect was found in mink selected for explorative behaviour at human contact.

A possible explanation may be that the basic level of explorative behaviour in the population was relatively high, but also that the test used did not allow for a graduation of the explorative behaviour towards confidence. Apart from the last two generations of mink selected for fear, all lines have shown a pronounced difference in temperament between sexes showing that females were more fearful than males.

Applied Animal Behaviour Science 49, pp. 137-148, 1996. 2 tables, 3 figs., 23 refs. Author's abstract.

Current production of Mahogany mink

Outi Lohi, Michael Sønderup

The coat colour of Mahogany mink is intermediate to that of Standard and Scanbrown mink, and their pelts have dark guard hairs and brown underfur tinged with blue or red. The expected production of Mahogany mink pelts in Denmark in 1995-96 is around 500,000. Data are tabulated on the purity of colour of Mahogany pelts produced at 2 farms, and details are given of prices. In 1995, the average number of kits weaned per Mahogany female mated was 5.24.

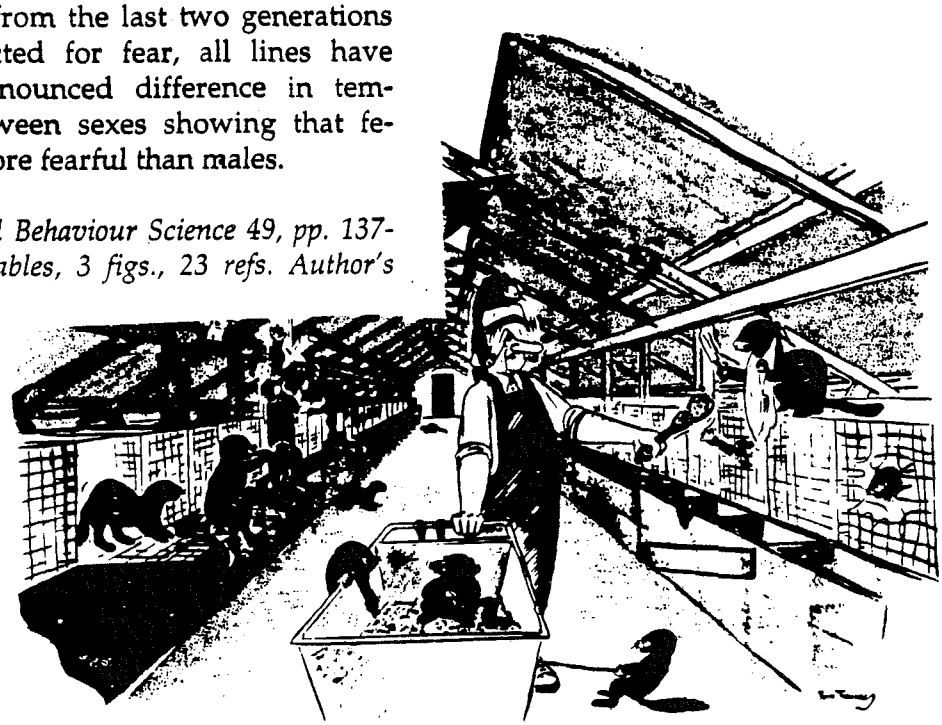
Dansk Pelsdyravl 59, 2, pp. 59-62, 1996. 6 tables. In DANH. CAB-abstract.

Inherited diseases in mink

J. Hansen

An account is given of some inherited diseased in mink. The symptoms and mode of inheritance of tyrosinaemia and the red, wrinkled kit disorder are described.

Dansk Pelsdyravl 59, 5, pp. 223-224, 1996. 2 [illegible] In DANH. CAB-abstract.



Semen cryopreservation in dogs and foxes

W. Farstad

Low temperature preservation of canid semen has been a subject of increasing interest among dog breeders, fur breeders and scientists. Research has focused on the use of different buffers, cryoprotectants, egg yolk additions, equilibration and cooling rates, semen packaging techniques, and freezing-thawing protocol. Some laboratories have seen a beneficial effect of post-thaw dilution, especially with vaginal semen deposition. Few reports have given fertility results on a larger scale as a basis for recommended protocol. However, it is established that artificially inseminated frozen semen can yield good fertility results (75-80% whelping rate) in dogs and in blue fox-silver fox cross-breeding, whereas pure breeding with frozen blue fox semen yields fertility results far below those from natural service. More basic research on membrane function during exposure to freezing regimes and media is called for in this species.

Animal Reproduction Science 42, pp. 251-260, 1996. 51 refs. Author's abstract.

Symptoms of estrus in spayed female ferrets

Pia Englund

Female ferrets have an induced ovulation and can be in constant estrous during the whole breeding season. The influence of estradiol for long periods of time can lead to severe alopecia, pruritus, polydipsia/polyuria and bone marrow depression which results in an aplastic anemia. It is therefore common to spray female ferrets which are only going to be used as pets. The problem is that some female ferrets continue to show signs of estrus despite castration. If the female is not treated, she will experience constant hyperestrogenemia with aggravated symptoms. Today the ethiology is not clear and as a consequence there is no satisfactory treatment. Hyperestrogenemia in sprayed female ferrets is caused by the presence of remnants of ovarian tissue, hyperplasia or tumors of the adrenals. To determine the diagnosis and its ethiology, it is necessary to perform a laporatomy. This is most inconvenient for the ferret and expensive for the owner. Therefore the prognosis should be further disentangled before laporatomy is used as a routine treatment. Finally we should ask ourselves if this kind of manipulation with animals is ethical in order to make ownership of them as pets convenient.

Review article, 11 pp. Statens Veterinärmedicinska Anstalt, Uppsala (Sweden). In SWED, SU. ENGL, SWED. 2 tables. Author's summary.

Life history strategies in a fluctuating environment: establishment and reproductive success in the arctic fox

M. Tannerfeldt, A. Angerbjörn

Natal dispersal, territoriality and reproductive success can have a major impact on the range, genetics and risk of extinction of a population. The proportions of animals that disperse have often been investigated, but not their fate. We have studied the lifetime reproductive success of arctic foxes that successfully emigrated, travelled and settled. Of these, some settled in the vicinity of their natal site as residents and some immigrated from other areas, i.e. short- and long-range dispersers respectively. We found no sex bias in migration patterns. In presaturation years, more immigrants than residents settled. Immigrant females had higher reproductive success than resident females. There was strong support for the ultimate hypothesis of Competition For Resources (CFR), but not for the hypotheses of Competition For Mates (CFM), Resident Fitness (RFH) and Inbreeding Avoidance (IA). Our data on arctic foxes could not be fully explained by any of four proximate hypothe-

ses. We suggest that the reason is that dispersal and establishment should be considered as state dependent life history characteristics of individuals rather than population averages.

Ecography 19, pp. 209-220, 1996. 6 tables, 5 figs., 55 refs. Authors' summary.

Steroid hormones and reproductive behaviour in silver fox males

L.V. Osadchuk

The silver fox (*Vulpes vulpes*), a colour mutant of the red fox is an economically valuable fur animal in northern countries. It has been bred in captivity from the beginning of the 20th century. Reproductive physiology of the silver fox has been studied only scantily. There is still a need to obtain information about the relations between hormones and reproductive behaviour in this species. The aim of this study was threefold. First, to investigate sexual and agonistic behaviour of silver fox pairs during different stages of the reproductive cycle. Second, to analyse the correlation between seasonal changes in plasma levels of sex hormones and cortisol and behaviour in silver fox males. Third, to assess the effect of introducing a female to the male on the male hormonal status. In captive foxes, the breeding season extends from January to March. Silver fox males were tested for sexual and agonistic behaviour related to sexual interactions during different stages of the reproductive cycle in September, January, and February. The high levels of aggressive interactions between sexes and the very small number of mountings were observed in September and in January when the female introduced to the male was in estrus. In February, the introduction of a receptive female to the male resulted in decreased aggressive behaviour and increased sexual behaviour in pairs, and these changes occurred independently of mating. We observed wide variations in plasma levels of testosterone and estradiol, but not in those of cortisol between different stages of the reproductive cycle. During the reproductive season, silver fox males responded to the levels when the female was in estrus. In contrast, the levels of these hormones did not change in males, when they encountered a receptive female. A female did not elicit any cortisol response in males during all the periods of the reproductive cycle studied. The data obtained suggest that sexual behaviour in silver fox males can be facilitated by testosterone and estradiol while aggressive interactions between a male and a female are not related to these hormones.

1st International Symposium on Physiology and Ethology of Wild and Zoo Animals, Berlin, Germany, September 18-21, 1996. Only abstract received.

Influence of light wave length on the reproductive performance of mink

R.J. Aulerich, S.J. Bursian, C.R. Bush, A.C. Napolitano, P. Summer

The present two-year study was designed to investigate the effects of various wave lengths of light on the reproductive performance of mink. Information pertaining to stimulatory and/or inhibitory wave lengths of light for mink may have practical applications for mink producers interested in the use of artificial lighting regimes to enhance reproductive performance or influence molting in their animals.

The results of these studies have demonstrated that mink can reproduce when exposed exclusively to selected narrow ranges in wave lengths of visible light.

However, the reproductive performance of the mink was not equal to the standards for mink raised out-doors under natural light conditions. Although too few females whelped and produced too few kits to assess with certainty the influence of the vari-

ous wave lengths of light (colour) on the reproductive performance of the animals, the limited data obtained in these studies suggest that the longer wave lengths of visible light may be more beneficial to mink reproduction than the shorter wave lengths.

Michigan State University. Fur Animal Research, pp. 18-27, 1997. 7 tables, 3 refs. Summary by G. Jørgensen.

Efficacy of tamoxifen in reducing the hyperestrogenic effects of dietary zearalenone in mink

R.J. Aulerich, S.J. Bursian, B. Yamini

Recent accounts from fur farmers of reproductive impairment in mink have been associated with zearalenone (Z) contamination of mink diets. Z is a relatively common nonsteroidal estrogenic mycotoxin found in a variety of cereal grains. It is a toxic metabolite produced by numerous species of *Fusarium* fungi which can grow on grains prior to and after harvest under favorable environmental conditions. Z is usually nonlethal to animals but is important to livestock producers because its hyperestrogenic effects adversely influence the reproductive performance of animals.

Since the adverse effects of Z are manifested through its hyperestrogenic activity, this study was conducted to investigate the efficacy of tamoxifen (TAM), a synthetic triphenylethylene antiestrogen, in reducing or eliminating the detrimental effects of Z on reproduction in mink. TAM functions as an antiestrogen by binding to tissue estrogen receptors thus blocking the action of endogenous estrogen.

The results of this study indicate that TAM, at the dose administered, was not effective in ameliorating the estrogenic effects of dietary Z in female mink but rather it acted as a potent estrogen agonist resulting in complete breeding failure and numerous histopathologic alterations throughout the reproductive tract, including severe pyometra. Thus, in the mink, as in the closely related European ferret, TAM can be classified as an estrogen agonist.

Michigan State University. Fur Animal Research, pp. 47-58, 1997. 3 tables, 3 figs., 22 refs. Summary by G. Jørgensen.

Melatonin-induced downregulation of uterine prolactin receptors in mink (*Mustela vison*)

Jack Rose, O. Slayden, Fredrick Stormshak

A study was conducted to investigate the effects of exogenous melatonin on serum concentrations of estradiol-17β (E_2) and progesterone (P_4) and uterine prolactin (PRL) receptor concentrations in mated mink. In Experiment 1, two groups of adult, standard dark, female mink were mated to fertile males on March 8 or 9. On March 16, mink in group 1 (N=8) received an implant containing 10 mg crystalline melatonin. On April 2, all animals were lightly anesthetized and blood samples collected via cardiac puncture were analysed for serum concentrations of E_2 and P_4. Animals were subsequently sacrificed and uterine samples collected for analysis of PRL receptor concentrations. In Experiment 2, adult female mink were assigned randomly to three treatment groups and mated to fertile males between March 6 and 9. On March 16, mink in group 1 (N=6) received empty Silastic implants and served as controls. Mink in group 2 (N=6) received a Silastic implant containing 10 mg melatonin. Animals in group 3 (N=6) received an implant containing 10 mg melatonin and in addition each mink was given daily sc injections of P_4 (1 mg) from March 21 to April 5. At this time the mink were sacrificed, the number of implantation sites recorded, and uteri collected for quantification of PRL receptors. In Experiment 1, exogenous melatonin reduced serum P_4 concentrations to almost nonde-

tectable levels (controls, 8.08 ± 0.73 vs. treated 0.82 ± 0.12 ng/ml; $P < 0.001$) and resulted in increased concentrations of E_2 (controls, 13.3 ± 1.9 vs. treated, 22.0 ± 1.9 pg/ml; $P < 0.01$). Uterine PRL receptor concentrations decreased ($P < 0.05$) from 37.74 ± 9.37 fmol/mg protein (controls) to 23.74 ± 9.03 fmol/mg protein in response to melatonin treatment. In those mink treated with melatonin plus P_4 (Experiment 2), uterine PRL receptor concentrations were increased to levels not significantly different than those of controls. None of the mink treated with melatonin alone or in combination with P_4 exhibited implantation. Uteri of mink treated with melatonin or melatonin plus P_4 did not differ in weight but tended to weigh less than uteri of control mink. These data suggest that a high systemic ratio of P_4 to E_2 is essential for production of the uterine PRL receptor in mink and supports the findings of others that implantation in mink cannot be initiated with P_4 alone.

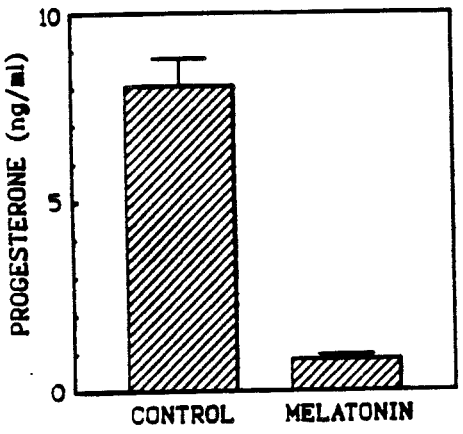


FIG. 1. Mean (±SE) serum progesterone concentrations in mated control and melatonin-treated mink ($N = 8$). Means are significantly different at the 0.001 level.

General and Comparative Endocrinology 103, pp. 101-106, 1996. 5 figs., 36 refs. Authors' summary.

