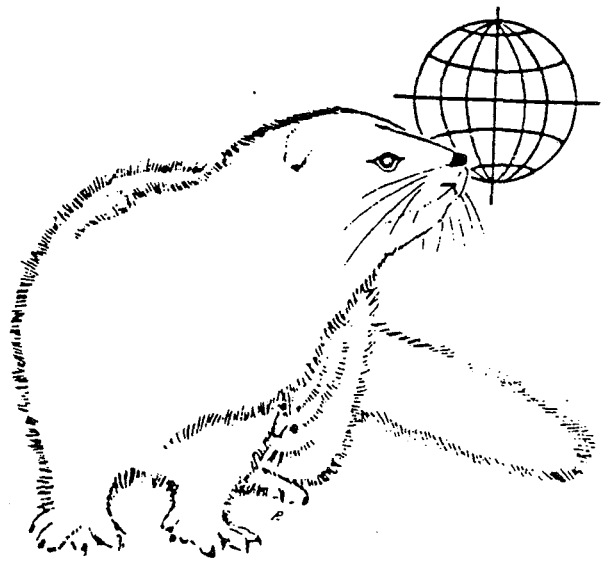


Published by **IFASA**

INTERNATIONAL FUR ANIMAL SCIENTIFIC ASSOCIATION

**SCIENTIFUR**
**ISSN 0105-2403**
**Vol. 20, No. 2**
**May 1996**

**List of other publications - not abstracted**

**Fur biting in mink.** *Ulla Lund Nielsen, Niels Therkildsen. Dansk Pelsdyravl, Vol. 57, 10, pp 430-431, 1994. 3 ill. In DANH. Code 2-9-M.*

**Lighting of mink is a good method for evaluation of fur quality: alternative sorting method.** *Janne Hansen. Dansk Pelsdyravl, Vol. 58, 1, pp 26, 1995. In DANH. Code 2-12-14-M.*

**Flea control on farm.** *K.S. Larsen. Dansk Pelsdyravl, Vol. 58, 2, pp 91, 1995. In DANH. Code 12-14-M-F-O.*

## 4. Genetics

**Titles of other publications - not abstracted**

**Peculiarities of organization and function of immunogenetic systems in American mink under domestication.** *D.K. Belyaev, O.K. Baranov. Commision on Animal Genetics. Session IV, 1986. Preprint, 4 pp. Code 4-11-M.*

## 5. Reproduction

## Titles of other publications - not abstracted

**High frequency of Escherichia coli in greasy kits.** *Mogens Jørgensen. Dansk Pelsdyravl, Vol. 57, 12, pp 546-551, 1994. 5 ref. In DANH. Code 5-9-12-M.*

**Greasy kits.** *L. Lonne. Norsk Pelsdyrblad 69, 4, pp 25-26, 1995. 9 ref. In NORG. Code 5-9-M.*

**Diagnostic exercise: Ataxia and incoordination in ferrets.** *Nora Rozengurt, Douglas Stewart, Susan Sanchez. Laboratory Animal Science, Vol. 45, No. 4, pp 432-436, 1995. 4 refs. Code 9-O.*

**Papillomavirus infection in raccoons (*Procyon lotor*).** *A.N. Hamir, G. Moser, A.B. Jenson, J.P. Sundberg, C. Hanlon, C.E. Rupprecht. J. Vet. Diagn. Invest. 7, pp 549-551, 1995. Code 9-O.*

**Eosinophilic encephalomyelitis in a raccoon experimentally infected with a dog isolate of rabies virus.** *A.N. Hamir, C.E. Rupprecht. J. Vet. Diagn. Invest. 2, pp 145-147, 1990. Code 9-O.*

**Adrenal gland adenomas in raccoons (*Procyon lotor*) from the eastern United States.** *A.N. Hamir, C.E. Rupprecht. J. Vet. Diagn. Invest. 7, pp 413-416, 1995. Code 9-O.*

**Fatal necrotizing encephalitis in a raccoon associated with a *Sarcocystis*-like protozoon.** *J.P. Dubey, A.N. Hamir, C.A. Hanlon, M.J. Topper, C.E. Rupprecht. J. Vet. Diagn. Invest. 2, pp 345-347, 1990. Code 9-O.*

## 8. New books



# IFASA

# VIth INTERNATIONAL SCIENTIFIC CONGRESS IN FUR ANIMAL PRODUCTION

Notes
SCIENTIFUR
Vol. 20, No. 2
Maj 1996

## August 21-23, 1996
## Warszawa, Poland

Hopefully you have all received the enlarged Vol. 20 No. 1, so you have got a heavy scientific input here at the beginning of the year when skin prices are increasing dramatically.

We can already feel the better economic situation and perhaps also the rapidly approaching time for the VITH INTERNATIONAL SCIENTIFIC CONGRESS IN FUR ANIMAL PRODUCTION in Warsaw, August 21-23, this year.

From the secretariat and arrangement committee of the congress we are informed that the 3rd announcement has now been sent to all pre-registered participants of the congress, i.e. approx. 220 participants from a total of 18 countries. The scientific committee is very busy with evaluation and programme setting of the nearly 100 reports and posters already received. All signs of a good congress are present. Why not participate, you too? Surely you will be welcome if you contact the secretariat immediately. The address is:

**VIth IFASA Congress**
**Polish Society of Animal Production**
**9 Kaliska Str.**
**02-316 WARSAW, POLAND**
**Tel/fax: 0-4822 22 17 23**

The congress will include a plenary programme covering Ethology of fur animals, Cromosomes and genome maps of dom. canids, Embryo-uterine interactions and embryo survival in carnivores, and the Current status of fur animal health and 5 sessions on Breeding, Reproduction and Genetics, 2 sessions on Nutrition, 3 sessions on Pathology and Disease, 2 sessions on Behaviour and Welfare, 2 sessions on Fur Properties and finally 1 multidisciplinary session as well as a poster session. This information should encourage very many people engaged in fur animal production to participate.

CONGRESS FEES:

| Paid | before 15 July | after 15 July |
|---|---|---|
| IFASA Members*) | 180.- USD | 220.- USD |
| Non-members | 220.- USD | 260.- USD |
| Accompanying persons | 90.- USD | 130.- USD |

*) Only members who have paid their 1996 membership fee can obtain the discount advertised.

ACCOMODATION:

| Hotel | single room | double room |
|---|---|---|
| 1. Forum**** | 110.- USD | 128.- USD |
| 2. Jan III Sobieski**** | 108.- USD | 118.- USD |
| 3. Novotel*** | 54.- USD | 78.- USD |
| 4. Grand*** | 53.- USD | 74.- USD |
| 5. Felix*** | --------- | 44.- USD |

Above rates include one night and breakfast. Hotel deposit at registration is the cost of the first night and will be subtracted from the total amount at the final settlement of accounts.

LUNCHES during the congress at the Forum Hotel where the congress will be: Price 14.- USD/person.
TRANSPORTATION Airport - Hotel incl. guide/-interpreter: 20.- USD/person.
SIGHTSEEING WARSAW, August 21 15:30-18:00: 21.- USD/person.
GALA DINNER August 22 at 20:00: 58.- USD/-person
EXCURSION incl. piano concert F. Chopin and Polish Dinner August 23, at 18:00: 55.0 USD/-person
POST CONGRESS EXCURSIONS:
**A**. Warsaw-Cracow-Warsaw August 24-26, incl. transportation, full board, guiding and accomodation: 265.- USD/person + 45.- USD for single room.
**B**. Warsaw - Mazurian Lake District - Warsaw, August 24-26, incl. transportation, full board, guiding and accomodation: 280.- USD/person + 40.- USD for single room.
**C**. Central Husbandry Animal Exhibition in Warsaw, August 22-25, incl. all farmed animals, also fur animals + exhibitions, seminars etc. Entry free of charge for congress participants.

Further information is given in the 3rd announcement which will also contain registration form which must be in the possession of the congress bureau before 15 July, 1996.

NOMINATION AND ELECTION OF COUNCILLORS AND THE IFASA BOARD OF DIRECTORS

In SCIENTIFUR Vol. 19, No. 4, pages 259 & 260, November 1995, IFASA informed members about the procedures, but due to the fact that nobody in the acting board of directors has had any indication from the IFASA members we recapitulate:

The procedure for nominations is directed by the constitution. Nominations may be made by any individual member and must reach the secretary not later than 30 days prior to the election. Members wishing to nominate others for the post of President, Vice President or one of the three members of the board, should submit the names of individuals to the President, Prof. Einar J. Einarsson, Drøbakveien 23, N-1430 Ås, Norway, or fax +47 64 94 11 35, prior to 20 July 1996. A statement from nominees indicating their willingness to serve on the Board should be included in the written nomination.
The present board members are:

| | | Alternate |
|---|---|---|
| President | Prof. Einar J. Einarsson, Norway | Prof. Anders Skrede, Norway |
| Vice president | Editor Gunnar Jørgensen, Norway | Prof. Maija Valtonen, Finland |
| Board member | Prof. Bruce Murphy, Canada | Prof. William Wehrenburg, USA |
| Board member | Prof. Stanislaw Jarosz, Poland | Dr. Alexander V. Taranin, Russia |
| Board member | Dir. Wim Verhagen, The Netherlands | vacant |

Gunnar Jørgensen and Stanislaw Jarosz have asked not to be renominated.

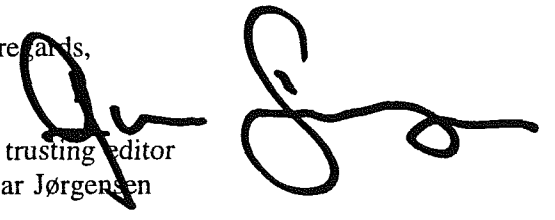
SCIENTIFUR ELECTRONIC INDEX

The SCIENTIFUR INDEX 1996 covering all reports, abstracts and titles published in SCIENTIFUR Vol. 1-19, i.e. totally more than 7,000 titles, mainly of scientific reports on fur animal production, will be demonstrated at the congress. This way you can be convinced how easy it is to get access to by far the largest data bank on fur animal science.

The INDEX as well as earlier advertised books will be available at favourable prices during the congress.

See you in Warsaw and have a good summer until then.

Best regards,



Your trusting editor
Gunnar Jørgensen

*Original Report*

# Analysis of the functional state of the pituitary-adrenal axis during postnatal development of domesticated silver foxes (*Vulpes vulpes*)

*I.N. Oskina*

*Institute of Cytology and Genetics, Siberian Branch of the Russian Academy of Sciences, Novosibirsk 630090, Russia*

## Summary

The postnatal course of changes in the pituitary-adrenal system were studied in domestic and aggressive (relatively wild) foxes under basal and stress conditions. It was demonstrated that changes in the pituitary-adrenal function correlate with advancement of domestication. Thus, the more profoundly reorganized behaviour under the effect of domestication was associated with the more marked changes in adrenal function. Analysis of phenotypic variability of the adrenal function of foxes at different ages demonstrated that stress facilitates identification of genotypic variability starting from the age of 4 months. Domestication widens genotypic variability of the adrenal function during early postnatal development. It may be concluded that selection for domestic behaviour was associated with changes in the time course of the pituitary-adrenal function and changes in the structure of its phenotypic variability of the various characteristics.

## Introduction

There is ample evidence indicating that early and late development are under the control of neurohormonal systems, the universal regulators of physiological and genetic processes (*Mitskevich, 1978; Buznikov, 1987*). Synchronous action of hormones, as morphological inducers, and the appearance of competence in target cells are particularly needed to provide the regulatory effect of hormones (*Csaba, 1986, 1991*). Slight changes in the maturation of interacting tissues can lead to irreversible consequences. These changes are thought to be of great evolutionary importance (*Schmalhausen, 1982; Raff, Kaufman, 1986*). For this reason, analysis of the course of changes in establishment of hormonal regulation and clarification of their role in the emergence of new forms of animals is an evolutionary problem. This problem is closely associated with Belyaev's concept of destabilizing selection (*Belyaev, 1983*) viewing evolution as a process of

changes in the regulatory systems at the level of organisms. Under the effect of domestication, selection for tame behaviour has a destabilizing function involving the neuroendocrine systems of the whole organism. Studies of the hormonal mechanisms underlying domestication of silver foxes have demonstrated that the first system affected by selection for tameness traits is the pituitary-adrenal (*Naumenko, Belyaev, 1981*). It should be emphasized that this system has been assigned an important role in adaptation of the organism to the environment (*Selye, 1976*) and also in stress mediated influence on reproduction (*Gilmore, Cook, 1981; Liptrap, 1993*). This study is concerned with the effects of selection for tameness on the establishment and function of the pituitary-adrenal system and also on the structure and phenotypic variability of the glucocorticoid function of the adrenals in foxes of different ages.

## Materials and methods

The studied foxes were bred at the Experimental farm of this Institute. The foxes were of both sexes and taken from the population selected for domestic behaivour (tame) and from a commercial population (relatively wild). The total number of studied foxes was 256: 125 foxes, the offspring of 9 males and 27 femaels of the domesticated population and 131 foxes, offspring of 10 males and 30 females of the population not selected for tame behaviour. The foxes that had not been subjected to selection for domestication, showing an aggressive response to humans (regardless of the degree to which aggression was expressed) composed group I. Those not showing aggression were referred to group II. Members of group II have previously been used for developing the domestic population (*Trut, 1980*). The following three groups consisted of foxes at different levels of domestication estimated by the three score scale. The criteria and methods for estimating the behavioural responses have been described elsewhere (*Trut, 1980*). In a separate experimental series, hormonal characteristics were analyzed in foxes outstanding in aggressiveness and tameness at early ages, at 1-2 days, and 1, 1.5, 2, and 3 months. Fifty four pups were taken from the population selected for enhanced aggressive responce to humans and 59 offspring were taken from "elite mothers" superior in tameness to the rest in the domestic population. The foxes were stressed by immobilization for 20 min at the ages of 2, 4, and 6 months. Blood was collected mainly from the same foxes before immobilization (basal level) and immediately after. Blood was withdrawn from *vena saphena* in the morning hours before feeding. The time elapsed from which a fox was caught and its blood being sampled never exceeded 2-3 min. At the age of 8 months, foxes were not intentionally stressed because they were killed for commercial purposes and their adrenals were widely available. In this study, the following characteristics of the pituitary-adrenal system were studied; the time course of changes in the concentration of plasma cortisol and ACTH; production of glucocorticoids under the effect of endogenous and exogenous (5 IU ACTH per g of adrenal tissue) stimulation.

The concentration of blood glucocorticoids and their production *in vivo* by the adrenals were determined by the methods of competitive binding with the use of standard kits supplied by the Minsk Biorganic Chemistry Institute. Plasma ACTH concentration was determined with the use of standard kits (Sea-Ire-Sorin, France). In treatment of phenotypic variability of the hormonal characteristics of the adrenals, factorial variance analysis according to the hierarchic scheme was used. To estimate the contribution of additive variance ($\delta A^2$), the component of differences between half sibs ($\delta_s^2 = 1/4\delta A^2$) was used. The variance ($\delta ec^2$) due to the environment common to the litter of each female included pre- and postnatal maternal effects. The variance ($\delta ec^2$) was expressed as $\delta d^2$-$\delta s^2$, where $\delta d^2$ is the component of differences between males which included interaction between genotypes of the mothers and fathers. The variance ($\delta ew^2$) due to uncontrolled environmental effects was also estimated (*Falkoner, 1960*).

## Results and discussion

Foxes of both the domestic and relatively wild populations show high levels of plasma ACTH at the ages of 1-2 days and 1 month. This is followed by a decrease in plasma ACTH with lowest values observed at the age of 2 months (fig. 1).

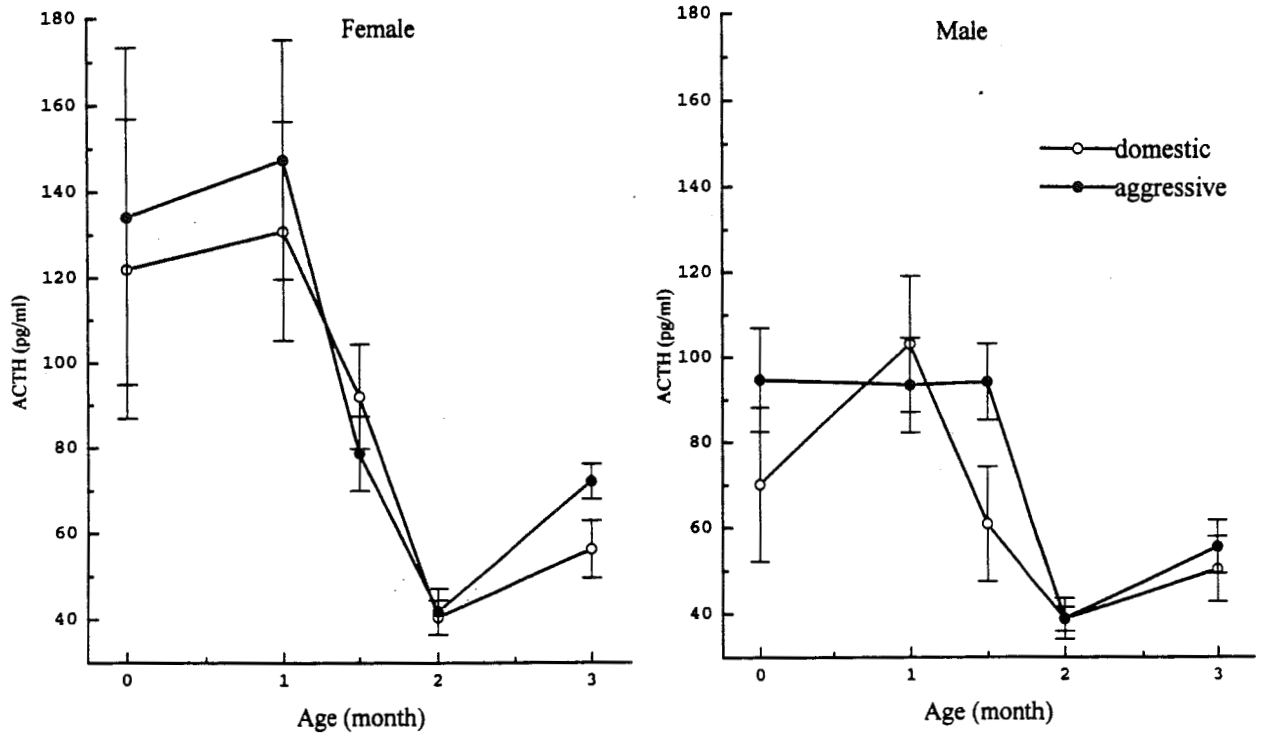



**Fig. 1.** Mean (±SEM) plasma ACTH (pg/ml) levels in domestic and aggressive (relatively wild) foxes during early postnatal development.

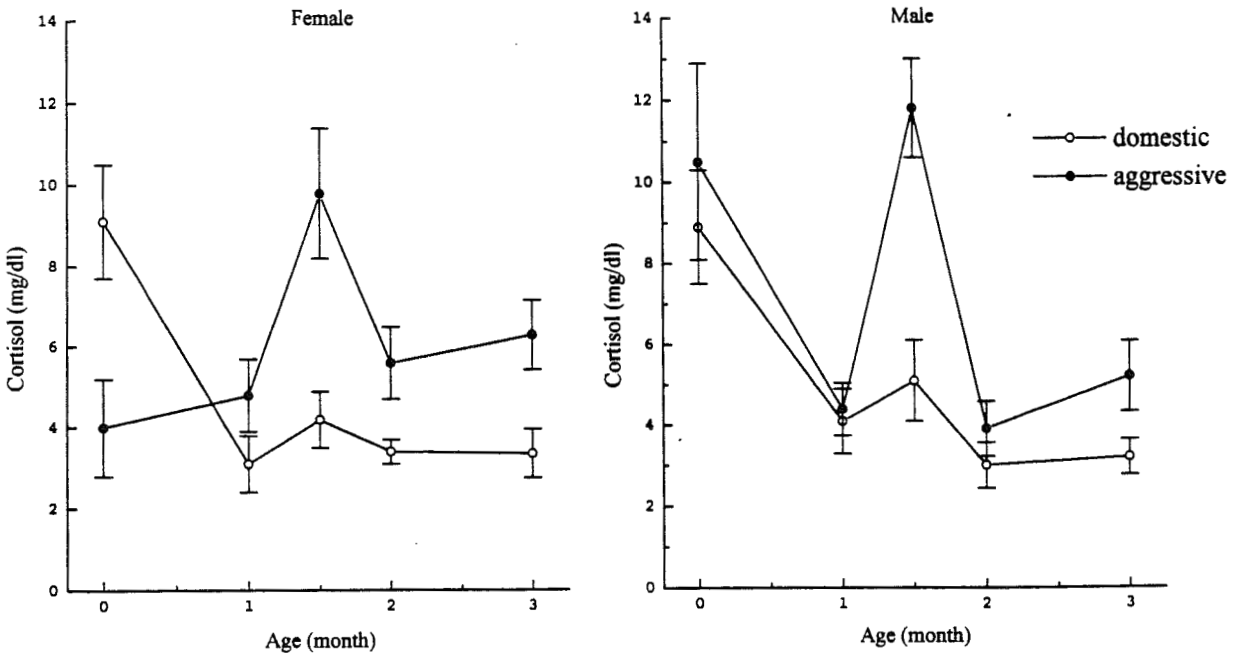



**Fig. 2.** Mean (±SEM) plasma cortisol (μg/dl) levels in domestic and aggressive foxes during early postnatal development.

During the interval from 1-2 days to 3 months, there are no significant differences in plasma ACTH levels between the domestic and relatively wild foxes. In tame and relatively wild newborns of both sexes, the levels of plasma cortisol are also high (fig. 2). This is in agreement with the data in the literature indicating that the levels of plasma glucocorticoids and ACTH are elevated in newborns of other mammalian species, including man (*Butnev et al., 1985; Dupouy, Chatelain, 1986*). However, by the age of 1 month, in contrast to ACTH, the level of glucocorticoids significantly decreases by more than twofold. By the age of 1.5 months, aggressive individuals of both sexes show a sharp increase in plasma cortisol concentration, while it does not substantially change in tame foxes (fig. 2). It has previously been demonstrated that 30-35 days, when orientation-exploratory behaviour predominates in a novel situation, are optimal for socialization (*Belyaev et al., 1985*). Attenuation of exploratory behaviour with concommitant enhancement of defensive responses at the age of 1.5 months is associated with a sharp rise in plasma cortisol in aggressive foxes. In contrast, further enhancement of exploratory behaviour takes place in tame foxes and their glucocorticoid level do not change appreciably. It is pertinent to recall that there is a relation between the activity of the pituitary-adrenal system and development of defensive behaviour (*Plyusnina, Oskina, 1991*). Study of the adrenal function in foxes aged from 2-8 months demonstrated that domestication produces changes in the establishment of the pituitary-adrenal system at this age, too (fig. 3).