Placental scars and estimation of litter size: an experimental test in the Arctic fox

Olav Strand, Terje Skogland, Tor Kvam

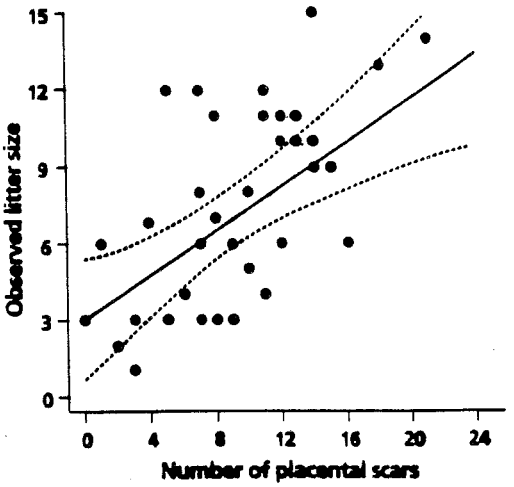


FIG. 1.—Observed litter size plotted against counts of placental scars equal to or darker than category 3. Dotted line represents the 90% *CI* for predictions of litter size, while the solid line represents the regression of litter size on number of scars.

The assumptions required to estimate litter size at birth from counts of placental scars were experimentally tested in the Arctic fox (*Alopex lagopus*). Effects of abortions were tested by examination of uteri from females caused to abort at 20 and 40 days pregnancy. The reliability of estimated litter sizes was tested by comparing litter size at 2-3 days postpartum with counts of placental scars. placental scars were categorised according to their visibility, with pale and hardly detectable scars designated as category 1 and dark and fully pigmented scars as category 6. The results showed that scars from abortions and scars that persisted for 80 weeks postpartum were paler and less visible than scars from full-tern fetuses at 20-35 weeks postpartum. Pale scars from abortions and scars sustained from earlier pregnancies, therefore, should be excluded

when estimating litter size at birth. Litter size at 2-3 days postpartum was not significantly different from estimated litter size when pale scars were excluded from the estimates. Our results confirmed that breeding females might be distinguished from nonbreeders by the visibility of placental scars. The accuracy of this approach, however, depends on the frequency of late abortions in the population.

Journal of Mammalogy 76 (4), pp. 1220-1225, 1995. 2 tables, 2 figs., 19 refs. Authors' summary.

Some observations on the mating behaviour of captive American pine martens *Martes americana*

Judith Grant, Alex Hawley

Four male and 8 female captive pine martens *Martes americana* (Turton, 1806) were observed for signs of mating. Behavioural changes associated with the breeding season began in mid-June. Subjective observation indicated that the frequency of abdominal scent marking and body contact between males and females increased from June through July and decreased during August.

Aggression between females increased markedly during the breeding season. The animals emitted diverse vocalizations, including a throaty chuckle that was associated with breeding and that was indistinguishable by observers from a call emitted when females appeared to be consoling young kits. Copulation was observed on 4 occasions during July in one pair of martens, and was typical of that described for *Martes* species in general. Two female appeared to control the timing and duration of copulation and seemed in one instance to actively solicit the attention of the male.

Acta Theriologica 41 (4), pp. 439-442, 1991. 12 refs. Authors' summary.

Reproduction of the red fox *Vulpes vulpes* in Central Italy

Paolo Cavallini, Simona Santini

The reproductive output (ovulation rate, fertility, barrenness, productivity, pre-natal mortality) of the red fox *Vulpes vulpes* (n=317) has been studied in a Mediterranean region (Pisa province, Central Italy) in 1992 by post-mortem analysis. On average, female foxes shed 5.03 ± 1.27 ova, had 3.995 ± 1.25 placental scars and 3.88 ± 1.55 live embryos. Twenty percent of foxes were barren, and intra-uterine mortality was common: 47% of females lost at least one ovum before implantation; 43.5% of yearlings (≤ 1 year old) lost at least one foetus, whereas only 16.7% of adults did so.

Male yearlings had lower testis mass than adults. The reproductive output was higher for heavier females, but marginally so for those with greater head and body length. Barrenness and intra-uterine mortality were not related to body size. Amount of body fat and age were unrelated to reproductive output, with the exception of post-implantation mortality (higher for yearlings).

All these results suggest that the reproduction of the red fox was not limited directly by food availability, but rather by social modulation. The reproductive output in this population was low in comparison with other populations, in spite of faster physical development. A review of the literature suggests compensatory reproduction in the red fox, litter size being larger in areas of higher mortality.

Ann. Zool. Fennici 33, pp. 267-274, 1996. 1 table, 4 figs., 46 refs. Authors' summary.

Body weight of kits from young and adult females

T.N. Clausen

Data on the reproductive performance of 478 standard mink females, aged 1 or 2 years, were analysed. The incidence of infertility was 4% higher for females in their 1st than their 2nd parity, and litter size at birth was 0.6 kits higher for the latter than for the former. Kit weaning weight was higher in 2nd than in 1st litters and decreased with increasing litter size. The incidence of nursing disorders and overfat kits was higher in 2nd than in 1st litters, but dam body weight in February had no significant effect on litter size at birth.

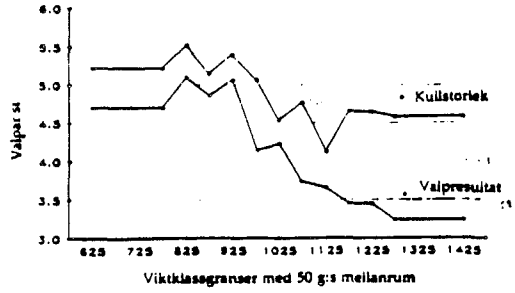
Dansk Pelsdyrblad 59, 5, pp. 225, 1996. In DANH. 2 figs. CAB-abstract.

Body weight at mating affects whelping performance

T. Dahlman

An investigation carried out at Maxmo in 1988 revealed that mink females that mated at a body weight of around 900 g had significantly larger litters than those mated at a body weight of <800 or >1000 g. In trials carried out in 1993, 29.3% of mink females fed ad lib. failed to give birth to a litter vs. 19.3% of females subjected to restricted feeding (10% below average) from Sept. to Feb. and litter size per mated female averaged 3.5 vs. 3.9. For 114 blue fox females, mated in 1989 at a body weight of <5500, 5500-5999, 6000-6499 or >6500 g, the percentage of females failing to produce a litter was 5, 10, 17 and 9, the number of cubs born per female whelping 11.1, 11.6, 9.8 and 9.2, and litter size at 3 weeks 8.6, 8.0, 8.2 and 6.2 per female whelping and 8.1, 7.2, 6.8 and 6.2 per female mated. It is suggested that, for optimum results, females should be fed restricted amounts of high-quality food in the months before mating, but sudden weight loss should be avoided.

Figur 1. Moderns parningsvikts inverkan på avelsresultatet hos mink.
Maxmo 1988, N = 384
Kullstorlek = valpar/hona som valpat 31.5.
Valpresultat = valpar/parad hona 31.5.



Finsk Pälstidskrift 29, 12, pp. 302-304, 320, 1995. 1 table, 1 fig. In SWED. CAB-abstract.

The lactating period

L.L. Dille, G. Sanson

The possible causes of reduced milk supply of mink bitches are discussed, with particular emphasis on the composition of their feed. It is recommended that dry matter should not exceed 32%, and that the salt content should be between 0.40 and 0.45 g NaCl/100 kcal. The salt balance appears to be critical; drinking water with appropriate salt and glucose concentrations can be used for treatment, but if the animals are severely affected injections of physiological saline with glucose are required.

Norsk Pelsdyrblad 70, 4, pp. 6-8, 1996. 3 tables. In NORG. CAB-abstract.

Artificial insemination of foxes in 1995

Erik Smeds

For 5000 silver fox females and 122,700 blue fox females inseminated in Finland in 1995 with blue fox semen, and 13,000 silver fox

females inseminated with silver fox semen, the CR was 85, 88 and 85% respectively, and litter size per inseminated female averaged 4.95, 5.93 and 2.67. For 87 and 73% and litter size averaged 3.79, 4,87 and 2.11. Results are compared with those in 1994.

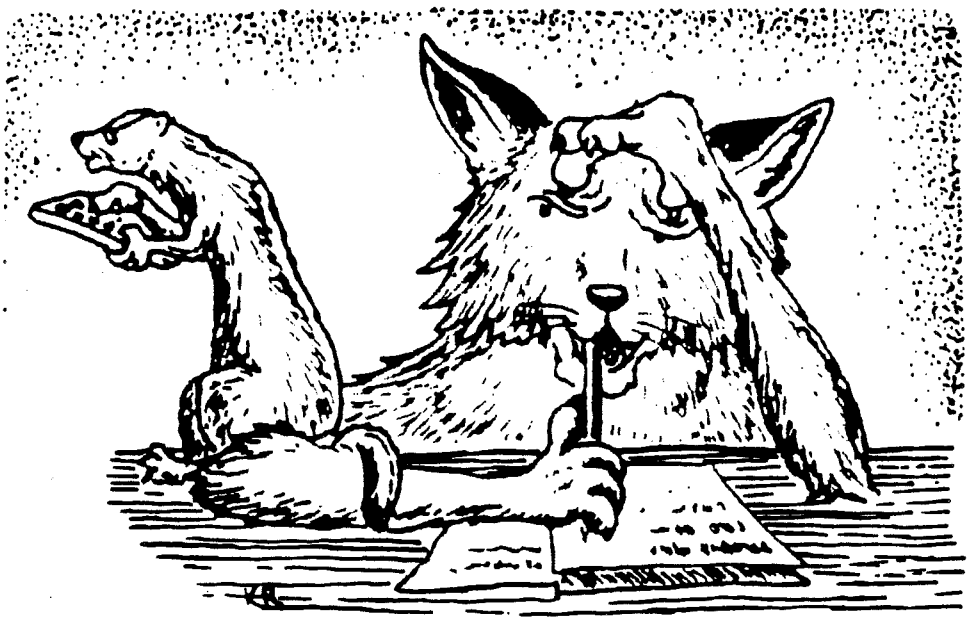
Finsk Pälstidskrift 29, 12, pp. 321, 1995. 2 tables. In SWED. CAB-abstract.

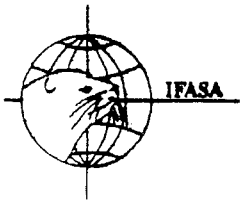
Artificial insemination in foxes. Results in 1995

Jan Fougner

For 9066 blue fox females (inseminated with blue fox semen) and 332 blue and 2597 silver fox females (inseminated with silver fox semen) in Norway in 1995, the CR was 81.8, 86.1 and 82.9% respectively, and litter size averaged 8.04, 8.11 and 4.3 at birth and 5.87, 6.03 and 3.39 at weaning. The number of cubs weaned per inseminated female averaged 4.8, 5.19 and 2.81.

Norsk Pelsdyrblad 70, 1, pp. 37, 1996. 1 table. In NORG. CAB-abstract.





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Original Report

Studies on the use of whey-fat concentrate in feeding growing Polar foxes.

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Summary

Studies were carried out on 80 young Polar foxes aged 6 to 20 weeks, divided into two groups. The objective of the studies was to estimate the effect of a whey-fat concentrate on the selected parameters. Analyses were made of body weight increments, the animal habit, morphological changes in the internal organs and fur quality. The results suggest a beneficial effect of the analysed feed on the animal growth and pelt trait. On the other hand, no effect was observed on fox health.

Introduction

Good pelt quality obtained in fur-bearing animals depends to a large extent on proper feeding, i.e. on proper selection of feeds and levels of energy from particular nutritive components. The results of many studies on the feeding of carnivorous fur-bearing animals showed that it is beneficial to increase the energy level in the diets of growing foxes and mink. Energy levels and energy sources seem to be an important problem. Fats and carbohydrates represent major sources of energy. Utilisation of different energy sources in animal diets and their mutual proportions should depend on the animals' requirements, biological value and energy content of the components, but also on economic factors which affect profitability of animal breeding. Carbohydrate energy supplied with cereal components is relatively expensive due to an expensive and labour-demanding thermal processing of these components. Fats are cheaper sources of energy, and their excess in the total feed balance impels more interest in these energy sources. Fats are not uniform substances and they are of multiple importance. This increases their biological value. It should be remembered that fats also contain unsaturated fatty acids, which are not synthesised by the animal organism and which should be supplied with the feed. Fat is also indispensable for the assimilation of some vitamins: A, D, E and K. It is a carrier of the most condensed metabolic energy and thanks to this it has a protective function for the proteins, as has been confirmed in many scientific studies, in which better weight increments were obtained with animals given diets with increased fat content (*Ahlstrom 1995, Barabasz 1984, Gugolek et al. 1993a, b, Skrede et al. 1992, Pierieldik et al. 1975*). Moreover, a negative correlation was found between the increase of fat content in the diet and feed use per unit of growth,

and this is an important economic aspect (*Lorek et al. 1993a, Lyngs 1990*). Hence, an increase of the energy content in the diet, achieved by adding fats to the feed, seems to be justified. It is, however, still to be found out what kind of fat should be used and in what form. These problems have been dealt with among others by Rouvinen et al. (1989). These authors studied the digestibility of different fats by Polar foxes and showed better suitability of fish and plant oil compared with the animal fat (tallow). Also the percentage of fat in the diet is still a subject of scientific research. Recent studies on increased energy content in the diets for young foxes and mink showed that when good quality proteins are maintained at an optimal level of 30% of EM from this component, the energy content from fat may be as high as 60% of the whole energy in the diet (*Ahlstrom 1995*). Also Skrede et al. (1992) analysed the proportion between fat and carbohydrates in the diets for growing Polar foxes and mink and showed that it was possible to further increase the energy content; the growth of the animals and pelt traits improved in the group fed diets with a high energy content. Various dry preparates with a high fat content have recently appeared on the market.

They facilitate preparation of the feed mixtures, as they can easily be mixed with other components. Usually these fats are also stabilised to prevent oxidation, so they can be stored and used to feed animals for a long period. A whey-fat concentrate belongs to this category. In view of its high energy content it can become a substitute for feed fats. The first attempts to use this concentrate to feed mink were fairly promising. The objective of this study was to find out if there was a possibility to use whey-fat concentrate to balance energy in the diets for Polar foxes during their growth and development of their winter coats. This possibility was assessed on the basis of utility indices and histopathological examination of some internal organs.