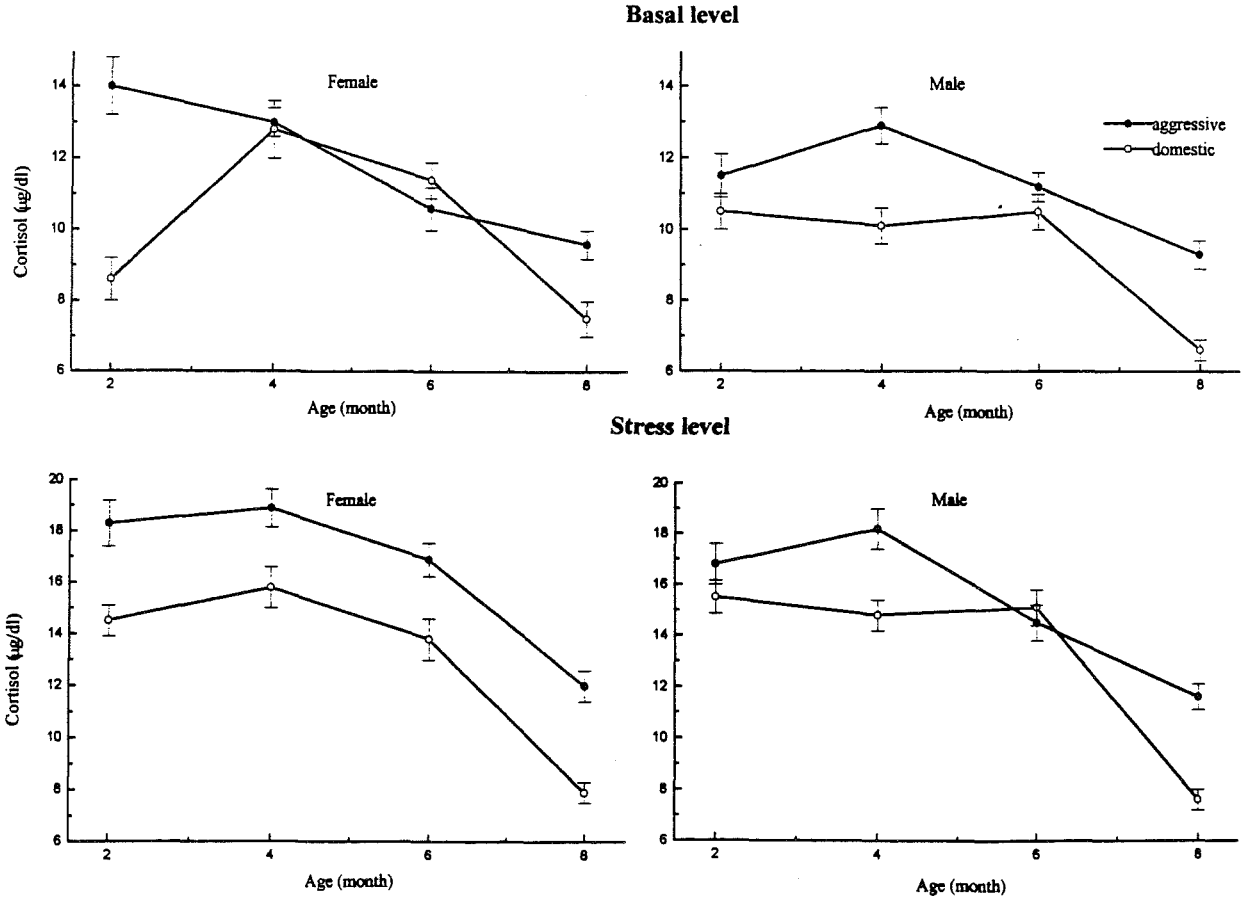



**Fig. 3.** Mean (±SEM) plasma cortisol (µg/dl) levels in domestic and aggressive foxes under basal and stress conditions at the age of 2-8 months.

Analysis of plasma glucocorticoids provided support for the idea that their developmental changes are correlated responses to selection for tame behaviour. Indeed, the higher the level of domestication is, the later plasma glucocorticoids rise. In foxes of the population unselected for behaviour and showing aggressiveness (group 1), glucocorticoid concentration is highest at the age of 2 months, while in the population selected for behaviour (group V), it is highest at age 6 months (fig. 4). Evidence that changes in plasma glucocorticoids are produced by selection for tame behaviour came from comparisons of hormonal levels in foxes of different behavioural groups of the same age. There were no significant differences in glucocorticoid levels between foxes of groups 1 and II, i.e., between foxes differing in defensive behaviour, although not intentionally selected for tameness. It should be noted that foxes of the domesticated population (groups III, IV and V) domesticated to different degrees significantly differed in plasma glucocorticoids from foxes of the unselected population and also one from another (fig. 4). Plasma glucocorticoid concentration in foxes outstanding in tameness (group V) was generally lower than in those with lower domestication scores (groups III and IV). The time course of changes in plasma glucocorticoids under stress from 2 to 6 months of age follows the one observed for the basal level in females and males (fig. 3). The stress response is weaker in tame than wild foxes. By the age of 8 months, there is a significant fall in plasma glucocorticoids to the level characteristic of adult foxes in all the groups (figs. 3, 4). It is by this age that significant differences in the function of the pituitary-adrenal system are formed between tame and relatively wild foxes. Plasma glucocorticoids and ACTH, the *in vitro* production of glucocorticoids by the adrenals, as well as the response of the adrenals to ACTH, are all reduced in the tame foxes (figs. 3, 5). Changes in adrenal function became more pronounced with increasing degree of domestication. The smallest change was in basal production reflecting the biosynthetic adrenal activities; the differences here were significant between males and females of the two contrasting groups I and V.

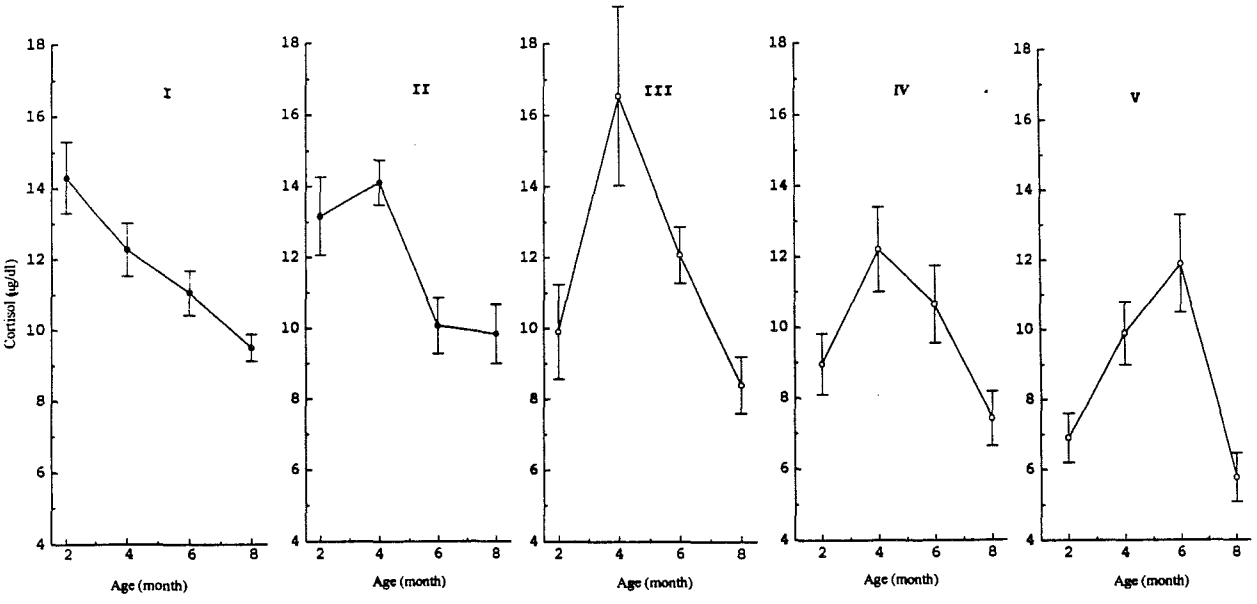



**Fig. 4.** Time course of changes in plasma cortisol (µg/dl) levels in females differing in behaviour. I, II - foxes of the unselected population showing: group I - aggressive, group II - no aggressive respones to humans. III, IV, V - foxes of the groups selected for domestic type of behaviour. Scores for tameness: group III - low, group IV - intermediate, group V - high.

When ACTH was added in the same amounts to the incubation medium, there were differences not only between the groups of the domesticated and wild populations, but also between foxes differing in domestication scores. Under the effect of endogenous stimulation, the differences became more prominent. Production of hormones by the adrenals of group I was lower by 30% in females and by 66% in males than in their counterparts of group IV (fig. 5). It may be concluded that selection of foxes for domestication traits affects the establishment of the entire pituitary-adrenal system during postnatal development.

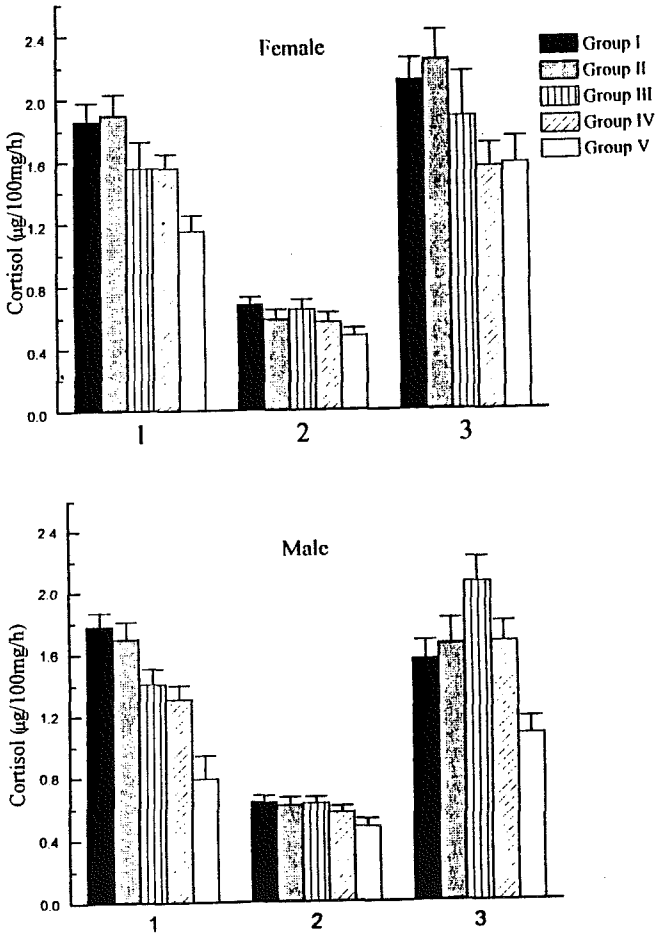



**Fig. 5.** Adrenal activity *in vitro* in foxes with different scores for tameness. Foxes of the unselected population showing: group I - aggressive, group II - no aggressive responses to humans. Group scores for tameness: III -low, IV - intermediate, V - high. Pattern 1 - preincubation represents the production of glucocorticoids (µg/100 mg/h) after sacrifice. The measurement data cannot be free from the endogenous effects to which the living foxes were subjected. Pattern 2 - baseline production represents the biosynthetic activities of the adrenal themselves. Pattern 3 - production of glucocorticoids under the effect of ACTH (5 IU/100 mg of adrenal tissue) added to the incubation medium.

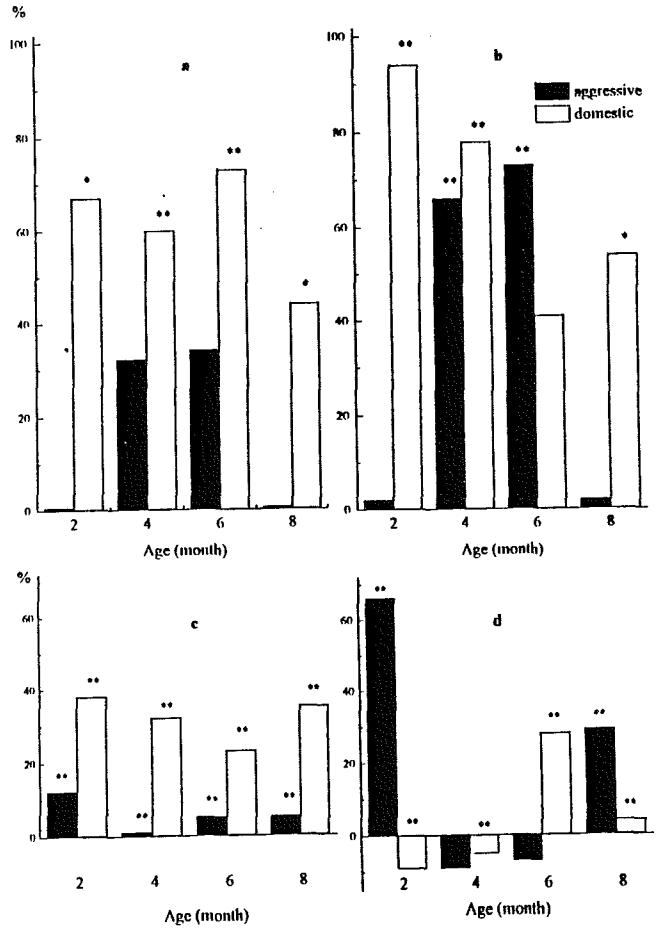



**Fig. 6.** Variance analyses of plasma cortisol in domestic and aggressive foxes under basal and stress conditions during postnatal development. a, b - additive variance; c, d - common environmental variance. Conditions: a, c - basal; b, d - stress. *P<0.1; **P<0.05 - 0.01; variances are significant.

To elucidate the role of genetic factors in changes of the glucocorticoid function of the adrenals, the structure of the phenotypic variance of the variables of the pituitary-adrenal system was analyzed in tame and wild foxes during postnatal development. The results demonstrated that wide genotypic diversity

in plasma glucocorticoids in wild foxes can be revealed only in stress conditions (fig. 6). The contribution of the genetic component of the basal level of glucocorticoids is insignificant at all the studied ages. Analysis of the phenotypic structure of the various parameters of adrenal activity *in vitro* demonstrated that genotypic variability of the secretory function of the adrenals increases only when ACTH, the main regulator of adrenal function, is added to the incubation medium (fig. 7). Summarizing the *in vivo* and *in vitro* results obtained for adrenal function in wild foxes, it may be concluded that stress is a factor bringing into prominence the genetic specificities of the population. This conclusion agrees with that made for other animal species under stress (*Eisner, Reznichenko, 1976; Markel, Borodin, 1982; Shabalina et al., 1984*) and possibly proves that there is a common pattern for the effects of stress on the structure of phenotypic variability. However, there is an increase in genetically determined variation in plasma glucocorticoids in stressed wild foxes only by the age of 4 months. Before this age, adrenocortical function is determined mainly by maternal effect and common environment (between group environmental component) by all the litter (fig. 6). Presumably, during early postnatal life, maternal effect plays an important role in the formation of the adrenocortical response (*Trieman et al., 1970; Kraus, 1978*). By the age of 4 months, pups leave their nests, when no longer needing continuous contact with the mother. Later on, stress increases the contribution of genetic factors to total variability of glucocorticoid function.

The pattern is different for variability of this trait during postnatal development in tame foxes. Genetic variability for plasma glucocorticoid level is revealed without additional stress imposed on the adrenals even during early postnatal development. Domestication reduces maternal effect on the formation of this trait during development (fig. 6). Under the effect of stress, the contribution of the additive component increases further in the tame foxes.

The results obtained for the effect of domestication on the structure of phenotypic variability in the *in vivo* experiments are confirmed by those obtained for phenotypic variability in the *in vitro* experiments (fig. 7).

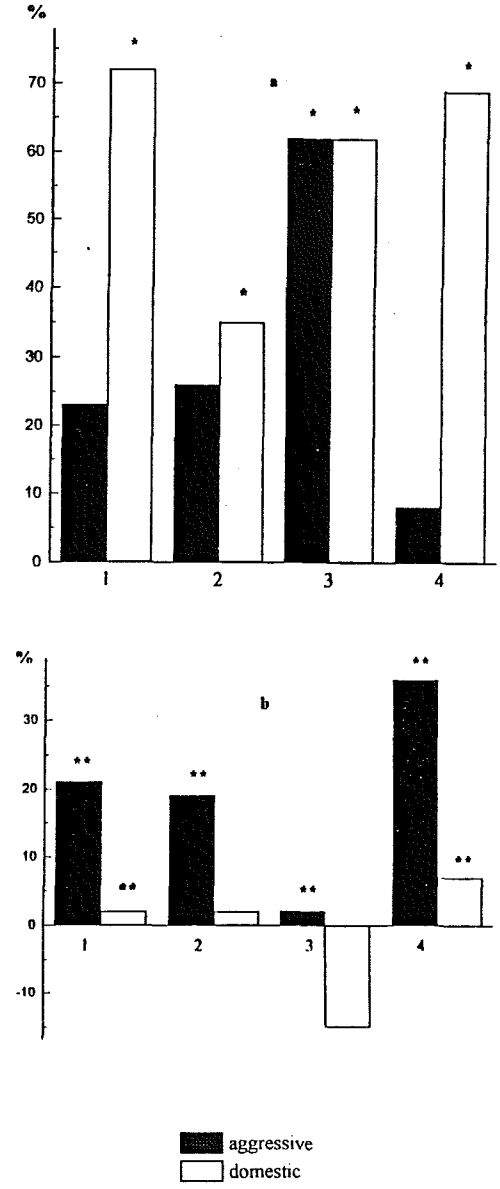



**Fig. 7.** Variance analyses of the *in vitro* glucocorticoid production by the adrenals and tameness scores in foxes. a - additive variance; b - common environmental variance. Pattern 1 - preincubation represents the production of glucocorticoids after sacrifice. Pattern 2 - baseline production represents the biosynthetic activities of the adrenal themselves. Pattern 3 - production of glucocorticoids under the effect of ACTH (5 IU/100 mg of adrenal tissue) added to the incubation medium. Pattern 4 - tameness scores. *P<0.05; **P<0.01; variances are significant.

In the domestic foxes, genetic variability is significant for all the characteristics of the adrenocortical function in *in vitro* conditions. There is no significant difference in additive variance of both basal and under ACTH effect glucocorticoid production between tame and wild foxes. In contrast, glucocorticoid production under the effect of endogenous factors was 3.1 times higher in the tame than in the wild foxes. This increase in genetic variability may be evidence for increase in genetic variability of the central regulatory mechanisms in the course of selection for behaviour. Thus, selection of foxes for domestic traits produces changes in the brain mediator systems which, as known, are involved in behavioural responses (*Naumenko et al., 1987*). Analysis of variations in the degree of domestication or in the expression of the aggressiveness of these foxes demonstrated that the contribution of the additive component increases and that of maternal effect decreases (fig. 7). In other words, comparison of the various components of behavioural and hormonal characteristics reveal unidirectional changes in these variances, when foxes are selected for domestic traits. The present results are consistent with those obtained in analysis of the role of genetic factors in the function of adaptive systems in stressed rodents. It will be remembered that behavioural, vegetative and endocrine systems respond in a correlated manner to stress in rodents (*Markel, Borodin, 1980*). Thus, this study of phenotypic variability of adrenocortical function at different times during postnatal development revealed additive variance in wild foxes from the age of 4 months and only in stressed individuals. Wide genotypic variability is observed in domesticated foxes during development, when they are not stressed.

## Acknowledgements

This work was supported by the grant 93-04 6936 from the Russian Fund of Fundamental Researches and the grant RBD000 International Science Foundation.

## References

Belyaev, D.K. 1979. Destabilizing selection as a factor in domestication. J.hered., Vol. 70: 301-308.

Belyaev, D.K., Plyusnina, I.Z., Trut, L.N. 1985. Domestication in the silver fox (*Vulpes fulvus Desm.*) changes in physiological boundaries of the sensitive period of primary socialization. Appl. Anim. Behav. Sci., Vol. 13: 359-370.

Buznikov, G.A. 1987. Neurotransmitters in ontogenesis. Moscow, Nauka (in Russian).

Butnev, A.L., Goncharov, N.G., Timofeeva, G.A. 1985. Endocrine function of the adrenals and gonads of man during the neonatal period. Vopr. okhr. mater. and detst., Vol. 30: 19-23 (in Russian).

Csaba, G. 1986. Development of hormone receptor: ontogeny and hormonal imprinting. Experienta, Vol. 42: 750-759.

Csaba, G. 1991. Interactions between the genetic and environmental influences in the perinatal critical period. Zoological Sci., Vol. 8: 813-825.

Dupoyu, J.P., Chatelain, A. 1986. Effects of progesterone induced postmaturity on CBG and pituitary-adrenal activity in the rat foetus. Acta Endocrinologica, Vol. 112: 396-403.

Eisner, F.F., Reznichenko, L.N. 1976. Heritability and repeatability of certain characteristics of the functional adrenocortical activity in cattle. Genetica, Vol. 13: 630-638 (in Russian).

Falconer, D.S. 1960. Introduction in quantitative genetics. Edinburgh, London: Oliver and Boyd.

Gilmore, D., Cook, B. 1981. Environmental factors in mammal reproduction. Hong Kong.

Kraus, M. 1978. Activity of adrenal cortex and postnatal development. Praha: Acad. Ved.

Liptrap, R.M. 1993. Stress and reproduction in domestic animals. Corticotropin-releasing factor and cytokines: role in the stress response. Annals New York Academy of Sciences. New York, Vol. 697: 275-284.

Markel, A.L., Borodin, P.M. 1980. The stress phenomenon genetic and evolutionary approach. Problems in general genetics. Proceed. of the XIY Int. Cong. Genet., Vol. 2, Book 2, p. 51-65.

Markel, A.L., Borodin, P.M. 1982. Problems of stress genetics. Communication 5. Genetics of stress responsiveness of the adrenal cortex in rats under emotional stress. Genetica, Vol. 18: 19-23 (in Russian).

Mitskevich, M.S. 1978. Hormonal regulation in ontogenesis in animals. Moscow, Nauka (in Russian).

Naumenko, E.V., Belyaev, D.K. 1980. Neuroendocrine mechanisms in animal domestication. Problems in general genetics. Proceed. of the XIY Int. Cong. Genet., Vol. 2, Book 2, p. 12-24.

Naumenko, E.V., Popova, N.K., Ivanova, L.N. 1987. Neuroendocrine and neurochemical mechanisms of domestication. Genetica, Vol. 23: 1011-1025 (in Russian).

Plyusnina, I.Z., Oskina, I.N., Trut, L.N. 1991. An analysis of fear and aggression during early development of behaviour in silver foxes (*Vulpes vulpes*). Appl. Anim. Behav. Sci., Vol. 32: 253-268.

Raff, R.A., Kaufman, T.C. 1986. Embryos, genes and evolution. Moscow: Mir.

Selye, H. 1976. Stress in health and disease. Butterworth. Boston, MA.

Schmalhausen, I.I. 1982. Selected works. The organism as an entity in individual and historical development. Moscow, Nauka (in Russian).

Shabalina, A.E., Gerasimova, G.G., Dmitriev, V.G. 1984. Genotypic characterization of birds based on plasma corticosterone level. Dokl. Bolg. AN, Vol. 37: 521-524 (in Russian).

Trieman, D.M., Fulker, D.W., Levine, S. 1970. Interaction of genotypic and environment as determinant of corticosteroid response to stress. Dev. Psychobiol., Vol. 3: 131-142.

Trut, L.N. 1980. The role of behaviour in domestic transformations of animals. Doctoral theses, Doctor of Biological Sciences Novosibirsk. Institute of Cytology and Genetics, 30 pp (in Russian).

*Original Report*

# An attempt to determine the pattern of winter hair cover of the raccoon dog (*Nyctereutes procyonoides Grey*) using linear measurements

*Stanislaw Niedzwiadek, Andrzej Zon*

*Instytut Zootechniki, 32-083 Balice k. Krakowa, Poland*

**Abstract**

The studies were carried out on 86 pelts of raccoon dogs slaughtered between 10 and 15 November. Measurements were done on raw and dried skins in 6 topographic parts. The length of the colour zones of the undercoat hair and guard hair was measured. It was found that the type of hair cover colour in the raccoon dog is determined by the zonal colouring of undercoat hair, while the tone and silver plating of the whole hair cover is determined by the zonal colouring of guard hair.

Raccoon dogs are characterized by different colours of their hair cover: from dark to very bright, with shades of brown and orange, with red and even white spots, and with a dark streak on the back. Undercoat hair is coloured all the way along the hair, and guard hair has a colourless zone, i.e. a silver plate. The distribution of undercoat hair and guard hair colour and its intensity makes it possible to determine the colour type of hair cover.

On a Polish farm Ciurzynski (1982) described three colour types of the raccoon dog cover: bright, dark, and red. He also distinguished three colours of undercoat hair: grey, brown-grey, and orange-red, but in most of the topographic parts, the tips of the hair are usually brighter.

According to Ciurzynski, guard hair is dark-coloured, and the colourless zone occurs in different places depending on the topographic part.

Sapovalova (1984) and Syrnikov (1982) distinguish three colour types of the raccoon dog hair cover: orange, silvery (dark, intermediate and bright) and intermediate, just as the Polish pattern of the raccoon dog exterior, which distinguishes three colour types: golden brown, silvery grey, and intermediate.

Silvery grey is the most preferred type, in accordance with the demands of the world markets (*Nowak-Nowicka and Szeleszczuk, 1988*).