Materials and methods

The studies were carried out on a commercial farm on juveniles of blue Polar foxes, in the period from weaning till the end of growth and attaining slaughter age. Different feeding regimes represented the experimental factor; they consisted of adding a whey which had been greased with pork fat according to the technology of the firm LOL AGR INTERNATIONAL. Its chemical composition (in %) was as follows:

- dry weight	- 95.40
- crude ash	- 5.84
- organic matter	- 89.56
- total protein	- 8.23
- crude fat	- 32.94
- nitrogen-free extractable compounds	- 48.39
- gross energy (MJ/kg)	- 23.894

80 animals born in the same period were randomly selected for the experiment. They were divided into two groups of 40, with the same number of males and females in each. Attention was also paid to animal origin, so that the same number of males and females from a definite litter was present in each group. The animals were placed in cages for young growing foxes, 4 animals of the same sex in each cage.

The experiment was divided into two physiological periods: intensive growth (July - August) and winter coat development (September - November). Animals in group I (control) were given a standard diet, the same that was given to the other animals on the farm. Foxes in group II (experimental) were given a standard diet supplemented with whey-fat concentrate at the rate of 10 % in the first experimental period, and 5 % (in relation to fresh weight) in the second one.

Feed and water were given ad libitum throughout the experiment. Diet composition changed in the course of the experi-

ment, being adapted to the requirements of growing animals. The following feeds were used, the percentage of which depended on the physiological period (%): beef with bone - 10-20, various slaughter leftovers - 30, hard cod offal - 5-10, hard poultry offal - 10-25, cottage cheese offal -5, barley grits - 18-22, vegetables and green fodder - 8-10, polfamix L - 2 kg/t.

The studies comprised measurements of body weight, estimates of animal habit, histopathological examination of some internal organs, and pelt assessment and classification.

Body weight was obtained by weighing each animal up to 0,1 kg every two weeks, always at the same time, before feeding. The animal habit was assessed by a commission which used the standards worked out for blue Polar foxes. Histopathological examinations were performed for 6 animals, selected randomly from each group. The animals were dissected immediately after slaughter and samples of heart muscle, liver, kidneys, spleen, stomach, duodenum, jejunum and colon were collected. They were fixed in neutralised 10 % formalin, immersed in paraffin blocks, and the obtained microtome scraps were stained with haematoxylin and PAS eosin according to the method of McManus. The results are presented as a quantitative list of the changes observed in particular organs. All the other animals were sacrificed and their furs prepared in the usual way. These were assessed as to their fur + leather quality. The results are presented as mean values.

Results and discussion

Addition of whey-fat concentrate to the animal diet changed the feeding indices of the experimental diet, both during the growing period and the period of winter fur development (Tab. 1). There was a slight decrease of the protein content, and an increase of fat and carbohydrate content, this being related to the chemical composition of the concentrate, which is presented in the methods. Energy content in the diet of group II also increased since the energy level in the concentrate was 23.894 MJ.

Table 1 Indices of nutritional values of feed rations

Period	Group	Digestible components g/kg			EM MJ/kg	% energy from:			Digestible protein g/MJ EM
		protein	fat	carbohydrates		protein	fat	carbohydrates	
Growth	I	117	55	83	5,779	38	37	25	20
	II	109	72	108	6,499	32	40	28	17
Fur development	I	112	50	95	5,693	37	34	29	20
	II	105	59	116	6,325	32	36	32	17

Table 2 presents the body weights of the foxes. Weights at the beginning of the experiment were very similar, but from the 10th week it was noted that the animals in the experimental group were heavier than those in the control. Statistical analysis showed that the difference in body weight between the two groups became statistically

highly significant from the 14th week, in favour of the experimental group. The final body weight of the animals, determined when they attained 20 weeks of age, was 0.650 kg higher in the experimental group than the control. Hence, the average difference between the two groups amounted to 11 %, and it can be concluded that diet supplementation with whey-fat concentrate affected the growth rate of Polar foxes.

Table 2 Body weights (kg)

Age (weeks)	Statistical measures	Group	
		I	II
	n	40	40
6	x	0,99	1,01
	v	0,25	0,22
8	x	1,94	1,95
	v	0,36	0,29
10	x	2,67	2,75
	v	0,43	0,40
12	x	3,40	3,57
	v	0,48	0,40
14	x	$3,94^{B}$	$4,36^{A}$
	v	0,44	0,43
16	x	$4,73^{B}$	$5,21^{A}$
	v	0,52	0,67
18	x	$5,25^{B}$	$5,92^{A}$
	v	0,51	0,66
20	x	$5,93^{B}$	$6,58^{A}$
	v	0,65	0,67

a,b -α = 0.05
A,B -α =0.01

Estimates of the animal habits are presented in table 3. Statistical analysis of the results revealed that the values of particular parameters were higher in the experimental group, the colour type being the only exception. Average animal size in group II was much higher than in the control (by 0,8 points) and this difference was statistically highly significant. The observed differences of this parameter confirm the difference in the animal weight between group I and II. Similar results were also obtained by Lorek et al. (1993b) who found statistically higher values of the animal size estimates in the group of Polar foxes given diets supplemented with another fat concentrate. Colour type and colour purity are to a large extent genetically determined, so feeding regimes have little effect on these traits. The observed differences might have been caused by randomised animal selection to the two groups. Fur thickness and such traits as hair length, silkiness and resilience are largely dependent on the environmental conditions, feeding inclusive. The animal habit estimates showed that the values were 0,43 points higher in the experimental animals than in the control, and the difference was statistically highly significant. Positive correlation between high energy content in the diet, originating from fat, and fur thickness has been observed by many authors. Lorek (1987) showed that domesticated polecats fed diets with plant oil supplements were characterised by thicker coats than animals on a diet with limited energy and fat. Also other experiments carried out by this author on Polar foxes fed diets containing greased extruded ground barley had a beneficial effect on fur thickness (*Lorek et al. 1994*). The same has been observed by other authors (*Skrede et al. 1988, Skrede et al. 1992*). Hair length, silkiness and resilience were 0,42 points better in the experimental animals.

This highly significant difference reflects the beneficial effect of the whey-fat concentrate on the animal habits. The experimental animals looked well, and when this character was expressed in points, they attained the highest values. Average sum of points of all parameters was 1.87 higher in group II, and this is a fairly large difference.
Hence, it can be concluded that the whey-fat concentrate added to the diet for growing Polar foxes had a positive effect on the animal growth and pelt traits.

Table 3 External conformation (points)

Feature of conformation	Statistical measures	Group I	Group II
	n	40	40
animal length	x	4,80^{B}	5,60^{A}
	v	1,49	1,13
colour type	x	3,00	2,93
	v	0,00	0,27
fur cleanness	x	4,95	5,25
	v	1,01	0,98
fur density	x	5,00^{B}	5,43^{A}
	v	0,45	0,55
hair length, elast., silk	x	5,33^{B}	5,75^{A}
	v	0,62	0,44
general appearance	x	3,00	3,00
	v	0,00	0,00
total points	x	26,08^{B}	27,95^{A}
	v	1,97	1,65

a,b -α = 0.05
A,B - α = 0.01

Quantitative presentation of the morphological changes observed in the internal organs of the foxes is given in table 4. Histopathological examination of heart muscle scraps revealed congestions and small foci of infiltrating lymphoidal cells only in one animal from each group. In all animals of the two groups there were parenchymatic and vacuolar degenerations in the liver, but in foxes from the control group bigger vacuoles were observed in the hepatocytes and degenerating cells were more numerous than in group II. Moreover, almost all control animals had infiltrations of uninuclear cells in the inter-lobe liver spaces. The majority of the animals in both groups had congestions in the liver, but they were more pronounced in the control group. The spleen of many animals also had congestions and the lymphatic nodules were enlarged. Kidneys of foxes from both groups showed parenchymatic degeneration of the tubule epithelial cells, vacuolar degeneration, and epithelium necrosis. In addition to this, many foxes in the experimental group had hemosiderine deposits. The kidneys were congested in both groups, and extravasations were noted. Infiltrations of lymphoidal cells were also observed in the intervasal connective tissue in 3 foxes from group I and 2 foxes from group II. Excessive peeling off of the epithelial cells was observed in stomach mucous membrane in animals from both groups, slightly less pronounced in the control group. Congestion and large amounts of serous-mucous exudate suggests acute gastritis. Pathomorphological changes in the mucous membrane of duodenum and jejunum were very similar. Peeling off of the epithelial cells and damage of the villi apices were observed; in many cases there was mucous, infiltrations of the lymphoidal cells and congestions of mucous membrane.

The inflammation process in the jejunum was more noticeable in the experimental animals. Enlarged lymphatic nodules and proliferation of connective tissue were observed in single animals. Epithelial cells in the large intestine were peeling off in the animals from both groups, and in group II villi apices were congested in the majority of the animals.

Table 5 presents the results of pelt estimates. Comparing the fur length in the two groups the beneficial effect of the experimental factor is quite noticeable. The pelts of the experimental animals were longer, the difference being 0.15 points. Fur and leather were 0,25 points better in the animals on the diet with concentrate supplementation than in the control. This estimate confirms the results obtained during animal habit estimation.

Table 4 Qantitative list of morphological changes in foxes internal organs

Organ	Kind of change	Group I	Group II
Heart	-congestion of cardiac muscle	1	1
	-infiltrations of lymphoidal cells	1	1
Liver	-parenchymatous degeneration	6	6
	-vacuolic degeneration	5	6
	-infiltrations of lymphoidal cells	5	2
	-congestion	4	4
Spleen	-congestion	5	6
	-proliferation of lymphatic nodules	4	2
Kidneys	-parenchymatous degeneration	6	4
	-vacuolic degeneration	3	4
	-necrosis	3	3
	-hemosiderine deposits	0	4
	-congestion	5	5
	-effusions in kidney medulla	0	2
	-infiltrations of lymphoidal cells	3	2
Stomach	-epithelium peeling	3	2
	-congestion	1	3
	-serous-mucous exudate	1	2
Duode-num	-epithelium peeling	1	6
	-villi degradation	3	5
	-necrosis of ephithelial cells	4	6
	-exessive amount of mucus	3	5
	-congestion	2	4
	-infiltrations of lymphoidal cells	0	4
Jejunum	-exessive amount of mucus	1	4
	-epithelium peeling	6	6
	-necrosis of villi apices	0	5
	-infiltrations of lymphoidal cells	5	4
	-congestion of villi apices	0	2
	-overgrowth of lymphatic nodules	0	1
	-proliferation of conective tissue	0	1
Colon	-epithelium peeling	6	6
	-congestion	0	5
	-infiltrations of lymphoidal cells	6	6

Table 5 Skin classification (pieces)

Specification	Group	
	I	II
Size (cm):		
1 (>115)	-	-
2 (106-115)	14	16
3 (97-106)	22	24
4 (88-97)	4	-
5 (79-88)	-	-
$\bar{x}$	2,75	2,60
2. Fur category		
1	12	20
2	24	18
3	4	2
$\bar{x}$	1,80	1,55

Conclusions

Addition of whey-fat concentrate to the diet for growing Polar foxes improved animal growth, fur quality and traits. Histopathological changes were observed in both groups of the animals, so it is not possible to conclude definitely on the effect of the analysed concentrate upon animal health, although in the experimental group the degenerative changes in liver were less pronounced. It is assumed that the changes observed in the digestive tract could have been caused by other factors resulting from the specificity of fox feeding in a commercial farm.

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Study of concentrations of some mineral elements in native feeds for carnivorous fur-bearing animals

D. Mertin, K. Süvegova, P. Sviatko, I. Tocka

Concentrations of Ca, K, Na, Mg, Fe, Zn, Cu, Mn, Pb, Cd and Co were determined in some feeds for carnivorous fur-bearing animals: whole chickens, poultry offal (shanks, heads), beef, beef lungs with trachea, beef mammary gland, beef offal (slaughterhouse offal), Mäsomix feed mixture (40% beef with bone, 40% mixed poultry offal, 20% beef viscera) and rabbit liver. Approximately 100 kg of each of the investigated feeds were homogenised, and three average samples of 200 g were taken afterwards. The samples were analysed using the method of atom absorption spectral photometry using a PERKIN-ELMER, model 5000 and a graphite cell HGA 500. Each feed sample was subjected to three measurements. The values of the concentrations of the investigated elements were treated by mathematical-statistical processing. The contents of the investigated mineral elements in the particular kinds of feeds were very different; highly significant differences were found mainly in macroelements - Ca (24.650-30 353.480 mg/kg dry matter), Mg (346.500-4 179.970 mg/kg dry matter), K (731.285-8 233.559 mg/kg dry matter). The value of the particular kinds of feeds is different with respect to mineral nutrition (in mg per kg dry matter): Whole chickens are relatively poor in mineral content, they have low contents of Cu (2.700 mg), Mg (778.933 mg) and Fe (114.300 mg) while the content of heavy metals is also low. Poultry offal - shanks have the highest content of Ca (30 353.480 mg), a low content of Cu (4.550 mg) and the lowest content of Pb (1.175 mg). Poultry offal - heads have a high content of Ca (22 825.500 mg) and a low content of Cu (3.900 mg). Beef without bone has a high content of Cu (9.967 mg), but low contents of Ca (192.100 mg) and Mg (409.067 mg). Beef lungs with trachea have the highest content of Na (3 247.790 mg) and Fe (323.708 mg), high contents of Mg (2 558.020 mg), Cu (8.923 mg), Pb (2.085 mg), but low contents of Ca (480.869), K (2 507.070), Mn (2.882 mg) and Cd (0.154 mg). Beef mammary gland is poor in mineral content, only Mg content is somewhat higher (1 706.210 mg), while the contents of Mn (2.100 mg), Zn (16.577 mg), Na (1 177.520 mg) and Co (0.547 mg) are the lowest. Beef offal (slaughterhouse offal) has the highest concentration of Mg (4 179.970 mg), as well as that of Cd (1.015 mg), Co (4.519±0.433 mg) and Pb (10.220 mg); it has, however, the lowest content of K (731.285 mg). Mg content in Mäsomix is lowest (346.500 mg) and the content of other minerals is also low; only C concentration is higher (0.733 mg). Rabbit liver has the highest content of K (8 233.550 mg), Cu (12.700 mg), Zn (113.900 mg), but its Ca content is lowest (24.650 mg).