On the whole, dark or white cover pelts are in greatest demand at fur auctions. It must be indicated that a new mutation type of the raccoon dog, with a totally white coat, was obtained in Finland (*Katajämäki et al., 1984*).

The colour type of the raccoon dog hair cover is one of the decisive factors that influence the demand for raccoon dog pelts at fur auctions. Hence, it was considered expedient to carry out detailed studies on the colour pattern of the raccoon dog winter hair cover and, in consequence, to ensure more effective selection of animals for the required colour type of hair cover.

## Material and methods

The test material was comprised of 86 pelts of yearling raccoon dogs, slaughtered between 10 and 15 November. The pelt-bearing animals (males and females) were raised in a pavilion system of cages at a farm of the Zootechnical Experimental Station of the Zootechnical Institute in Chorzelow.

The pre-processing and drying of pelts was done according to the requirements for this kind of pelts.

The following measurements were done on the raw skins:

- length of undercoat hair,
- length of guard hair,
- length of colour zones of both hair fractions.

The measurements were conducted for 6 topographic parts, that is, neck, shoulder girdle, middle back, pelvic girdle, side, and middle belly (fig. 1). A hair area of about 1 $cm^2$ was cut next to the skin for samples.

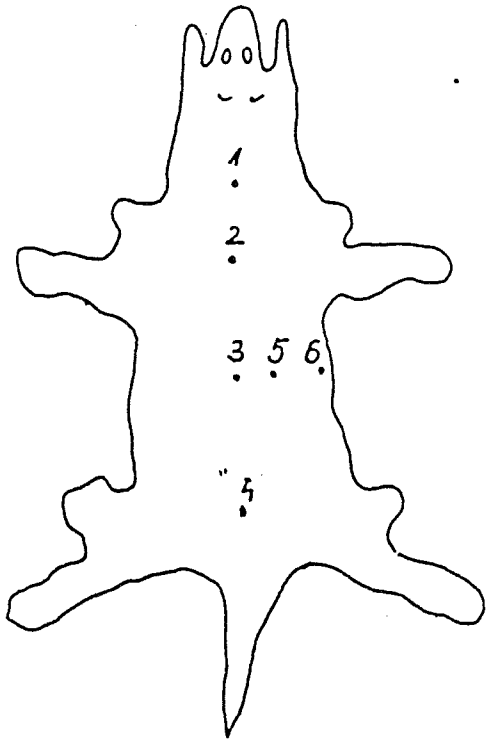
Next, undercoat hair was separated from guard hair. The length of hair colour zones was measured with a ruler, to an accuracy of 1 mm. The measurements were replicated three times for each sample under test.

NAP, or the ratio between length of guard hair and undercoat hair, and the ratio between length of colour zones of guard hair and its entire length, were measured to determine the colour pattern of the cover. The data obtained were analysed statistically using the following linear model:

$$Y_{ij} = u + a_i + e$$

where

$Y_{ij}$ - observations of j-individual of i-sex
u - overall average
$a_i$ - effect of i-sex
$e_{ij}$ - error




1. Neck
2. Shoulder girdle
3. Middle back
4. Pelvic girdle
5. Side
6. Middle belly

**Fig. 1.** Sites of hair sample collection.

## Results

The colour pattern of hair cover of raccoon dogs was evaluated by measuring the length of colour zones of both hair fractions and from the ratio be-

tween length of colour zones and length of guard hair.

Analysis of variance of the studied traits showed that the differences between means for corresponding sexes are negligible and statistically non-significant. Thus, the results of measurements are given together for both sexes. In trials 2, 5, and 6, a uniform colouring of undercoat hair was found. In the remaining trials two colour zones were distinguished: dark grey (brown) at base of the hair and light grey (brown) at tip of the hair (diagram 1).

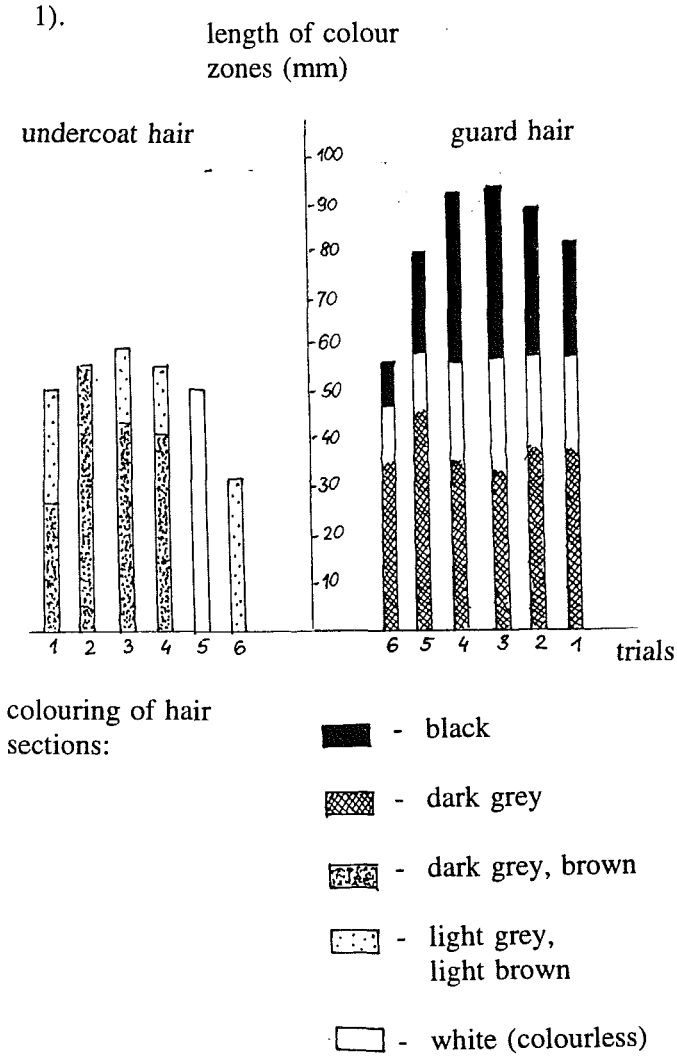



**Diagram 1.** Colour pattern of undercoat hair and guard hair in the winter cover of the raccoon dog.

In the successive 5 trials, the length of dark-grey (brown) streak was 27.3; 55.8; 42.4; 52.1 mm, respectively (table 1), with fluctuations ranging from 7.8 to 11.6%.

In middle belly (trial 6) undercoat hair was light-grey (brown) in its entire length.

Three colour zones, designated as A, B, and C, were found in guard hair in all the trials (diagram 1). The length of the dark-coloured zone at the base of guard hair (A) varied in the trials from 31.1 mm in trial 3 to 44.7 mm in trial 5 (Table 1).

The length of the colourless zone in mid-hair (B) was from 19.2 to 24.1 mm in trials 1; 2; 3 and 4, and 13.2 mm and 13.6 mm in trials 5 and 6, respectively. The longest black-coloured streak measured at the tip of the hair (C) was in trials 2; 3 and 4; it was 31.7; 37.1 and 34.9 mm, respectively.

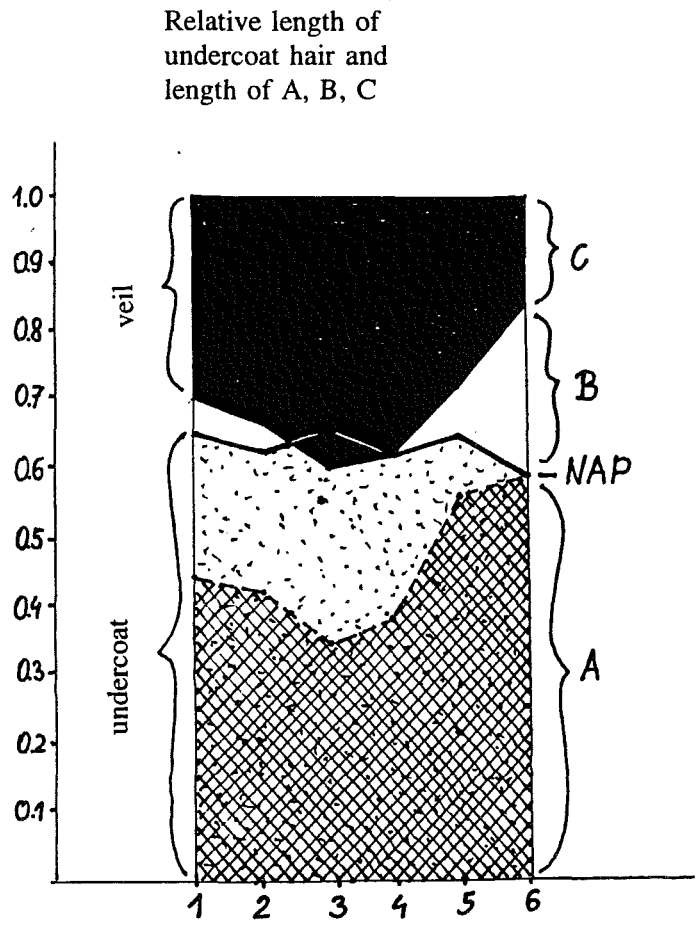



**Diagram 2.** Colour pattern of raccoon dog winter hair cover.

**Table 1.** Length of colour zones of undercoat hair and guard hair in the winter hair cover of the raccoon dog (mm)

| Trial | Section of measured hair | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | undercoat | | | | guard | | | | | |
| | at base (dark grey or dark brown streak) | | at tip (light grey or light brown, red) | | at base (dark streak) B | | mid-hair (white streak) C | | at tip (black streak) D | |
| | X | V | X | V | X | V | X | V | X | V |
| 1 | 27.3 | 9.6 | 24.9 | 10.5 | 35.6 | 12.4 | 21.2 | 8.5 | 23.6 | 10.5 |
| 2 | 55.8 | 11.6 | - | - | 37.3 | 7.5 | 19.2 | 11.6 | 31.7 | 12.4 |
| 3 | 42.4 | 8.4 | 17.8 | 6.7 | 31.1 | 9.7 | 24.1 | 7.4 | 37.1 | 7.6 |
| 4 | 41.8 | 7.8 | 15.1 | 9.2 | 33.4 | 10.2 | 23.2 | 7.6 | 34.9 | 8.5 |
| 5 | 52.1 | 11.2 | - | - | 44.7 | 7.7 | 13.2 | 8.9 | 21.3 | 10.2 |
| 6 | - | - | 32.7 | 8.4 | 33.9 | 8.4 | 13.6 | 10.6 | 9.9 | 8.4 |

**Table 2.** Colour pattern of the raccoon dog winter hair cover expressed in relative staple length of undercoat and of colour zones of guard hair (mm)

| Trial | Staple length of undercoat hair | Length of colour zones of undercoat hair | | | Staple length of guard hair | NAP | A / A+B+C | B / A+B+C | C / A+B+C |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 52.2 | 35.6 | 21.2 | 23.6 | 80.5 | 0.65 | 0.44 | 0.26 | 0.29 |
| 2 | 55.8 | 37.3 | 19.2 | 31.7 | 88.2 | 0.63 | 0.42 | 0.22 | 0.36 |
| 3 | 60.2 | 31.1 | 24.1 | 37.1 | 92.3 | 0.65 | 0.34 | 0.26 | 0.40 |
| 4 | 56.9 | 33.4 | 23.2 | 34.9 | 91.5 | 0.62 | 0.37 | 0.25 | 0.38 |
| 5 | 52.1 | 44.7 | 13.2 | 21.3 | 79.2 | 0.66 | 0.56 | 0.17 | 0.27 |
| 6 | 32.7 | 33.9 | 13.6 | 9.9 | 57.4 | 0.57 | 0.59 | 0.24 | 0.17 |

The length of colour zones was at a similar level of V = 7.4 - 12.4%.

NAP and the ratio between the length of colour zones of guard hair and its entire length (Table 2) were calculated for each of the trials. The colour pattern of the whole hair cover is presented graphically (diagram 2).

## Discussion

Raccoon dogs are characterized by various colouring of their hair cover. Three types of winter hair cover colour are distinguished: silvery grey, golden brown and intermediate (*Barabasz, 1980; Jarosz, 1987; Nowak-Novicka and Szeleszczuk, 1987; Sapovalova, 1984*). Depending on the satura-

tion of pigment in the hair, there can be different tones of the hair cover. The colour type of cover depends mainly on the colouring of undercoat hair.

The studies conducted on the raccoon dog pelts have shown the zonal colouring of undercoat hair in the following topographic parts: neck, middle back and middle belly. In the remaining topographic parts, the colour of undercoat hair was uniform, except that it was decidedly brighter on the belly.

Dark-brown and light-brown (red) undercoat hair formed the golden brown type and hair cover.

Silvery grey hair cover was made up of undercoat hair, grey at base of the hair, and brighter at tip.

Dark grey undercoat hair at base, and light brown at tip, were characteristic for the intermediate type of cover colour. Similar zones of undercoat hair colouring were found by Ciurzynski (1982).

The lining of the winter hair cover became brighter from mid-back towards the head, tail and belly. This was caused by bright tips of the hair and by pigment saturation at base of the hair.

The tone of winter hair cover and the silvery plate result form the zonal colouring of guard hair, which is dark grey at base, white (colourless) in the middle, and almost black at the tip. The silver plating of hair cover appeared in those topographic parts, in which the relative length of the colourless and dark zones at base of guard hair was greater than NAP. The silver plate of the cover increased from mid-back and pelvic girdle towards the head, but the greatest silver plating was on the side and belly. The veil colour intensity, which depended on the length of the black zone at the tip of the guard hair, was greatest in mid-back and pelvic girdle; then the veil became brighter towards the head, and especially the belly.

In summing up it must be said that the colour pattern of the raccoon dog winter cover depends on the ratio between the length of the colour zones of undercoat hair and guard hair and its entire length. Based on the colouring of colour zones of undercoat hair and guard hair, selection can be made for the required colour type of the raccoon dog hair cover, with regard to silver plating and the overall colour tone of the cover.

**References**

Barabasz, B. 1980. Okrywa wlosowa jenotow. Hod. Drbn. Inw., 3: 7.

Ciurzynski, T. 1982. Próby oceny okrywy wlosowej jenotów pochodzacych z hodowli krajowej. SGGW-AR Warszawa (praca magisterska).

Jarosz, S. 1987. Hodowla zwierzat futerkowych. AR Kraków.

Katajämäki, U., Mäkelä, J., Lohi, O. 1984. New colour mutations White Raccoon dogs and pastel ferrets. 3rd Int. Sci. Congr. Fur Anim. Prod., Versaille, France.

Nowak-Nowicka, M., Szeleszczuk, O. 1987. Czy jest potrzebne norma na skóry jenotów. Hod. Drob. Inwent. 12: 13.

Syrnikov, N.I. 1982. Rabota nad povyszeniem kacestva skurok jenotovidnych sobak. Krolikovod. Zvierovd. 5: 15.

Sapovalowa, I.W. 1984. Charakieristyka rozviedienia tiela i okraski volosiennego pokrova jenotovidnych sobak. Sbor. Nauc. trud., 31: 156.

*Original Report*

# Effect of single or group keeping of young common foxes (Vulpes vulpes) on feed consumption, growth rate and fur quality

*Stanislaw Krzywiecki[1], Janusz Kuzniewicz[2], Andrzej Filistowicz[3], Piotr Przysiecki[4]*

*[1]Department of Animal Feeding and Feed Management; [2]Department of Sheep and Fur Animals Breeding; [3]Department of Genetics and Animal Husbandry, University of Agriculture, Wroclaw, Poland; [4] Rolniczy Kombinat Spóldzielczy - Lubnica near Poznan*

## Summary

Pelts of fur-bearing carnivores, such as foxes, are in demand on the worldwide furrier's markets provided that they are of good quality. Their value mainly depends on the pelt size and quality. Many factors influence the size and quality of the pelt, such as genotype, level of nutrition and environment in which the animals are kept, as well as age and date of slaughter. So far, producers of the fur-bearing animals, both in Poland and in other countries, concentrate mainly on the breeding stock, whereas they give much less attention to the environmental conditions in which the animals are kept. Foxes are exposed to many stressing factors under conditions prevailing on the farm which are not found in nature. Among them, a system of group keeping of young foxes in a limited area is very stressful, so Norwegian breeders (4,6) recommend an individual system of keeping foxes in cages having a size of 0,6m$^2$. Other breeders prefer a system of collective keeping as being more economical (1,2). Growth rate of the foxes, development of their hair coat, and pelt quality depend mainly on proper nutrition (3,5). Thus, a question arises if the system of keeping foxes can have an influence on the amount of feed consumed and, in consequence, on animal growth and pelt quality. Divergent opinions concerning this problem encouraged to study the effects of single versus group rearing of foxes on production traits.

## Materials and methods

The experiment was carried out on the fox breeding farm in Sniaty (Rolniczy Kombinat Spóldzielczy - Lubnica near Poznan). Litters of common silver fox (Vulpes vulpes) were used for investigation. After weaning of 7-week-old cubs, all litters were placed in cages (size 200 x 100 x 100 cm) where they stayed for one month. After this period the animals were tattooed and divided into two experimental groups (12 animals per treatment):

- group I, collective keeping of 3 foxes per cage (0.66 m$^2$/animal), 4 cages,
- group II, single keeping of foxes (2.0 m$^2$/animal), 12 cages.

**Table 1.** Percentage share of feed components in daily rations

| Specification | Feeding periods | | | |
|---|---|---|---|---|
| | I | II | III | IV |
| | to Sept. 14 | from Sept. 15 to Sept. 30 | from Oct. 1 to Oct. 17 | from Oct. 18 to Oct. 31 |
| 1. Barley bruised grain | 35 | 35 | 33 | 33 |
| 2. Wheat bran | 3 | 3 | 3 | 3 |
| 3. Butcher's offals, including: | | | | |
| a. Beef | 15 | 15 | 15 | 10 |
| b. Horse intestines | 9 | 9 | 9 | 9 |
| c. Bones of heads | 6 | - | - | - |
| 4. Blood | 3 | 3 | - | - |
| 5. Poultry offal | 24 | 27 | 27 | 27 |
| 6. Yeast | 1 | 2 | 2 | 2 |
| 7. Potatoes | - | - | 5 | 5 |
| 8. Vegetables | - | - | - | 4 |
| 9. Whey | 4 | 6 | 6 | 6 |
| Σ | 100 | | | |
| 10. Mineral and vitamin additives | | | | |
| a. Polfamix LN kg/t of feed | 1 | 1 | 1 | 1 |
| b. Formosan kg/t of feed | 1 | 1 | 1 | 1 |

During the period from weaning till September 23rd, the animals were fed 2 times a day (1/3 of the daily dose in the morning and 2/3 in the afternoon). Since September 24th they were fed only once a day. Homogenized feed was used and the animals were fed according to requirements for common foxes specified in the standard tables for Polish conditions (5).

The basic feed composition and diets are shown in Table 1.

The body weight of each fox was measured at the age of 16, 20, and 24 weeks and on the day of final scoring. Occurence of agonistic and antagonistic forms of behaviour directed to mates and people was observed every day at feeding and during handling of animals (weighing). Feed refusals were subtracted from the daily rations to monitor feed consumption. Grading of animals (body conformation and fur quality scoring) were done by an expert, according to the protocol issued by Central Station of Animal Breeding in

Poland (7). This evaluation was done in the last stage of the experiment. Animal scoring took place in a room, on a table, with artificial illumination with white light, to create uniform conditions for classifying all the animals.

Size and conformation (on a scale from 0 as poor to 3 points as exellent), colour type and purity of pigment (from 0 as poor to 3 points), purity of fur colour, length, springiness and silkiness of hairs, hair density (from 0 as poor to 6 points), and general appearance of the animal (from 0 as poor to 3 points as exellent) were scored. One-way analysis of variance was used for statistical evaluation of the obtained results.

## Results and discussion

The behaviour of the foxes in the two groups was different. Foxes kept individually (Group II) were more aggressive towards the servicing personnel.

**Table 2.** Protein and energy content in daily rations and average feed consumption

| Feeding periods | Protein (g/kg) | Percentage share of energy from: | | | Metabolic energy (Kcal/kg dry matter) | Method of keeping | Average daily intake per head/day (g) | |
|---|---|---|---|---|---|---|---|---|
| | | protein | fat | carbohydrates | | | Fresh feed | Dry matter |
| I | 89 | 37.6 | 35.5 | 26.9 | 1033 | single<br>group | 784<br>846 | 321.4<br>348.7 |
| II | 90 | 38.4 | 33.3 | 28.3 | 1021 | single<br>group | 900<br>933 | 346.5<br>359.2 |
| III | 89 | 37.8 | 32.5 | 29.7 | 1047 | single<br>group | 1000<br>1040 | 366.0<br>380.6 |
| IV | 85 | 37.5 | 33.9 | 28.6 | 1009 | single<br>group | 791<br>816 | 262.6<br>270.9 |
| For the total period | | | | | | single<br>group | 869 a<br>909 b | 324.1 a<br>339.8 b |

a, b: differences significant at $P<0.05$

The animals kept collectively (Group I) were more gentle in relation to the servicing personnel but, when eating, more aggressive to one another (growling and biting). Such antagonistic behaviour lasted till the moment of establishment of mutual hierarchy. After about 3 weeks the foxes became more peaceful to one another. The level of protein feeding through the experiment was similiar except during the period IV, where protein decreased as a result of a decrease in slaughtering offal which were replaced by potatoes and vegetables (Table 2).

In this period, for the same reason, the level of energy also decreased. The animals derived the most energy from the protein source - from 37.5% in the period IV up to 38.4% in the period II. Energy in the form of fat was 35.5% in the period I and lowered to 32.5% in the period III. Increase of the energy share form carbohydrate form in the later feeding periods (II-IV) was caused by introduction of feeds of vegetable origin and whey into the daily ration (Table 1). During the experiment it was found that foxes kept individually were eating the feed slowly without any greediness, this being characteristic for this species. However, when the animals were kept in groups in one cage the feed was eaten greedily and in larger amounts in all periods of the experiment. The amount of the feed consumed by the foxes kept collectively was, on average, 339.8 g dry matter/fox/day and was conside-

rably higher than in Group II (324.1 g dry matter/-fox/day) (Table 2). The higher feed consumption by the animals kept collectively had an influence on their growth and body weight. In all periods these animals grew a bit better than those kept individually and, as a consequence, foxes in Group I, in the end of the experiment were considerably heavier (Table 3).

The results obtained during the fox grading (fur quality scoring) were good. Foxes kept individually scored 25.86 points and foxes kept collectively (Group I) scored 25.43 points out of 30 points (Table 4).

Substantial differences in evaluation of the fur quality were not observed. Pelts of the animals kept individually (Group II) had a lower percentage of mechanical damages which occured in pelts of animals of Group I as a result of fights between the foxes.

The most important element of estimation of the breeding value of foxes is hair coat quality as well as assessment of body conformation. Despite the differences obtained in body weight between the groups, the influence of the method of keeping the animals (individual or collective) on fur quality scoring was observed.

**Table 3.** Body weight of foxes

| Specification | Method of keeping | |
|---|---|---|
| | Single | Group |
| Body weight (kg) at: | | |
| -16 weeks | | |
| Females | 4.7 | 4.8 |
| Males | 5.13 | 5.26 |
| Average | 4.86 | 5.03 |
| -20 weeks | | |
| Females | 5.02 | 5.27 |
| Males | 5.83 | 5.91 |
| Average | 5.42 | 5.59 |
| -24 weeks | | |
| Females | 5.4 | 5.92 |
| Males | 6.1 | 6.50 |
| Average | 5.75 | 6.21 |
| - FINAL SCORING | | |
| Females | 6.14 | 6.49 |
| Males | 7.03 | 7.40 |
| Average | 6.58 a | 6.94 b |
| Average daily body weight gain (g) | 14.78 a | 16.32 b |

a, b: differences significant at $P<0.05$

**Table 4.** Results of body conformation and fur quality scoring

| Specification | Method of keeping | |
|---|---|---|
| | Single | Group |
| 1. Size | 2.86 | 2.91 |
| 2. Hair coat colour type | 2.92 | 3.0 |
| 3. Fur colour purity | 3.92 | 4.0 |
| 4. Pigment purity | 2.92 | 3.0 |
| 5. Hair density | 4.96 | 4.91 |
| 6. Length, springiness and silkiness | 5.42 | 5.08 |
| 7. General appearance | 2.76 | 2.52 |
| Total grading score (max 30 points) | 25.86 | 25.43 |

## Conclusions

1. The system of fox keeping in cages (individual or collective) appeared to have an influence on the amount of feed consumed and consequently on growth and size of common foxes. Foxes kept collectively showed substantially better growth and higher body weight in all periods of the experiment.