Zivocisna Vyroba 40, 10, pp. 465-470, 1995. 2 tables, 11 figs., 23 refs. In SLOE. Authors' summary.

Intestinal hydrolytic activity in young mink (*Mustela vison*) develops slowly postnatally and exhibits late sensitivity to glucocorticoids

Per T. Sangild, Jan Elnif

The development of hydrolase activity in the intestinal brush border membrane is important for the maturation of digestive function in early life. The development and glucocorticoid control of intestinal enzymes were investigated in the mink (*Mustela vison*), a carnivorous species, in which the intestine matures relatively late in postnatal life. Mink kits (n=110 from 20 litters) were either not treated or injected intramuscularly for 7 d with saline, adrenocorticotropic hormone [ACTH, 50 μg/(kg·d)]. The kits were killed at 2, 4, 6, 8 or 10 wk of age and the proximal, middle and distal intestine removed for analyses. Lactase activity was maximal at 4 wk and decreased to about 5% of this level during the following 2 wk. Cor-

tisol treatment stimulated total lactase activity at 2 wk (170% that of controls, $P<0.05$) and reduced this activity at 4 wk (20% that of controls, $P<0.001$). Aminopeptidases N and A underwent their major developmental increases in activity at 4-6 wk and again, enzyme development was stimulated by cortisol. Other enzymes showed either a gradual increase (maltase), a slight decrease (dipeptidylpeptidase IV) or no consistent change (sucrase) in activity with advancing age from 2 to 10 wk, but the activities remained highest in cortisol-treated kits. Treatment with ACTH enhanced the activity of all enzymes at 2 wk but had little effect thereafter. Intestinal hydrolases develop later in the mink and are sensitive to glucocorticoid induction for a longer period in postnatal life than in species such as rats, pigs or humans. The mink is a useful model in studies of the regulatory mechanisms which influence the development of intestinal brush border hydrolases.

J. Nutr. 126, pp. 2061-2068, 1996. 1 table, 2 figs., 36 refs. Authors' abstract.

The role of glucocorticoids in the growth of the digestive tract in mink (*Mustela vison*)

J. Elnif, P.T. Sangild

The effect of glucocorticoids on the growth of digestive organs was investigated in the postnatal period of mink. A total of 110 mink kits from 20 litters were either not injected or injected intramuscularly for seven days with saline, adrenocorticotropic hormone (ACTH, 50 µg/kg/day) or hydrocortisone-acetate (synthetic glucocorticoid, 50 mg/kg/day). The kits were killed at 2-10 weeks of age. Plasma cortisol levels did not change significantly with age in the control animals. In the ACTH group, plasma cortisol was minimum at 4 weeks of age, whereas in the hydrocortisone-acetate group, plasma cortisol was maximum at this age. The mink appears to have a period of reduced adrenal responsiveness to ACTH and a low metabolic clearance rate of cortisol around 4 weeks of age. The weight of the ventricle, pancreas and intestine per body weight reached a maximum at 6-8 weeks of age. Hydrocortisone-acetate treated kits showed reduced body growth at 2-6 weeks and increased weight of the pancreas and intestine at 6-10 weeks. The postnatal growth of digestive organs was relatively slow in mink kits and the effects of exogenous cortisol administration occurred relatively late in mink compared with some other species (rats, pigs). Cortisol may play a regulatory role in the growth of digestive organs in the postnatal period of mink kits.

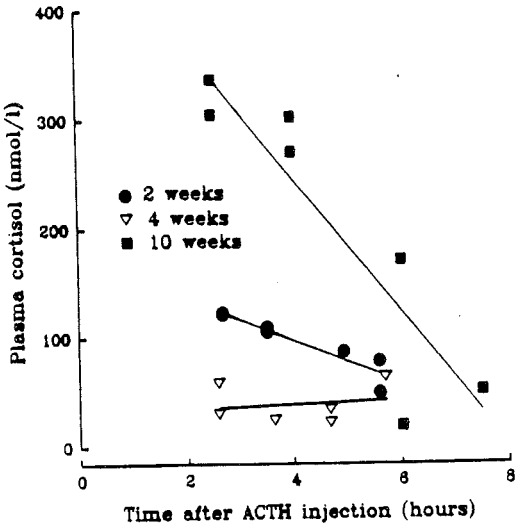

FIG. 2. Plasma cortisol in individual ACTH treated mink kits (Group A; 2, 4 and 10 weeks of age) as a function of the time after the last injection of ACTH. The linear regression lines are indicated.

Comp Biochem Physiol 115A, 1, pp. 37-42, 1996. 1 table, 3 figs., 31 refs. Authors' abstract.

Effects of feeding and short-term fasting on water and electrolyte turnover in female mink (*Mustela vison*)

Søren Wamberg, Anne-Helene Tauson, Jan Elnif

Daily (24 h) rates of water and electrolyte turnover were measured in a conventional balance study in ten adult female pastel mink (*Mustela vison*) given free access to a standard mink feed for a 1-week conditioning period, followed by a 4 d experimental period and a 2 d fasting period. Drinking water was available throughout. In addition, the completeness of urine collection and the fraction of urine collected with the feces were determined using a new experimental technique based on 24 h recoveries of specific urinary markers such as tritiated *p*-aminohippuric acid ([^{3}H]PAH) or ^{14}C-labelled inulin ([^{14}C]IN) continuously delivered by small Alzet® osmotic pumps implanted intraperitoneally. During feeding the mean individual percentage recovery in the urine of ([^{3}H]PAH) released from the osmotic pumps ranged from 68 to 88% (median 78%). The mean percentage of urinary ([^{3}H]PAH) recovered from fecal collections was 6% (range 3-12%). In response to fasting the mean individual percentage recovery of [^{3}H]PAH in urine ranged from 62 to 78% (median 68%). For urinary [^{14}C]IN the mean percentage recoveries in fed and fasted animals were 79 and 63% respectively. Furthermore, during fasting, withdrawal of the supplies of dietary water caused a slight but insignificant (P=0.17) increase in the daily intake of drinking water and, hence, the animals maintained their normal water balance by a dramatic reduction in urine excretion (P<0.001). At the same time urinary solute excretion declined significantly (P<0.001), due in part to the cessation of dietary electrolyte intake and in part to reduced formation of urea, whereas urinary osmolality decreased only moderately. The mean 24 h balances of Na, K, Ca, Mg, Cl and P were close to zero and only minor differences between the feeding and fasting periods were observed. When corrected for the measured inaccuracies in urine collection the balance data obtained in the present study represent useful reference standards for normally fed and fasted non-growing mink and, to some extent, useful guidelines for future studies in experimental animals.

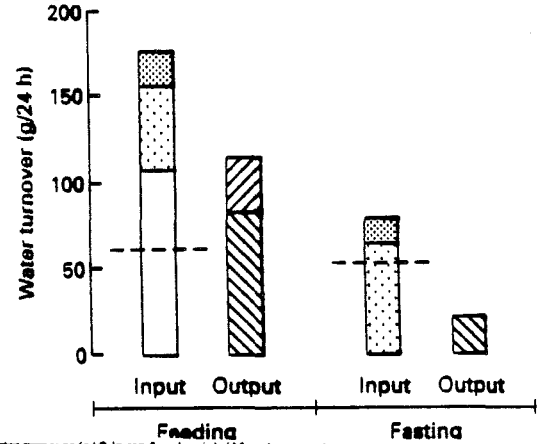

Fig. 2. Water turnover (g/d) in ten female mink (*Mustela vison*) during normal feeding (experimental days 4 and 5) and short-term fasting (days 6 and 7). Water output in urine was corrected to 100% *p*-aminohippuric acid recovery. Results are presented as paired means. (□), Dietary water; (□), drinking water; (▨), metabolic water; (▩), urinary water; (▩), faecal water. Broken lines indicate water balances. The following *P* values between fed and fasted animals were found: drinking water intake (49 *v.* 65 g/d) *P* = 0·17, metabolic water (21 *v.* 15 g/d) *P* = 0·02, urinary water (81 *v.* 58 g/d) *P* < 0·001, and water balance (63 *v.* 58 g/d) *P* = 0·44. During feeding the mean dietary water intake was 110 g/d and the mean faecal water output 32 g/d. For details of procedures, see pp. 713–717.

British Journal of Nutrition 76, pp. 711-725, 1996. 6 tables, 5 figs., 46 refs. Authors' summary.

Use of silver hake and herring and the corresponding silages in mink diets during the growing-furring period

K.I. Rouvinen, D.M. Anderson, S.R. Alward

Atlantic herring (*Clupea harengus*) and silver hake (*Merluccius bilinearis*) are readily available in Atlantic Canada either as processing waste or by-catch of the fishery. There is a vital need to reduce the cost of production in the mink industry, of which feed cost is a major proportion. A research effort was therefore targeted on the use of locally available opportunity feeds including silver hake and herring. A growth trial was con-

ducted with 192 mink of standard genotype from mid-August until pelting in December 1991. There were eight dietary groups as follows: two dry and six wet diets, with 12 male and 12 female mink in each. The dry diet groups were: control, commercial dry diet (COMDRY) and experimental dry diet (INSACDRY). The wet diets were: 10% silver hake (HAKE10), 5% silver hake silage (HASIL5), 10% silver hake silage (HASIL10), 10% herring in the diet (HER10), 5% herring silage (HER5), and 10% herring silage (HERSIL10). The basal wet diet mixture consisted of haddock offal (30-35%), chicken offal (10%), beef offal (15%), corn gluten meal (5%), extruded wheat (12%), rendered lard (1-2%), vitamin-mineral premix (0.4%) and water. The fish silages were preserved with formic acid (2% volume to weight).

Body weight gain of the animals was normal throughout the study. At pelting, the females in the HAKE10 (1043 ± 43.2 g, 59.1 ± 1.0 cm), HASIL10 (1157.4 ± 45.1 g, 61.3 ± 1.1 cm), HER10 (1078.9 ± 45.1 g, 59.6 ± 1.1 cm), HERSIL5 (1090.5 ± 43.2 g, 59.8 ± 1.0 cm), and HERSIL10 (1057.8 ± 43.2 g, 58.6 ± 1.0 cm) were significantly heavier and their processed pelts significantly longer, respectively, than in females in the COMDRY group (910.7 ± 47.3 g, 55.4 ± 1.1 cm) ($P<0.05$). In addition, the final weight of the females in the NSACDRY group (1051.6 ± 43.2 g) differed from the control ($P<0.05$).

There were no significant differences in the traits measured for the males among different treatments. No deleterious effects on the health of the animals fed the test diets were observed when evaluated by hematology, serum clinical chemistry and histopathology. Both herring and silver hake and the corresponding fish silages at 10% of the diet show good potential as alternative feedstuffs in growing-furring diets for mink.

Can. J. Anim. Sci. 76, pp. 127-133.6 tables, 30 refs. Authors' summary.

Response of female mink to folic acid supplementation during the reproductive period

R.J. Aulerich, S.J. Bursian, C.R. Bush, A.C. Napolitano, P. Summer

Forty-eight female pastel mink were assigned to the study and randomly allocated into three groups, each consisting of 16 mink, on February 21, 1994. Following a one week acclimation period, during which the mink were fed a basal mink reproduction diet, they were placed on the experimental diets which consisted of the basal mink reproduction diet supplemented with 0 (group 1, control), 2 (group 2), or 5 ppm folic acid (group 3). The results of this preliminary study showed a notable increase in litter size and decrease in kit mortality at birth for female mink fed supplemental folic acid. Folic acid supplementation, however, did not have a significant beneficial effect on kit body weights at birth, three or six weeks of age or survivability from birth through weaning. Although these results are based on a relatively small number of litters, they suggest that the mink's requirement for folic acid may be increased during gestation. Further large scale trials are, however, needed to confirm the results of this study and clarify the role of folic acid in mink reproduction.

Michigan State University. Fur Animal Research, pp. 59-67, 1997. 4 tables, 8 refs. Material and Methods + authors' summary.

Response of female mink and their litters to supplemental folic acid during the reproductive period - verification of preliminary results

R.J. Aulerich, S.J. Bursian

Forty four pastel and 66 standard dark female mink were allocated to the study and

randomly assigned to a control or folic acid-supplemented diet. The feeding trial was initiated on February 16, 1995, following a 10-day acclimation period during which all mink were fed the control diet. During the trial, the mink received *ad libitum* either the control diet or the control diet supplemented with 5 ppm folic acid.

Analysis of samples of the control and folic acid-supplemented diets yielded folic acid concentrations of 1.71 and 5.05 ppm, as fed, respectively (5.1 and 15.0 ppm, dry weight). There were few statistically significant differences in the reproductive performance of the females fed the control and 5 ppm folic acid-supplemented diets. This is not surprising because of the "high" concentration of folic acid in the control diet and the results of our preliminary trial (*Aulerich et al., 1995*) which showed the response of female mink fed 2 or 5 ppm supplemental folic acid to be similar but significantly different (in litter size and kit mortality at birth) from the control.

The mean litter size at six weeks per female that whelped (4.85 for the control pastels; 4.86 for the folic acid-supplemented pastels; 4.23 for the control darks and 4.19 for the folic acid-supplemented darks) in this study would probably be considered satisfactory, but not exceptional, by commercial mink farm standards. Thus, based on these results and the "high" folic acid content of the control diet, we can neither confirm nor refute the positive response in reproductive performance previously observed in mink fed folic acid-supplemented diets (*Aulerich et al., 1995*). However, several reports from mink ranchers who have fed diets supplemented with folic acid during reproduction have indicated a beneficial effect on litter size, larger kits at birth, reduced kit mortality at birth, and fewer deformed kits. Thus, additional studies involving a large number of mink of various colour phases fed diets containing a range of folic acid concentrations during the reproductive period are needed to clarify the mink's requirement for folic acid and the role of this vitamin in mink reproduction.

Michigan State University. Fur Animal Research, pp. 68-73, 1997. Summary by G. Jørgensen.

Potential dietary toxicants and their effects on mink

R.J. Aulerich, S.J. Bursian

In the wild, mink are opportunistic predators that feed on small mammals, birds, fish, amphibians, reptiles, crustaceans, and insects. When raised commercially on farms, they are fed diets composed of a wide variety of agricultural and fisheries products and by-products. The vast diversity of feed ingredients used for feeding mink greatly increases the chances of exposure to harmful substances. These toxicants may be natural substances or synthetic compounds.