2. Quality of the hair coat scored during the evaluation did not depend on the method of keeping the animals.

## References

1. Filistowicz, A., Przysiecki, P. 1990. Zesz. nauk. AR. we Wroclawiu. Zoot.XXII.

2. Gawlikowska, B. 1986. Hodow. Drobn. Inwen. 7. Warszawa. 8-9.
3. Kaleta, T., Frindt A., Parysek A. 1987. Hodow. Drobn. Inwen. 11. Warszawa. 10-12.

4. Rewers, W. 1985. Hodow. Drobn. Inwen.1. Warszawa 6-9.

5. Slawon, J. 1978. Normy zywienia zwierzat futerkowych. Ministerstwo Rolnictwa. Warszawa.

6. Tenessen, T.1989. Animal Behavior Science. 22, 139-149.

7. Wzorzec oceny lisów. 1984. Cenralna stacja Hodowli Zwierzat. Warszawa.

*Original Report*

# The level of α-tocopherol in blood of mink and polar foxes of different ages

***T.N. Il'ina, T.R. Ruokolaynen***

*Karelian scientific centre of Russian Academy*

*of Sciences, Institut of Biology, Petrozavodsk, Russia*

## Abstract

The concentration of vitamin E (α-tocopherol) in the serum of blood of mink and polar foxes was studied using high-performance liquid chromatography. The results show that the level of vitamin in the blood of adult animals is rather stable, but depends on sex and physiological condition.

## Introduction

According to the most widespread point of view, vitamin E functions in animal tissues exclusively as an antioxidant, protecting unsaturated tissue lipids from peroxidation. The presently available experimental data show that considerable changes of antioxidant activity - both increase and decrease - result in pathology (*Zhuravlev, 1975*). Antioxidant peculiarities are most clearly displayed at energetic overloads of organisms (*Tarusov, 1972*). At the same time, the opinion exists that vitamin E plays an important role in the metabolism, not connected directly with its antioxidant properties. In particular, the influence of vitamin E on reproductive functions of animals has been investigated in many works (*Bremener, 1966; Yokoe et al., 1969*).

It is known that insufficiency of vitamin E results in numerous physiological infringements. Avitaminosis demonstrates itself differently in various animal species and depends considerably on age, diet, increased demand in important biological periods and other factors. Age changes of vitamin E levels in man and animals have been investigated in many works (*Catigani, 1975; Bucher, Roberts, 1981*). However, information about the content of vitamin E and its isomers in mink and polar fox blood serum was not to be found in the literature accessible to use. It was, in this connection, interesting to determine to what degree ontogenetic changes influence the concentration of α-tocopherol in blood serum - the isomer displaying the highest biological and antioxidant activity.

## Methods

The content of α-tocopherol in the blood serum was studied in healthy kits of dark-brown mink and polar fox. Groups had females and males at the age of 3, 6, and 9 months. All this time the animals were on economic diet, including the vitamin E. The concentration of α-tocopherol in the blood serum was determined by high-performance liquid

chromatography. Proteins in the blood were precipitated by ethanol, then α-tocopherol was extracted by n-hexane. Chromatographic separation was executed on a microcolumn chromatograph with an ultraviolet detector, supplied with a 64x2 mm column, filled with Separon SGS sorbent (size of particles - 5 mkm). A mixture of hexane with isopropanol served as the eluent (85.5, 1.3). The mixture was supplied to the column at the speed of 200 mkl/min. The volume of sample entered in the column was 10 mkl. Detection of α-tocopherol was conducted at a wave length of 294 nm.

## Results and discussion

At the age of 3 months all the animals had a high level of α-tocopherol concentration in the blood. Significant difference was observed between male and female mink at this age, the concentration of α-tocopherol in the blood of females being 37.2 and of males - 28.0 mkM/l (fig. 1).

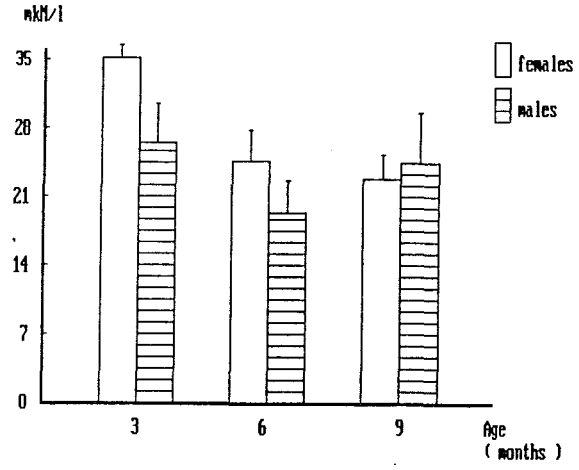



**Fig. 1.** Concentration of α-tocopherol in blood serum of mink.

In foxes the level of tocopherol was higher in males, though not much higher than in females. A positive decrease of α-tocopherol concentration was observed in all groups at 6-months of age as compared with the previous period. The correlation between males and females of both mink and foxes remained the same, but lower, expressed quantitatively (fig. 2).

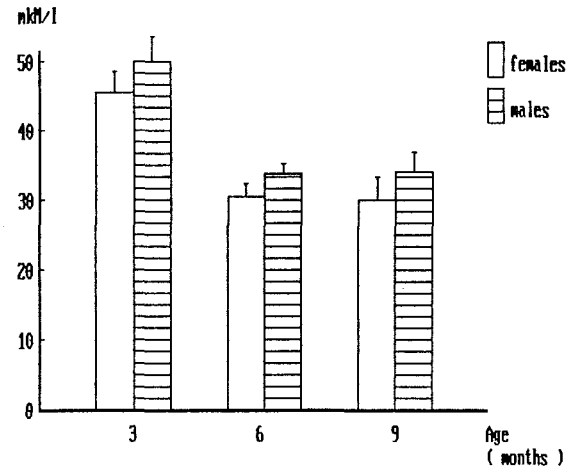



**Fig. 2.** Concentration of α-tocopherol in blood serum of polar foxes.

By 9 months no significant changes were noted in comparison with previous research on the content of α-tocopherol. However, by this time some increase of concentration in the blood of mink males, in comparison with females, can be seen. In polar foxes the correlation between females and males stays practically the same.

Our reseach permits us to draw some conclusions concerning age-dependent changes in the concentration of α-tocopherol in the blood serum of mink and foxes. As seen in fig. 1 and 2, in 3-month old animals the highest level of α-tocopherol concentration was observed both in mink and foxes, which is explained by a high degree of vitamin utilization in immature animals (*Spryshkova, 1980*). It is known that tocopherol in animals acts not only as an antioxidant, but also as a regulator of energy metabolism. At the age of 3 months the intensity of metabolism grows (*Mel'kina, 1966*), which is expressed by a significant consumption of oxygen which results in increased activity of the antioxidant system. These reasons must have caused the high level of tocopherol both in mink and in foxes at this age. Previously, it has been noted in the literature that young growing males of both mink and foxes are more sensitive to vitamin E undersupply (*Albert, Wenzel, 1988; Helgebostad, Ender, 1973*). In our research we also observed the distinctions in the degrees of α-tocopherol accumulation in the blood

of males and females. However, in mink and polar fox such differentiation took different directions. A.I. Mel'kina (1966) reported that mink females in postnatal ontogenesis waste more energy than males and then the high α-tocopherol concentration in the blood of females quite explicable.

The process of growth is completed by the age of 6 months, the energy dissipated is reduced. The antioxidant protection system, of which tocopherols a component, is stabilized even earlier (*Iliukha, 1995*). This explains the practically identical levels of α-tocopherol concentration in the blood of mink and foxes at the ages of 6 and 9 months, respectively. Interestingly, at 9 months all animals received more vitamin E in their feed than in the period of the previous research. However, the concentration of tocopherol in the blood remained at the same level.

This confirms the opinion about the ability of erythrocytes to support a fixed level of tocopherol in the absence of metabolic stress (*Nadirov, 1991*) and appears to be true for fur-bearing animals. It should be noted that, at this age, increase of α-tocopherol concentration in the serum of mink males was observed as compared with the previous research (by 26%), which resulted in the change of male-female correlation for the former. Probably, such an increase is connected with the period of mink preparation to heat and the influence which vitamin E exerts on testicle reproductive tissue.

Our observations have shown that the level of α-tocopherol is subject to the heaviest changes at the early stages of ontogenesis under conditions of physiological strain with additional metabolite waste. Later on, fur-bearing animals are sufficiently supplied with vitamin E and the level of tocopherol remains stable. The ability of antioxidants to react to energy overload is clearly expressed here as was mentioned above (*Tarusov, 1972*).

The stability of tocopherol levels in late ontogenesis of mink and polar foxes and the individuality of these levels serve, obviously, as characteristics of homeostasis, which is provided by removing extra tissue bioantioxidants from the organism. Vitamin E can participate in maintaining homeostasis at the macroorganism level, by means of influence on cell membrane permeability. Being an inhibitor of lipid peroxidation, it prevents the destabilization of membranes due to its antioxidant properties (*Nadirov, 1991*).

Thus, the data received by us characterize the normal level of supply of mink and polar foxes in the examined age groups with α-tocopherol, which does not prevent further study of the problem.

**References**

Albert, G., Wenzel, U.D. 1988. Vitamin E deficiency in silver foxes. Brühl, 29, 4, p 37.

Bremener, S.M. 1966. Vitamins and their clinical application. M. Medicine, p 420 (in Russian).

Bucher, J.R., Roberts, R.J. 1981. α-tocopherol (vitamin E) content of lung, liver, and blood in the newborn rat and human infant: Influence of hyperoxia. J. Pediat. Vol. 98, N 5, p 806-811.

Catigani, G.L. 1975. An α-tocopherol binding protein in rat liver cytoplasm. Biochem. and Biophis. Res. Commun. Vol. 67, N 1, p 66-72.

Helgebostad, A., Ender, F. 1973. Vitamin E its function in the health and disease of fur-bearing animals. Vitamin E in animal nutrition. Acta Agricult. Scandinavica. Suppl. 19, p 79-83.

Iliukha, V.A. 1995. Enzymes of antioxidant system. Ontogenesis, Vol. 26, N 2, p 115-118.

Mel'kina, N.A. 1966. Laws of growth and energy metabolism in postnatal ontogenesis of american mink. Author's abstract of the Cand. thesis, Petrozavodsk, 27 pp. (in Russian).

Nadirov, N.K. 1991. Tocopherols and their uses in medicine and agriculture. M. Science, p 198-236. (in Russian).

Spryshkova, N.A., Serebryakov, N.G., Spryshkova, R.A. 1980. Depositing role of digestive tract in D-α-[5-methyl-$^3$H]-tocopherol exchange in blastomogenesis in rat cerebrum. Actual problems of vitaminology: Report theses of a scientific conference, Tartu, p 39-41 (in Russian).

Tarusov, B.N. 1972. The role of antioxidants in reliability of biological systems. Report of theses of the symposium "Bioantioxidants and control of oxidation processes in cells", MGU, p 80 (in Russian).

Yokoe, Y., Means, A.P., Hall, P.E. 1969. The influence of follicle-stimulating hormone on testicular phospolipids. Biochim. et Biophis. Acta, Vol. 187, p 278-280.

Zhuravlev, A.I. 1975. Bioantioxidants in animal organism. Bioantioxidants. MOIP proceedings, Vol. 52, p 15-29 (in Russian).

## Content of oxygen-damaged collagen in oxidized mink skin

*Bent Riis, Outi Lohi*

Oxidized spots on the leather side of mink skin has been creating problems in tanning and production of furs. The defect is seen as weakly coloured spots on the leather side and the affected areas become less elastic and absorbe dye in a different manner compared to non-affected areas. Several investigations have previously addressed the problem and the microbial activity on these spots has been shown to be high.