They can be produced by living organisms growing on crops or feedstuffs under certain favourable climatic conditions (mycotoxins), they may be the result of environmental contamination (pesticides), or they may find their way into the diet through misuse of improper handling of feed or feed ingredients (nitrosamines). Some substances are extremely lethal to mink while others cause only subtle adverse effects resulting in suboptimal performance. Certain substances, such as trace elements, are required in small quantitites by mink and other animals but may be toxic in higher concentrations. Mink occupy a top position in the food chain. Although some toxic substances may be present in the diet in only minutes, parts per million (ppm) or even parts per billion (ppb) quantities, they can cause

devastating effects. Years of dedication and hard work by a mink farmer to produce fine quality mink can be wiped out by a single encounter with these injurious substances. This paper contains an account of the more common toxicants that have been associated with mink feeds and their effects on mink.

Michigan State University. Fur Animal Research, pp. 137, 1997. Authors' summary.

Effects of diet on captive black-footed ferret (*Mustela nigripes*) food preference

Astrid Vargas, Stanley H. Anderson

Black-footed ferrets (*Mustela nigripes*) are both habitat and prey specialists that depend on prairie dogs (*Cynomys* spp.) for food and utilize prairie dog burrows for refuge. In this study we investigated the effects of captive diet during early development on adult black-footed ferret food preferences. To test the hypothesis that early diet affects the food preferences of adult black-footed ferrets, we exposed 22 kits (divided into three experimental groups) to different quantities of prairie dog in the diet: no prairie dog, prairie dog three times per week, and prairie dog daily during the assumed sensitive period for olfactory imprinting, i.e., between 60-90 postnatal days.

At age 5 months, kits were individually tested in a food choice cafeteria trial. Results indicated that higher amounts of prairie dog in the ferrets' early diet led to a higher preference for this food item when ferrets reached adulthood. These results have important implications for black-footed ferret recovery and have been considered in the reintroduction protocol.

Zoo Biology 15, pp. 105-113, 1996. 1 table, 2 figs., 40 refs. Authors' summary.

In vitro measurement of β-carotene cleavage activity: methodological considerations and the effect of other carotenoids on β-carotene cleavage

Trinette van Vliet, Frank van Schaik, Wil H.P. Schreurs, Henk van den Berg

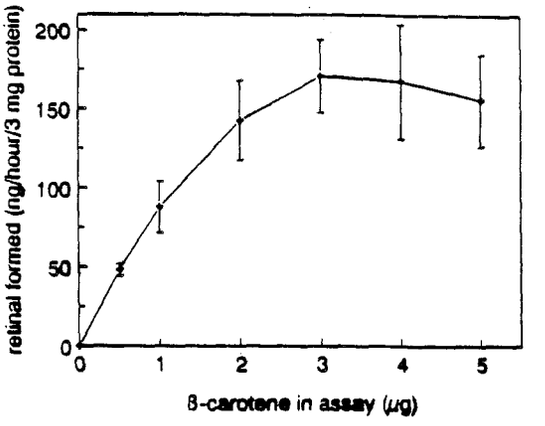

Figure 1: Amount of retinal formed in the dioxygenase assay after incubation for 1 h with 3 mg protein S-9 and different amounts of β-carotene. Mean with SD of triplicate incubations.

In view of controversies about assessment of the β-carotene cleavage activity, methodological aspects and problems of the dioxygenase assay are described. Using rat and hamster intestinal preparations the method was optimised on retinal formation, the only cleavage product we could demonstrate. It appeared that the cell fraction with the highest cleavage activity was the 9,000 g supernatant (S-9). Maximal retinal formation was obtained with SDS, taurocholate and egg lecithin in the buffer and 3 μg β-carotene dissolved in acetone. Ethanol, THF/DMSO (1:1) or propylene glycol as solvent for β-carotene reduced retinal formation to 55, 24, and 19%, respectively.

Retinal formation increased proportionally with the amount of protein S-9 used and was linear up to 40-60 minutes of incubation. Incubation with α-carotene or β-cryp-

toxanthin resulted in a retinal formation of 29 and 55% of the amount formed from β-carotene. Addition of 9 μg of lutein to an incubation with 3 μg β-carotene reduced retinal formation, while lycopene had no effect. In conclusion, the β-carotene cleavage assay with S-9 as enzyme source described in this report, seems a useful tool to study (dietary) determinants of β-carotene cleavage activity, but for other purposes adaptation of the method is required.

Internat. J. Vit. Nutr. Res, 66, pp. 77-85, 1996. 2 tables, 4 figs., 33 refs. Authors' summary.

Growth and food consumption of young raccoon dogs in shaded housing

H. Korhonen, P. Niemelä

Growth and food consumption of 5 male and 4 female raccoon dogs from around 1 month of age in June 1993 to August 1994 were compared. In June, body weight averaged 569 g for males and 513 g for females, and in August it averaged 1270 and 998 g respectively. Males weighed 330 g more than females in October, 179 g more in January, and 392 g more in April. Daily food intake averaged 343 g for males and 308 g for females, and it was lower than average in November in both sexes.

Finsk Pälstidskrift 30, 6-7, pp. 174-175, 1996. 2 tables, 9 refs. In SWED. CAB-abstract.

The effects of Melacryl on the skin of fur bearers

N.A. Slesarenko, N.V. Babichev

Mink were given an implant of Melacryl (a synthetic melatonin) between 10 and 25 June, and control mink were not implanted. The treated animals were slaughtered in Sept.-Oct. and the controls in Nov., and skin measurements were made. For mink aged approximately 12 months, thickness of the dermis averaged 1182 and 1054 micro m in treated and control animals, and thickness of the epidermis 25 and 20 micro m. The corresponding values for mink aged 2 years were 606, 771, 17 and 19 micro m. Similar data are given in respect of silver foxes implanted with Melacryl. In the foxes, the dermis was thicker in treated than in untreated animals, but the epidermis was thinner in treated animals.

Krolikovodstvo i Zverovodstov No. 3, pp. 5-6, 1995. 3 tables. In RUSS. CAB-abstract.

Original Report

Evaluation of the polymerase chain reaction (pcr) as a tool for diagnosing infections with the Aleutian mink disease parvovirus (ADV)

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Abstract

We compared the sensitivity of polymerase chain reaction (PCR) and counterimmune electrophoresis (CEP) in detecting infection in 94 serum samples collected from commercial mink ranches during an outbreak of ADV in Utah. Results of the 2 assays agreed 85% of the time. Of serums positive by either or both assays, CEP was more effective (97%) than PCR (62%) in identifying the presence of ADV infection. Thus, for routine screening in a field setting, the determination of anti-ADV antibody by CEP was a superior diagnostic assay for the detection of ADV infections. A strategy is presented for using PCR and restriction enzyme mapping for "typing" of ADV isolates.

Introduction

Infections with the Aleutian mink disease parvovirus (ADV) are a significant economic problem for the mink industry. The presence of ADV on commercial mink ranches can lead to decreased fur quality, decreased fertility and decreased production (15,16). Severe outbreaks can result in near total losses of animals, particularly at whelping time (15,16). Use of counterimmune electrophoresis (CEP) in a conscientious program to identify and to cull ADV infected mink from ranches can lead to the eradication of ADV from infected farms (7). CEP measures antibody that mink make following exposure to ADV (3,4,6). Although this test is extremely sensitive and

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cost-effective, it is not necessarily a measure of existing virus infection. Furthermore, in some infections, detectable antibody may not develop until at least 30 days after infection (4,11,19). Another means to detect ADV infections would be to look for evidence of the virus itself. Inoculation of mink or cell culture with samples of mink tissues to detect virus is very expensive, not entirely reliable and requires a long time to obtain the results (5,12,14). The demonstration of ADV DNA in the serum or tissues provides a surrogate measure for active virus infection or viremia. The polymerase chain reaction (PCR) is a molecular biology technique that makes it possible to amplify exceedingly small amounts of DNA in a highly specific fashion (8,20,21). In a previous study, we developed a simple PCR assay to detect ADV DNA directly in mink serum(19). The specific ADV DNA amplified was a 0.7 kb segment located in the portion of the viral genome coding for the virion proteins (1,9,19). The sequence of this region varies significantly between isolates of ADV, and is referred to as "hypervariable." However, it is flanked on both sides by highly conserved sequences that can be used to capture the variable region. We found that PCR is capable of detecting <1 femtogram (fg) of ADV DNA in serum, an amount equivalent to <4,000 viral genomes per ml of serum. To examine the relative utility of CEP and PCR in a field setting, we obtained sera from Utah ranch mink at pelting time. In this brief report we present data about the evaluation of PCR as a tool for diagnosing ADV infection and compare PCR with CEP.

Materials and methods

Serums

Serums were collected using Vacutainer Plus plastic blood collection tubes with SST Gel and Clot Activator (Becton-Dickinson) by cardiac puncture from mink on several ranches in Utah at the time of pelting. (The use of these tubes was crucial in preventing cross-contamination among samples.) Some of these ranches were experiencing problems with ADV whereas others were ADV negative. Control samples were from experimental animals at Rocky Mountain Laboratories. After centrifugation in a clinical centrifuge, portions for PCR were transferred into 0.5 ml thin-walled Gene Amp tubes (Perkin Elmer) and held at -20°C until PCR was performed.

Polymerase chain reaction

The specific primer pair spans the 692 bp fragment corresponding to ADV-G nucleotides 2587-3279 (2,3,9,19). The designation of these 2 primers, based on their position on the ADV-G genomic map and their sequence, are:

54.47(+): 5'-CTTGTCACGCTACTA-GAATGGT-3' and
68.49(-): 5'-AGCTTAAGGTTAGTTTA-CATGGTTTACT-3'.

Aliquots of serum samples to be tested were held at 70°C for 45 sec in the thermocycler. After heating, 2.5 ml of serum were used as template in triplicate 25 ml PCR reactions using a "hot start."(8,21) PCR products (10 ml) were subjected to electrophoresis in 2.5% agarose gels in TBE buffer and visualized under UV light following ethidium bromide staining. A positive result was indicated by the presence of a 0.7 kb fragment. Negative controls, included in each set of amplifications, included normal serum and reactions from which template was omitted. As a positive control, we used serial dilutions of a serum in which we had previously determined the number of ADV genomes by DNA hybridization.

In order to eliminate the possibility that inhibitory substances were present, any serum testing negative was "spiked" with 100 genomes (10 fg) of the positive control serum. Following addition of the "spike," all serums were positive. Thus, hemolysis and hypergammaglobulinemia were not interfering with the assay. Specimens in which 1 of the 3 PCR triplicates were positive were scored as positive. The results were read by

an observor, blinded to the source of the serum samples. Counterimmune electrophoresis (cep). CEP was performed using a commercially available ADV-G derived antigen (United Vaccines, Madison, WI).(4)

Results

Serum samples were obtained from 94 mink on 8 commercial mink ranches at the time of pelting in December of 1994. Several of these ranches were experiencing severe problems with ADV infections. The samples were tested for the presence of ADV DNA in serum by PCR (Figure 1) and for anti-ADV antibody by CEP. The results are depicted in Table 1. Twenty mink were positive by both assays and 60 animals were negative by both assays. Thirteen mink reacted in CEP, but were PCR negative and a single animal was PCR positive but CEP negative.

Table 1. Comparison of polymerase chain reaction (PCR) with counterimmune electrophoresis (CEP) for the detection of ADV infection in ranch mink

		PCR RESULT	
		+	-
CEP RESULT	+	20	13
	-	1	60

Of the 21 sera that were PCR-positive, 3/3 replicates were positive for 10, 2/3 for 4, 1/3 for 4, 2/2 for 1 and 1/2 for 2. Thus, in this field setting, PCR was very unlikely to detect a mink that was CEP negative, whereas a substantial number of CEP positive mink scored negative in PCR.

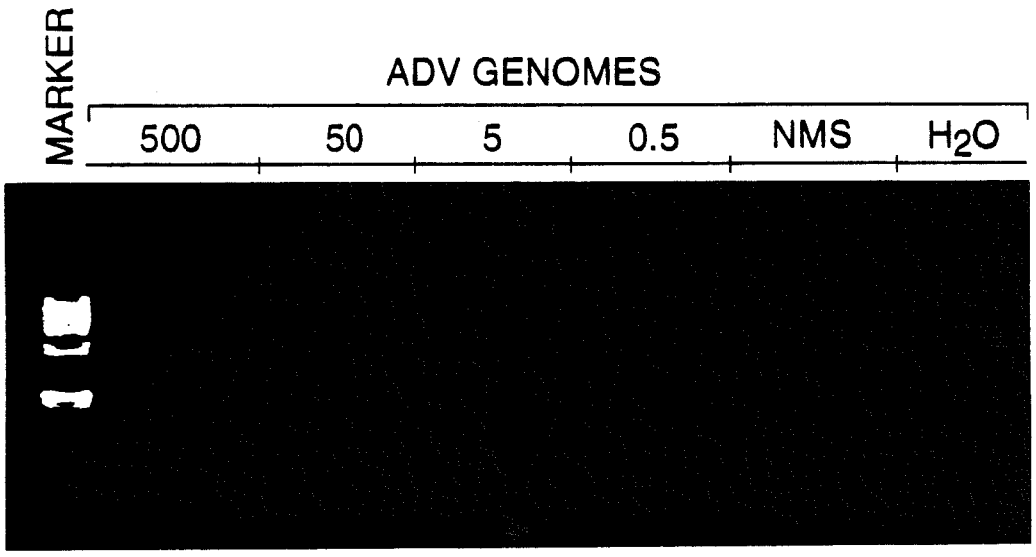

Figure 1. **Detection of ADV serum DNA by PRC.** An ADV positive mink serum was serially diluted into normal mink serum (NMS). 2.5 µl of the serum dilutions were subjected to 40 cycles of direct PCR amplification in 25 µl reaction volumes as described. A single species of the expected mass was clearly detected in the dillutions containing 500 and 50 genomes in 2.5 µl of serum.

Discussion

We compared 2 measures of ADV infection under field conditions. Serum PCR assay reveals the presence of ADV DNA, whereas CEP detects antibody against ADV. The viral DNA is a measure of active virus infection(3,19), whereas CEP measures the presence of antibody directed against virus proteins and is thus an indicator of both current and past exposure to virus(4). Previous work unequivocally reveals that use of CEP in a conscientious eradication program is highly effective in identifying infected animals that pose a risk to normal animals on a mink ranch(7). The reason for comparing CEP with PCR was to determine if PCR offers any advantage as a screening assay for ADV infections.

The results of the 2 assays agreed 85% of the time (Table 1). Of serums positive by either or both assays, CEP was more effective (97%) than PCR (62%) in identifying the presence of ADV infection. The level of sensitivity of our PCR correlates to approximately 4000 virus particles per ml of serum(19). Results from our experimental infections indicate that most animals infected with a high virulence isolate of ADV (such as ADV-Utah or ADV-TR) would test positive in this assay throughout the course of their disease(19). Nevertheless, there are well documented instances where the amount of virus in the serum of an infected animal would fall below this level(11-13,19). In fact, in our experimental infections, we observed some mink that were PCR negative in the face of high antibody levels and obvious progressive disease(19). The only instances in which mink consistently were PCR positive but CEP negative were noted shortly after infection with high virulence strains of virus. There are a number of maneuvers, such as "nested PCR", using cellular DNA instead of serum or performing Southern blotting on the PCR products, that might increase the sensitivity of PCR(8,21). However, it is very likely that the potential value of this increase would be negated by problems with sample cross-contamination and other artifacts(8,17,18,21).

The DNA sequence of high and low virulence isolates of ADV differ significantly in the hypervariable fragment of DNA amplified with our primers(2,9,19). A strategy to elucidate these differences by detailed analysis by restriction endonuclease mapping is depicted in Figure 2.

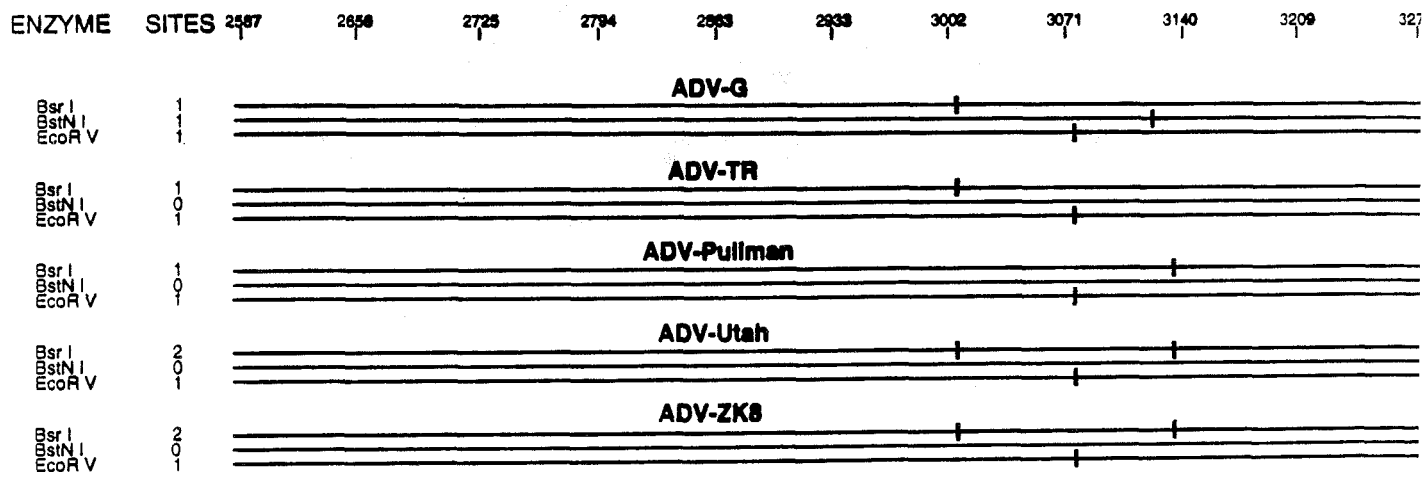

Figure 2. **Strategy for typing of ADV isolates by restriction mapping of PCR fragments.** A schematic of the ADV segment PCR amplified with primers 54.47(+) and 68.49(-) and digested with several restriction enzymes was developec for several characterized isolates of ADV. By comparing the restriction fragment patterns, it should be possible to discriminate among or "type" the isolates.

For example, the enzyme Bst N1 makes a single cut in the non-pathogenic ADV-G, but not in the highly related, but pathogenic, ADV-TR. Bsr 1 makes a single cut in ADV-G, ADV-TR and ADV-Pullman, but cuts twice in ADV-Utah and the Danish ADV-ZK8(19). Eco R5 makes a single cut in all isolates examined and thus can serve as a control for the digestions. Additional enzymes such as Rsa 1 and Alu 1 should also be able to distinguish isolates, but in practice they do not afford adequate resolution. The preliminary results suggest that "typing" of isolates by restriction enzyme mapping may prove a useful technique and this line of research is currently under study in our lab. Thus, analysis of PCR products might prove useful in identifying the type and source of virus involved in ADV outbreaks.

A previous study involving the use of PCR in detection of experimental ADV infections amplified a portion of the nonstructural protein genes of the virus(2,17). The method of sample preparation involved numerous steps and sample cross contamination was evident by Southern blotting analysis. Furthermore, no quantitation was done so it is impossible to compare the sensitivity with our results. In addition, the sequence variability of nonstructural viral genes between isolates of ADV is not as well characterized as for the capsid genes(2,10). Thus, the PCR strategy used in that study is not as convenient for "typing" studies.

In summary, these findings clearly suggest to us that screening by PCR offers no advantage over CEP in routine detection of ADV infections in the field. Nevertheless, application of this sensitive technique may be of value in certain circumstances in the identification or "typing" of ADV isolates responsible for outbreaks.

Acknowledgements

This work would not have been possible without the generosity, support and cooperation of Mr. Kent Vernon, the Utah Fur Breeders Agricultural Cooperative and the Mink Farmers Research Foundation. K.L.O. and P.C. were Special Volunteers employed by the Utah Fur Breeders Agricultural Cooperative. These results were presented at the VI-th International Scientific Congress in Fur Animal Production, August 21-21, 1996 in Warsaw, Poland.

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Original Report

Listeriosis of blue fox

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Abstract

In autumn of 1996, a kind of epidemic called Listeriosis was found among the local blue foxes, mainly among the pups. The incidence was about 17% and the lethality was about 60%. The clinical manifestation showed that the diseased foxes moved in circles at will and bit themselves with nervousness (mainly the hips and tails), accompanied with screaming. The course of the disease was about 5-7 days and for very few 40 days. The pathological changes were necrotic hepatitis, encephalitis and myocarditis. After artificial infection, 3 rabbits all died within 3-10 days, with clinical symptoms, and post mortem lesions similar to the foxes in the spontaneous cases. The pathogens were also isolated from the viscera and CSF of the rabbits dead from the challenge. Good preventive and therapeutic results were obtained after applying the Listeria inactivated vaccine made from the viscera by our institute.

Introduction

Listeriosis is a kind of acute bacteriological infectious disease caused by Listeria, featuring encephalitis and septicaemia accompanied by pathological changes of viscera and central nervous system.

I. Occurrence of the disease

In the first ten-day period of July 1996, the local area suffered an unbroken spell of wet weather when this disease first appeared in a young fox at the age of 3 months on our fox farm. It died 5 days later. In the first ten-day period of August, the disease attacked another young fox at the age of 4 months and it died 6 days later. In September, the number of young foxes that fell ill reached 15, of which 4 died. In October, it came to a climax: 16 were ill and 4 died; altogether there were 33 foxes which fell ill and 22 of them died. The incidence of the disease was about 17% and the lethality was about 60%.

These affected foxes were all of pups born in the same year. There were several litters of young foxes of the groups kept together and we found they enjoyed stronger resistance to the disease. Whether they were kept separately or together with affected ones, it was impossible for them to be infected, while several other litters of foxes were always easy to be infected whether they were kept separately or together with the affected ones. From this, we could obviously come to the conclusion that this disease was present by heredity.

According to our investigation, on the other two fox farms next to ours, there were no signs of this disease.

II. Clinical manifestation

When this disease appeared in blue foxes, it showed that excitation and inhibition went alternately. With the development of the condition becoming worse, the foxes suffering from the disease had a poor appetite or refused to take food. When excited, they often showed incoordination, moving in circles and dashing about, accompanied by unusual screaming. At the same time, they bit themselves nervously, mainly gnawing parts of their tails or the hips and legs on the same side(s) of the bodies. The worst ones often had nothing left on their hips and legs, with bones exposed. Some foxes challenged with Listeria often propped their heads against the iron cages with ears backward, eyes opened widely, staring forward, eyeballs being bug-eyed, hips gnawn tightly. It looked as if it was hard to endure the pain, giving out painful noises rhythmically. It often made people feel that the foxes were wretched and miserable. Where the blue foxes gnawed themselves the affected parts became infected with streptococcus and suppurated. If the affected parts were pressed, pus came out and would last for a long time. It was very common that simultaneously with the hips being gnawn came the tails' being gnawn. When the hips hurt, the fox bit off half of its tail or even the whole of it. The final result was death.

When blue foxes were attacked by the disease, they were excited very much and highly sensitive to their surrounding. Even a sign of little disturbance or trouble or the appearance of human being would make them frightened out of their wits, causing them to gnaw further and move in circles, screaming continuously. It would be terribly bad at seven o'clock in the morning before feeding, but better at other times of the day. The course of the disease was about 5-7 days, for very few up to 40 days.

III. Pathological changes

We dissected 7 blue foxes which had died of Listeriosis. The folllowing was found: apostematose catarrhal pneumonia, hepatauxe with diffuse, milliary and caseous necrotic lesions, splenomegaly, cortauxe with hydropericardium, apexcordis hemorrhage and cardiac muscle presenting light grey; meningo and cerebral blood vessel hyperaemia with inflammation or oedema, cerebrospinal fluid increased, which was a bit turbid and contained more bacteria, and brainstem became soft with parts suppurated. Microscopical examination showed that leptomeninx, brainstem, especially the blood vessel of pons, medulla-oblongata and spinal cord were hyperaemic, and the monocytes around the blood vessel were infiltrated through with the nerve-cell destroyed. With the help of tissue smears from the lesions and Gram staining, gram positive micrococcobacilli could be observed (Listeria). There were a lot of infiltrated lymphocytes in the meninx, and it was the feature that changed with development of the disease.

IV. Diagnosis

Isolation of bacteria

(1) Using the smear done with the liver and spleen of infected foxes, as well as Gram

and Giemsa staining, microscopic examination showed: With Gram staining, gram-positive coccobacilli were found, which were round, sometimes presented individually in "V" pattern or bar form. The forms by Giemsa staining were similar to those by Gram staining.

(2) After inoculating the liver and spleen of the diseased foxes to the blood agar plate respectively and culturing for 24 hours at 37°C, colonies could be observed on the surface of the culture medium, which were round, smooth and diaphanous, 1-2 mm in diameter, and narrow strips of hemolysis (β hemolysis) appeared. In the culture medium of broth, it was turbid, showing no difference. There was no annulus or microderm formed in broth.

(3) Biochemical assay: The seven strains isolated were from seven different diseased foxes, the code names were L_1-L_7 and the results shows as following: All the strains could ferment glucose, trehalose and salicin and, within 24 hours at 37°C, acid was discovered. But for arabinose, lactose, maltose, sucrose, rhamnose, dextrin, sorbitol and glycerine, these strinas sometimes produced acid within 3-10 days, but sometimes did not. And for raffinose, inositol, dulcitol and glycol, they did not ferment..

When gelatine stab-culture was carried on, lateral branches were formed along the stab-line with villus-like something raised. The gelatine did not liquefy. This kind of bacteria did not produce Hydrogen Sulfide and indole, it did not reduce nitrate either. It could make milk with litmus sour slightly, but could not make it solidify.

According to the microscopical, cultural and biochemical assays, we could determine that the seven strains, L_1-L_7, isolated were of L.monocytogenes.

Animal test

Three white rabbits in good health, two months old, each weighing 1.5 kg had been in isolation for one week, and the results were that they were full of vigour, had a good appetite and their movement, feces and urine were normal. After being inoculated intravenously with a dose of 1 ml of the strain of Listeria (material cultured in blood broth for 24 hours) per rabbit, one of them died acutely 72 hours later after injection, and on the 10^{th} and 12^{th} days, two died separately. Opisthotonos emerged on the dead body, and the post mortem lesions were similar to those in spontaneous cases among the blue foxes.

V. Prevention and care

1. Once diseased foxes are found, they must be isolated and laid aside in a quiet place. Then sterilize the farm, fox coops, delivery rooms by spraying carbolic acid once daily for ten days.
2. The vessels for food and water must be sterilized by boiling or soaking in a solution of potassium permanganate for an hour.
3. The fox coops must be laid in places where it is sunny, dry and well-ventilated and the coops having been placed in dark corners for a long time must be exchanged regularly to the sunny places.
4. Pay close attention to killing mice, mosquitos and flies.
5. Treatment:
   a) In the early stages an injection of Cefazolin Sodium to the diseased foxes is needed, 50-100 mg per kilo of body weight daily in 3-4 divided doses. The dosage should be increased according to the degree of infection.
   b) Suit the remedy to the case: to those diseased foxes highly excited or suffering from severe pain, chlorpomazine hydrochloride and analginum may be used to calm them and stop the pain.
   c) Give intramuscular injection of inactivated vaccine made from the brains and viscera of diseased foxes. The dose is 10 ml per fox, 5 ml per fox for prevention.

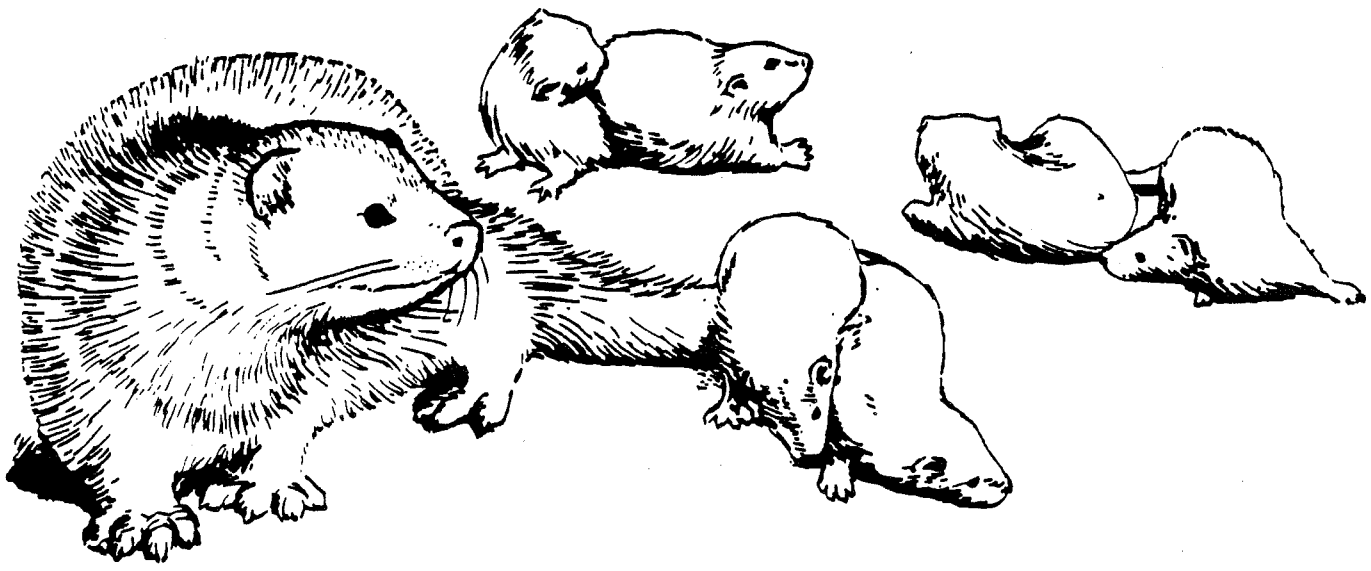
d) During the period of treatment, the infected parts should be washed with a 1% solution of potassium permanganate and 5% hydrogen peroxide, then tincture of iodine applied. As for the local bleeding, stop the bleeding by hot brand.

VI. Brief summary

1. According to the epidemic, clinical symptoms, pathologic anatomy, post mortem lesions in animals, microbial exam, biochemical assay and animal test, we could make sure that the death of the diseased foxes was caused by Listeriosis.
2. According to the drug sensitive test, streptomycin, norfloxacin and chloramphenicol were effective to Listeria, but had no good therapeutic effect in clinical practice because of Listeria's frequent invation of brains. It might be that these kinds of medicine could not pass through the cerebral barrier, thus there was no effect.
3. Treatment by the injection of Cefazolin Sodium was effective in the early stages, but Listeria became drug-resistant to it, there would be no good effect continuing with it.
4. According to the introduction of reference material, there is Listeria inactivated vaccine abroad, but not at home. The Listeria inactivated vaccine produced by our institute could be used to cure and prevent this disease. It could relieve the infected foxes obviously and slightly restore health. Besides the results above, it could make the infected parts become astringent and scarred.

Translated from Chinese Wildlife, No. 6, pp. 37-38, 1992. ISSN 1000-0127.

(The English translation was checked and corrected by Professor Sheng Zhengda, Department of Animal Medicine, Gansu Agricultural University).

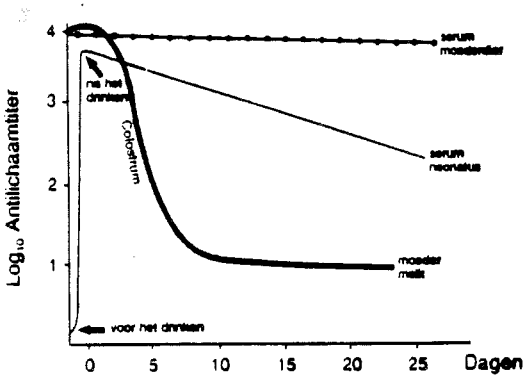


Immunoprofylaxis in the dog and cat

P.A.M. Overgaauw

After the introduction of different ways of immunisation, the technical aspects of vaccines are discussed. In this section, the properties, advantages and disadvantages of the different types of vaccines, adjuvans and determination of titers are described.

In the second part, practical aspects of vaccination of the dog, cat and ferret are reviewed. The third part describes vaccination failures and complications after vaccination and finishes with general vaccination schemes for dogs and cats.



Figuur 1. Antilichaamtiter in het serum en colostrum van het moederdier en in het serum van de neonatale pup of het kitten. Uit: Infectious diseases of the dog and cat, ed. by CE Greene 1990 (24) (met toestemming overgenomen).

Tijdschr Diergeneesk 121, pp. 90-105. 5 figs., 1 table, 60 refs. Author's summary.

Efficacy of six anthelmintics against luminal stages of *Baylisasccaris procyonis* in naturally infected raccoons (*Procyon lotor*)

C. Bauer, A. Gey

The efficacy of six anthelmintics against natural infections of *Baylisascaris procyonis* in raccoons (n=7) per drug) was determined in a series of critical tests. The drugs were given via moist cat food as a single dose or once daily for three consecutive days. Raccoons treated with pyrantel embonate (1 x 20 mg base kg^{-1} bodyweight (bwt.), ivermectin (1 x 1 mg kg^{-1} bwt.), moxidectin (1 x 1 mg kg^{-1} bwt.), alb endazole (3 x 50 mg kg^{-1} bwt.), fenbendazole (3 x 50 mg kg^{-1} bwt.) or flubendazole (3 x 22 mg kg^{-1} bwt.) expelled 1-198, 2-24, 2-14, 3-80, 2-70, or 2-35 *B. procyonis* stages, respectively, with the feces. No roundworm was detected in any raccoon at post mortem examinations 7 days after the end of treatment. These results suggest that any of the six anthelmintics can be used at the dose rates tested in a deworming programme for captive raccoons.

Veterinary Parasitology 60, pp. 155-159, 1995. 1 table, 13 refs. Authors' abstract.

Staphylococcidiosis in rabbits and other fur bearing animals

S. Matthes

Staphylococcidiosis is a commonly occurring disease in domestic rabbits and other fur bearing animals. The disease is characterised by a fatal septicaemia or suppurative inflammation in almost any organ or site. Staphylococcus aureus was most consistently isolated from afflicted rabbits, but S. intermedius and S. lentus were isolated from other fur bearing animals, notably mink. An overview of the clinical signs and the control measures is presented.

Tierärztl. Umschau 51, 1, pp. 18, 21-23. In GERM. Su. ENGL. Author's abstract.

Prevalence of parvoviral antibodies in breeding foxes and mink in Poland

Beata Mizak, Jerzy Gorski

The purpose of the study was to carry out serological examinations in foxes originating from farms with unsatisfactory repro-

duction results located in the Silesia, Lublin, Mazowsze, Pomorze, Mazury and Wielkopolska districts. Moreover, the same examinations were conducted in reference to sera of mink with poor reproduction findings. Out of 435 sera from 17 fox farms, HI antibodies were found in 28.6 per cent. Specific antibodies were also recorded in 2 of 3 mink farms. Of 132 sera, the antibodies were found in 72 samples (54.5 per cent). In addition, from 19 samples of feces, homogenized internal organs of 7 fetuses and the uterus of a pregnant mink, a parvovirus was isolated (their HA=640-2560). A marked distribution of parvovirus infections in foxes indicates that vaccination should be carried out in the animals before mating. However, other reasons, such as unsatisfactory nutrition, could influence reproduction results.

Medycyna Weterynaryjna 52, 3, pp. 177-179, 1996. 2 tables, 14 refs. In POLH, Su. ENGL. Authors' summary.

Endoparasitic fauna of the stoat (*Mustela erminea* L.) and the weasel (*Mustela nivalis* L.) in Hessia, Germany

Uwe Peuser

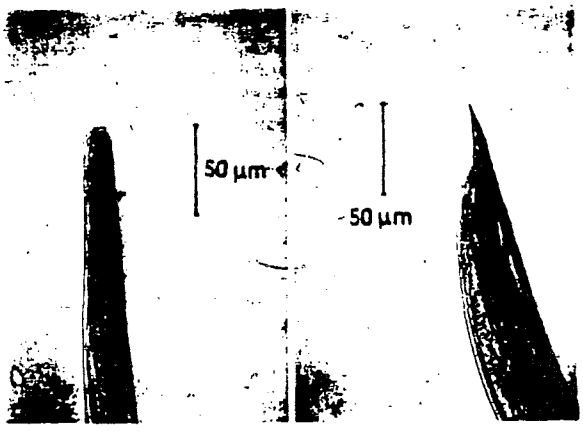


Abb. 11 und 12. Adulte *Strongyloides mustelorum* (Vorderende, Hinterende) aus dem Dünndarm von *M. erminea*

This survey was performed to investigate the infection with endoparasites in non-selected stoat (*Mustela erminea* L.) and weasel (*Mustela nivalis* L.) populations in Hessia, Germany. The necropsy material was trapped over a period of 9 years (1983-1991) and originated from 11 different districts. Some of the 102 stoats (66%) and the 100 weasels (44%) were examined after deep-freezing. This material was supplemented by freshly caught animals. There was no significant difference between frozen and fresh carcasses with regard to their parasites and their prevalences. The techniques employed were parasitological necropsy, enzymatic digestion, coprological and hematological investigations. The prevalences and the semiquantitatively estimated intensities of infection with endoparasites were reported. Macroscopically visible pathological alterations due to parasites have not been recorded in any animal.

In total, 67.6% of the stoats and 61.0% of the weasels were infected by one or more endoparasite species. The spectrum of endoparasites was very similar in the two mustelinae investigated. The following endoparasites were detected: *Eimeria mustelae* (stoat: 19.6%; weasel: 11.0%), *Sarcocystis spp.* (6.9%; 28.0%), *Isospora laidlawi* (2.0%; 0%), *Taenia mustelie* (15.7%; 11.0%), *Strongyloides mustelorum* (1.0%; 0%). Trematode eggs probably of *Euparyphium melis* (2.0%; 2.0%) were sporadically found. A significant difference of the prevalence rates between the two host species was seen only for *Sarcocystis spp.*; this difference is suggested to be due to a dissimilar prey spectrum.

Isospora laidlawi was found in the feces of the stoat for the first time worldwide. *Eimeria mustelae, Sarcocystis spp., Strongyloides mustelorum,* and *Capillaria putorii* were reported first in stoats and weasels from wildlife in Germany, *Molineus patens* in weasels and *Capillaria mustelorum* in stoats.

Helminth stages were not detected in the cranial cavities, lungs, liver, kidneys, and urinary bladder of any animal. *Capillaria paranalis* (anal sacs) and *Trichinella spiralis* (muscles) were not found. Neither could endoparasites be discovered by hematological investigation.

References from all over the world, in particular those from Europe, were combined to a synopsis on the endoparasites of stoat and weasel that have been diagnosed in Germany.

Using this review and the experience gained from the present investigation a simple key was developed. This should allow us to determine common endoparasitic species of the European stoat and the European weasel to at least genus level.

Thesis, 141 pp. 22 tables, 14 figs., 214 refs. In GERM, Su. ENGL. Author's summary.

Workplace-related infections of humans with the raccoon roundworm Baylisascaris procyonis

F.J. Conraths, C. Bauer, Josefine Cseke, H. Laube

Raccoons are frequently parasitized by the roundworm Baylisascaris procyonis. Humans belong to the wide range of intermediate hosts of this parasite whose larvae can cause the clinical picture of visceral larva migrans. The eye and the central nervous system (CNS) represent the predilection sites of the larvae. Massive infections of the CNS may lead to lethal eosinophilic meningoencephalitis. In the course of this study, sera of 31 individuals were tested by immunoblotting. Thirteen individuals had been in contact with raccoons for a longer period of time (risk group 1), for 7 persons could it not be excluded that they might have been in contact with infectious B. procyonis eggs or larvae. As controls served sera from further 11 individuals for whom a previous contact with raccoons or their feces could be excluded. None of the sera from the control group reacted with B. procyonis EIS antigens. With one exception, which reproducibly yielded a border line result, all sera of risk group 2 proved serologically negative. Four individuals out of risk group 1 had antibodies against B. procyonis, for 3 of them there were further indications that an infection with a parasite had taken place. Results of the clinical and laboratory examinations of two patients are reported. Although the clinical signs observed in one case cannot unambiguously be attributed to a B. procyonis-infection, individuals who deal with raccoons and are exposed to their feces should be advised to adopt prudent measures of precaution.

Arbeitsmedizin Umweltmedizin 31, pp. 13-17, 1996. 1 table, 1 fig., 15 refs. In GERM, Su. ENGL. Authors' summary.

Diagnostic value of detecting the circulating immune complex in mink with Aleutian disease

M. Spinu, A. Popoviciu, G.F. Brudasca

Circulating immune complex (CIC) levels of plasma from mink with Aleutian disease and serologically negative mink (both evidenced by countercurrent immunelectrophoresis) were quantified by two alternatives of a polyethylene glicol turbidity method.

Samples from serologically positive animals showed significantly higher levels of CIC by both precipitation methods when compared to that from serologically negative ones ($p<0.001$).

The technique employing a 4.2% PEG solution proved to be the more useful of the two tests, for more positive results being obtained and its simplicity.

Seminarul-Actualitati in Patologica Animalelor Domestic 15, pp. 237-241, 1989. 1 table, 19 refs. In ROMN, Su. ENGL. Authors' summary.

Immunotoxicity studies in mink (*Mustela vison*) chronically exposed to dietary bleached kraft pulp mill effluent

J.E.G. Smits, B.R. Blakley, G.A. Wobeser

The immunotoxic potential of bleached kraft pulp mill effluent (BKME) to cell-mediated immunity in mink (*Mustela vison*) was investigated October 1993 through May 1994. For 26 weeks, 20 mink were fed a diet based upon fish caught within 6 km downstream of a bleached kraft mill in Saskatchewan, Canada. Water for this group contained 25% softwood-run BKME. Twenty control mink were fed nutritionally matched diets based upon fish from lakes receiving no municipal or industrial effluent and tap water. Using in vitro and in vivo immunotoxicity assays, the proliferative response of mink peripheral blood mononuclear cells (PBMC) to nitrogens was optimal, at 72 hr with 10 µg/ml Concanavalin A, 1/80 dilution pokeweed mitogen, and 1/80 dilution phytohemagglutinin. Bacterial cell was *Escherichia coli* lipopolysaccharide did not stimulate mitosis of the mink PBMC. No difference ($P<0.05$) in PBMC proliferation was seen between the control and BKME-exposed mink with any of the mitogens used. Delayed type hypersensitivity (DTH), a cell mediated response, was assessed in mink vaccinated with live bacille Calmette-Guérin (BCG) and then challenged by intradermal toe web injection with 200 µg of sonicated BCG approximately 6 weeks later. The DTH response in the BKME-exposed mink was impaired based upon assessment using skin thickness measurements, histopathological assessment and image analyzer technology. This decreased response is evidence for suboptimal immune function associated with BKME exposure, which could affect the competitive fitness of piscivorous mammals naturally exposed to BKME.

Journal of Wildlife diseases, 32 (2), pp. 199-208, 1995. 5 tables, 2 figs., 31 refs. Authors' summary.

Assessment of humoral immune response in mink (*Mustela vison*): antibody production and dectection

Judit E.G. Smits, Dale L. Godson

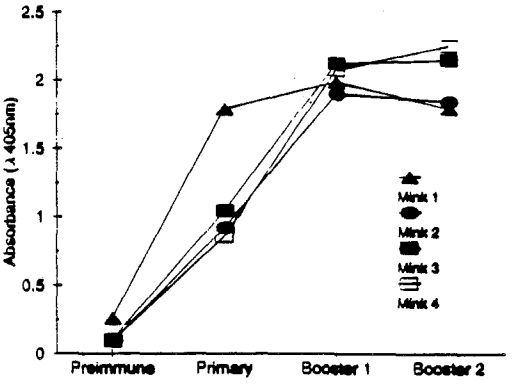


FIGURE 1. Relative antibody levels in 1:1280 dilution of sera from DNP-KLH vaccinated mink. Serum samples collected before immunization, 10 days after primary immunization (primary), and 7 and 9 days after boosters 1 and 2, respectively, were analyzed for DNP-KLH specific antibody levels using an indirect ELISA. Mink 1 and 2 are females, mink 3 and 4 are males.

A method for investigating the humoral immune response in mink (*Mustela vison*) was developed between October 1993 and March 1994. Protein A, 1:8000 dilution, had a high affinity for mink immunoglobulin, while anti-ferret (*Mustela putorius*) antibody, 1:200 dilution, had a weaker affinity. Four adult mink were immunized with a hapten, dinitrophenol (DNP), conjugated to a large carrier protein, keyhole limpet hemocyanin (KLH), and received two boosters at 3-week intervals. This provoked a strong T-lymphocyte dependent humoral immune response. An indirect enzyme linked immunosorbent assay (ELISA) was used to quantify the antibody produced. All mink had undetectable anti-DNP-KI,II antibody in the pre-immune sera, with antibody levels increasing post-immunization, and peaking after the first or second booster.

Journal of Wildlife Diseases, 32 (2), pp. 359-361, 1996. 1 fig., 10 refs. Authors' abstract.

Enhanced antibody responses in mink (*Mustela vison*) exposed to dietary bleached-kraft pulp mill effluent

Judit E.G. Smits, Deborah M. Haines, Barry R. Blakley, Gary A. Wobeser

Mammalian top predators such as mink (*Mustela vison*) that inhabit a semi-aquatic environment may be exposed to bleached-kraft mill effluent (BKME), directly through the water, or indirectly through bioaccumulation of compounds in BKME via the food chain. To assess the potential immunotoxic effects of this exposure, the antibody response of 20 female mink exposed to dietary BKME for 26 weeks was studied. After 16 weeks on the BKME diet, sera were collected to determine prevaccination antibody levels against a mycobacterial antigen. For weeks later, during early gestation, mink were immunized with a vaccine prepared from a culture of bacillus Calmette-Guérin (BCG). Sera were collected 6 weeks following vaccination and antimycobacterial antibody levels measured. A protein extract from cultured BCG was used as the capture antigen in an indirect enzyme-linked immunosorbent assay to quantify mink immunoglobulin specific for BCG. Both the control and BKME-exposed mink had significantly increased BCG antibody concentrations postimmunization compared to preimmunization levels. The BKME-exposed group antibody levels postimmunization were significantly higher ($p=0.029$) than the corresponding control group. These results demonstrate immune modulation from dietary BKME, which was expressed as enhanced specific antibody production in mink. A related study describes cell mediated immunosuppression in these BKME-exposed mink, supporting the hypothesis of immune deviation proposed here.

Environmental Toxicology and Chemistry, Vol. 15, No. 7, pp. 1166-1170, 1996. 3 tables, 33 refs. Authors' summary.

Cystic urogenital anomalies in ferrets (*Mustela putorius furo*)

X. Li, J.G. Fox, S.E. Erdman, N.S. Lipman, J.C. Murphy

Single or multiple semispherical to bilobulated fluid-filled cystic structures of variable size were observed on the dorsal aspects of the urinary bladder of four male and two female ferrets (*Mustela putorius furo*). All ferrets had been neutered. On physical examination, the cysts were palpated as caudal abdominal masses. Three of the six ferrets presented with dysuria, and two ferrets had signs compatible with endocrine dysfunction. Adrenal cortical hyperplasia or neoplasia were observed in all of the five ferrets examined. Sex hormones assayed in one of the six ferrets revealed elevated levels of serum estrodiol. The posterior aspect of the cysts was located on and/or attached to the trigone or neck of the bladder, with variable intraluminal communication with the bladder and/or the urethra. The anterior aspect of the cysts projected dorsally or dorsocranially into the caudal abdomen. The cysts were thin walled and contained urine-like fluid (n=5) or viscous yellow fluid (n=1). Histologically, the cyst walls were composed of three layers, epithelium, muscle, and serosa, with fibrovascular stroma between layers. The epithelium consisted of simple to stratified transitional, columnar, or squamous epithelial cells. The muscular layer consisted of intermittent bundles and/or single to double layers of continuous to discontinuous smooth muscle. The serosal layer consisted of loose fibrous stroma covered by flattened mesothelial cells. The cystic anomalies in these ferrets were most likely derived from the urogenital glands/ducts or other remnants.

Vet Pathol 33, pp. 150-158, 1996. 2 tables, 8 figs., 43 refs. Authors' summary.

A cluster of cases of juvenile mediastinal lymphoma in a ferret colony

Margaret A. Batchelder, Susan E. Erdman, Xiantang Li, James G. Fox

Three cases of juvenile mediastinal lymphoma developed in a laboratory colony of ferrets. Two ferrets became acutely moribund, and one was found dead with no preceding signs of illness. Splenomegaly, hepatomegaly, and a large thoracic mass were the primary features in each case. All three ferrets had multiorgan metastasis of the tumor. Two ferrets were tested for feline leukemia virus and Aleutian disease virus with negative results.

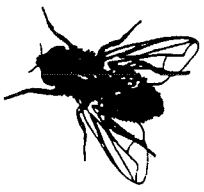
Laboratory Animal Science, Vol. 46, No. 3, pp. 271-???, 1996. 1 table, 3 figs., 31 refs. Authors' abstract.

Control of ear mites in farmed foxes by ivermectin incorporated into the feed

H. Holm, B. Gjerde

A treatment schedule has been designed for the control of Otodectes cynotis in farmed foxes in Norway. Ivermectin (Ivomec) is mixed with the wet feed to give a dose of 0.5 mg/kg body weight. The animals are left without food for 1-2 days, then given half of their normal ration, including the ivermectin, for the next 2 days. The feed intake of each animal is noted separately, and any that have not taken all the feed on either day is sprayed with ivermectin. The procedure is repeated 2 weeks later. On both occasions dogs and cats that have access to the farms are also treated for ear mites. Treatment of animals during very cold weather is not recommended as the treated feed may freeze and therefore remain uneaten.

Norsk Pelsdyrblad 70, 1, pp. 17-19, 1996. In NORG. CAB-abstract.



Acta Theriologica, Vol. 41, No. 2, 1996. Journal issue with special reference to otter, mink and polecat.

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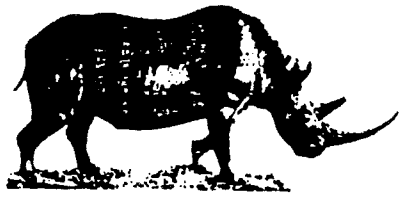

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MSU - Fur Animal Research, 1997

This research report consists of a ccompilation of araticles and abstracts of studies pertaining to fur bearing animals that were conducted by scientists at the Michigan State University Fur Animal Project during the past few years. The report contains the results of basic and applied research concerning mink, ferrets and otter. The information contained in the report should be of use to fur farmers, as well as allied fur industry personnel, teachers, veterinarians, pathologists, nutritionists, wildlife biologists, researchers, and others interested in these animals.

The articles appearing in the report are presented in their entirety. The abstracts are of articles that were published in scientific journal. Reprints (or copies) of the articles abstracted in this report are available from Dr. Richard J. Aulerich, Department of Animal Science, Michigan State University, East Lansing, MI 48824.

145 pp.

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Abstracts from page 125-145.

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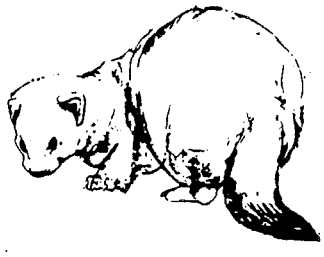

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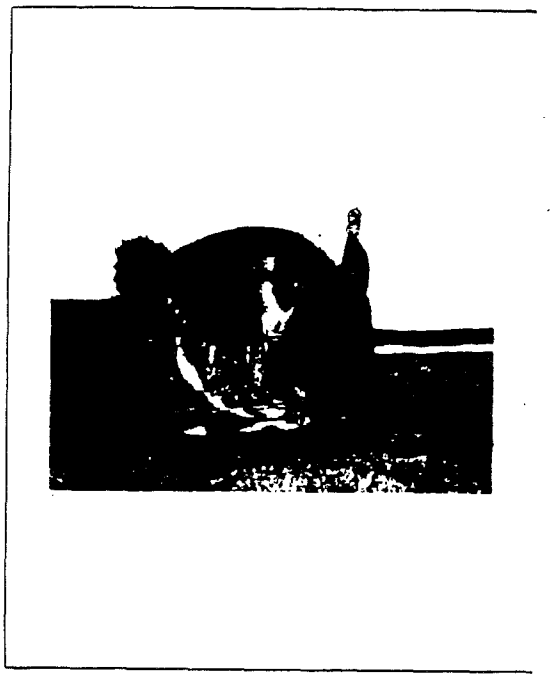
All drawings by Michele Earle-Bridges of New York City.

Chinchilla: domestic animal and patient

Guido Schweigart



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Chinchilla

Heimtier und Patient

Guido Schweigart

10 Abbildungen
3 Tabellen

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Vorwort

Aufgrund der zunehmenden Zahl von Chinchillas in der Heimtierhaltung steigt auch in den letzten Jahren der Anteil dieser Tiere unter den Patienten in der tierärztlichen Praxis kontinuierlich an. Sehr häufig sind haltungs- und fütterungsbedingte Krankheiten sowie Verhaltensanomalien zu beobachten. Da auf diesem Gebiet bisher nur wenig Literatur existiert, muß der Tierarzt immer häufiger, oft schon vor Anschaffung der Tiere, in seiner Funktion als Berater des Tierbesitzers tätig werden. Aus diesem Grund soll hier zunächst vor allem auf praktische Aspekte der Haltung und Fütterung von als Heimtiere lebenden Chinchillas eingegangen werden. Daneben werden auch Diagnose und Therapie der in der Heimtierhaltung zu beobachtenden Erkrankungen der Chinchillas besprochen. Auch auf die Untersuchungstechnik, die sich aufgrund vieler anatomischer und physiologischer Besonderheiten der Chinchillas sowie des oft weitgehenden Fehlens einer eindeutigen Symptomatik bei vielen Krankheiten zum Teil recht deutlich von der bei anderen Nagern unterscheidet, wird großer Wert gelegt. Zur Veranschaulichung einiger Sachverhalte werden häufig Vergleiche zu den weitgehend bekannten Verhältnissen bei anderen Nagern (z. B. Meerschweinchen) oder Kaninchen herangezogen. Die „klassischen" Bestandserkrankungen von Chinchillas in der Pelztierzucht sowie die dortigen Zucht- und Haltungstechniken sind in der Heimtierhaltung nahezu ohne Bedeutung; sie werden daher nur am Rande erwähnt. Zu diesem Thema sei auf die einschlägige Fachliteratur verwiesen.
Ich hoffe, daß dieses Buch dazu beiträgt, Verständnis für die besonderen Aspekte der Chinchillahaltung und -behandlung sowohl bei Tiermedizinern als auch bei interessierten Heimtierhaltern zu wecken, so daß die faszinierenden kleinen „Kobolde der Nacht" die optimale Pflege und Behandlung erhalten, die sie verdienen.
Mein Dank gilt allen, die bei der Entstehung dieses Buches mitgewirkt haben. Erwähnt seien hier vor allem die vielen Chinchillabesitzer, die durch die geduldige Schilderung der Haltungstechnik und Krankheitsgeschichte sowie des Verhaltens ihrer Tiere manches wertvolle Detail beitragen konnten.
Meinen besonderen Dank möchte ich an dieser Stelle Frau cand. med. vet. Birgit Klein für die Erstellung der Zeichnungen in diesem Buch aussprechen.

Berlin, im Dezember 1994 *Guido Schweigart*

Guido Schweigart

Chinchilla

Heimtier und Patient

Inhaltsverzeichnis

MINK - Biology, health and disease

Mink...

biology, health and disease

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Memorandum

To: GUNNAR JØRGENSEN, EDITOR, SCIENTIFUR

From: CANADA MINK BREEDERS ASSOCIATION

Date: JANUARY, 1997

Subject: "MINK ... biology, health and disease"

The above-referenced publication, funded by Canada Mink Breeders Association, has been printed and is ready for distribution. This 300-page, soft cover text book on mink diseases was produced primarily as a resource guide for members of CMBA. However, detailed reviews of anatomy, physiology and pathogenesis of disease make it a valuable reference tool for veterinarians, veterinary pathologists and scientists interested in the biology and husbandry of mink.

Sixteen recognized authorities in the mink industry are contributing authors to the 19 chapters which include a list of suggested further readings for each section, tables, black and white photographs and 16 full-colour plates of 84 pictures:

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The members of Canada Mink Breeders Association wish to acknowledge the invaluable contribution of the book's director and scientific editor, D. Bruce Hunter, University of Guelph, Guelph, Ontario, Canada.

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