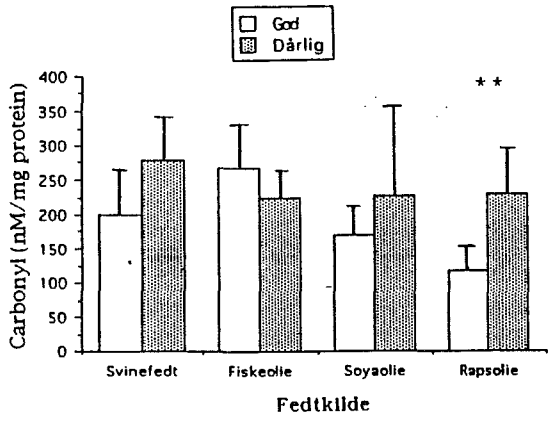



**Fig. 1.** Oxidation of collagen in relation to fat source and fleshing.

The physical behaviour of mink skin depends on many parameters including the distribution and amount of collagens, the major proteins found in skins. Molecular oxygen induces damages to the proteins by inducing carbonylation of some of the amino acids. This is the first step in a very complex metal-ion catalysed degradation process where the protein is cleaved by chemical and enzymatic means.

Once induced this degradive process will proceed until the skin is totally destroyed. Briefly, the collagens were extracted from approximately 1 x 4 cm large affected skin-pieces and similar sized controls by 0.5 M acetic acid extraction. The content of carbonyl groups was measured using a chemical reaction with 2,4-dinitrofenylhydrazin and the content correlated to the content of acid soluble protein. This investigation showed that poorly fleshed skins contained significantly larger amounts of carbonylated collagen compared to well-fleshed skins (239.1 ± 82.4 vs. 188.0 ± 73.5 nmol/mg extracted collagen). The reason is that poorly fleshed skins contain many microorganisms which induce the metal ion catalysed degradation of the collagens - a degradation which will continue after the skins have been dried. In order to address this problem in more details result from another experimental series using a more gentle extraction procedure will appear elsewhere[1].

1. Riis, B and Loti, O (1996) Amount of soluble and carbonylated collagen in oxygen-damaged mink skin, Appl. Sci. Reports of Polish Soc. of Anim. Prod., submitted.

*Technical Annual Report 1995, pp. 127-134. Danish Fur Breeders Research and Advisory Service, Herningvej 102C, DK-7500 Holstebro. In DANH. 2 tables, 2 figs., 11 refs. Authors' abstract.*

## Flea control with permethrin in pregnant mink

*H. Zimmermann*

In trials with 40 pregnant mink, treatment of each nest box (26 x 22.5 cm) with permethrin (Wellcare-Puder, 2-2.5 g per nest box) just before parturition was very effective for flea control (species not given) and well tolerated by the mink.

*Kleintierpraxis 40, 6, pp. 484, 487, 1995. In GERM. 1 table, 8 refs. CAB-abstract.*

## Why is the European mink (*Mustela lutreola*) disappearing? - a review of the process and hypotheses

*Tiit Maran, Heikki Henttonen*

The historical range of *Mustela lutreola* extended from Finland to east of the Ural Mountains, to northern Spain and the Caucasian Mountains. The species became extinct in some parts of Central Europe already a hundred years ago. During this century, populations have declined almost everywhere.

Several hypotheses have been put forward to explain the disappearance of the species. These include climatic changes, competition with the American mink (*M. vison*, destruction of the habitat, disease transmitted by the introduced American mink, crash of the favoured food item, crayfish *Astacus astacus*, hybridization with the European polecat *M. putorius*, etc. It is very clear, however, that none of the hypothesized factors alone could explain the events in various place at different times. The early declines in Central Europe and later in Finland took place before the spread of the American mink. On the other hand, the present decline of *M. lutreola* in Estonia seems to coincide well with the spread of *M. vison*. The early declines in Central Europe could have been caused by destruction of the natural river ecosystems, especially riverbanks. Still, in Finland the major disappearance happened well before the major environmental changes of natural small river ecosystems due to modern forestry. Even if the detailed explanations seem to vary, there is an underlying theme: environmental change. The European mink seems to be a much more specialized species than the American mink. Before the arrival of *M. vison*, the changes in the preferred habitat, small sandy brooks, or the disappearence of the food source, could have been the underlying cause. With the arrival of the American mink, the European one loses even without the environmental change.

*Ann. Zool. Fennici 32, pp. 47-54, 1995. 61 refs. Authors' summary.*

## Pine marten (*Martes martes*) selection of resting and denning sites in Scandinavian managed forests

*Scott M. Brainerd, J.-O. Helldin, Erik R. Lindström, Erlend Rolstad, Jørund Rolstad, Ilse Storch*

We examined selection of resting and denning sites by the Eurasian pine marten (*Martes martes*) in southern boreal Scandinavia. We radio-instrumented and monitored 25 pine martens during 1987 and 1989-1991 in two managed forest areas at Grimsö, Sweden, and Varaldskogen, Norway. Pine martens were radio-located at 299 resting sites 358 times, and at 49 denning sites 109 times. Cavities in trees and rotten snags were preferred by adult females as dens for birthing and early rearing of juveniles. Such cavities were rarely used as resting sites. Use of underground resting sites was negatively correlated with mean 24-hour ambient air temperature ($T_a$). During winter, the marten rested underground at $T_a$ significantly lower than when they rested in trees. Selection of resting and denning sites may be influenced by predation risks and energetic constraints. Arboreal cavities for denning and underground sites as thermal cover appear to be important for Scandinavian pine marten. We hypothesize that in areas with cold winter temperatures and/or an abundance of enemies such as the red fox (*Vulpes vulpes*), the lack of such sites may limit pine marten distribution and abundance.

*Ann. Zool. Fennici 32, pp. 151-157, 1995. 2 tables, 3 figs., 39 refs. Authors' summary.*

## Environmentally safe fur farming relies on the farmers' responsibility and self-regulation

*Bente Kjærgård, Jesper Holm, Henning Schroll, Per Homann Jespersen*

Regulation of fur farms by fixed environmental standards has improved the state of the environment. The reasons being that environmental problems related to fur farming are well-defined and well-known, and in most cases can be solved by appropriate siting, design and daily operation of the individual farm. However, standards related to the daily operation are difficult to control and enforce. Especially the regulation laid down for clearing away the manure under the open mink sheds once a week relies on the fur farmers' responsibility and self-regulation. Alternatively, the run-off of nutrients could be prevented by the use of manure ditches. Whether run-off of nutrients from manure should be prevented by a standard regulating the design (manure ditches) or the daily operation (clearing away the manure once a week) is an open question depending on the farmers' attitudes and willingness to handle the manure problem in an environmentally safe manner.

*Dansk Pelsdyravl 8, pp. 349-351, 1992. In DANH, Su. ENGL. 1 fig. Authors' summary.*

## Environmental regulation of trades by fixed standards: the Danish experience (minkfarms & auto repair shops)

*Bente Kjærgård, Jesper Holm, Henning Schroll, Per Homann Jespersen*

In 1986, the Danish Environmental Protection Agency established a new regulatory system aimed at small-scale polluting activities. Contrary to the dominant regulatory system based on individual standards for each polluting activity, the new regulatory system established uniform and fixed environmental standards for all activities within a trade. The fixed standards concern location, design and daily operation. Thus far, the new regulatory system has been implemented in the trades of fur farms and auto-repair shops.

This study shows that fixed environmental standards reduce the total administrative costs, intensify local monitoring and enforcement of the standards, and improve the environmental state. It is proposed that the following criteria should be considered if the regulatory system is to be implemented in other trades. The trade should consist of many units and be characterised by a moderate pace of technological development, it should posses well-defined and well-known environmental problems, and have a cooperative trade association. In Denmark several trades have been identified as obvious objects for future regulation by fixed environmental standards.

*The Environmentalist, Vol. 14, No. 4, pp. 243-251, 1994. 2 tables, 5 figs., 8 refs. Authors' summary.*

## Accommodation systems in mink - Comparison of grouping siblings versus non-siblings and singly versus in pairs.

*Ulla Lund Nielsen*

This investigation shows that whether mink kits are grouped as siblings or non-siblings has no influence on growth rate, feed consumption, pelt results nor frequency of pelt nibbling. However, it does make a difference if the kits are accommodated singly or in pairs. Single accommodation affects especially growth rate and frequency of pelt-nibbling. Generally, there were no cases of neck-nibbling and fewer cases of body-nibbling when kits were accommodated singly. None of the accommodation systems affected feed consumption. The pelt parameters were more dependent on the genetic background than the system of accommodation.

*Technical Annual Report 1995, pp. 181-188. Danish Fur Breeders Research and Advisory Service, Herningvej 102C, DK-7500 Holstebro. In DANH. 8 pp, 6 tables, 1 ref. Authors' abstract.*

## Elasticity in silky pelts

*Ulla Lund Nielsen*

Pelts from very heavy animals can be stretched more in absolute length than pelts from lighter animals. The percentage stretch in length, however, has no correlation to the weight/size of the animal. There is no correlation between quality/silkiness and absolute/percentage increase when the data is adjusted for weight differences.

*Technical year Report 1995, pp. 163-164. Danish Fur Breeders Research and Advisory Service, Herningvej 102C, DK-7500 Holstebro. In DANH. 2 pp, 4 figs. Authors' abstract.*

## Immunohistochemical identification and morphometric study of ACTH cells of mink (*Mustela vison*) during growth and different stages of sexual activity in the adult

*Sergio Vidal, Albina Román, Lucas Moya*

The morphological characteristics and changes in the cellular area and volume density of ACTH cells have been examined in mink from the first half of the suckling period to adulthood and in adult mink at different stages of the sexual cycle. ACTH cells were identified immunohistochemically (avidin-biotin complex) and applied over semithin sections.

Unlike in suckling and prepubertal mink, there was a clear topographic relation between adenohypophysial follicles and ACTH cells in pubertal and adult animals. The ACTH cells presented a morphological

pleomorphism, appearing from oval or round to stellate or angular. The morphometric study demonstrated that the cellular area and volume density of ACTH cells varied during growth and in adult mink there were sexual variations.

Gonadal steroids may influence ACTH cells especially in females, in which there were variations before and after puberty. The heterogeneity in size, shape, secretion, and storage parameters of the ACTH cells could explain the presence, in some of the groups studied, of an increased or decreased cellular area, while the volume density remained unchanged.

*General and Comparative Endocrinology 100, pp. 18-26, 1995. 9 figs., 1 table, 31 refs. Authors' summary.*

## Seasonal fiber growth cycles of ferrets (*Mustela putorius furo*) and long-term effects of melatonin treatment

*A.J. Nixon, M.G. Ashby, D.P. Saywell, A.J. Pearson*

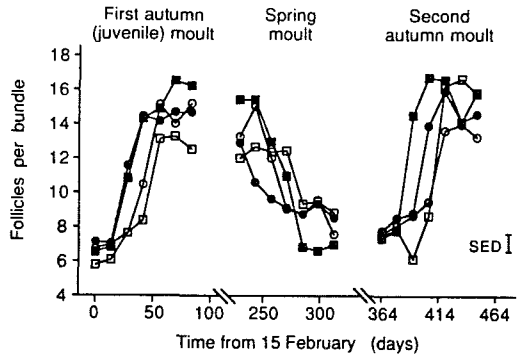



Fig. 6. Influence of melatonin on seasonal changes in follicle numbers. Mean compound follicle sizes are shown for 84-day periods of transition of three successive molts. Symbols are as follows: untreated females (open circles), untreated males (open squares), treated females (solid circles), treated males (solid squares). Groups 1 and 3 (treated 2nd year) and groups 2 and 4 (untreated 2nd year) have been combined for the second autumn molt. Vertical bar indicates standard error of the difference.

Pelage cycles of ferrets are poorly documented, although it is clear that their timing is sensitive to daylength, mediated by pineal melatonin. Hair follicles were monitored histologically in ferrets from 3 to 19 months of age in order to describe naturally occurring changes in follicle growth status and follicle number over three successive cycles of fur growth. Melatonin was administered to some of these animals in late summer to determine the long-term effects of perturbation of hormonal control. Circulating melatonin was elevated for approximately 50 days by 8-mg continuous release implants. Treated animals grew both their first winter coat, and subsequent summer coats 18 days in advance of untreated controls, but this effect did not extend to the second winter coat. Reimplantation the following year induced an advancement of the autumn follicle growth as in the 1st year. Autumn fiber growth occurred at similar times in untreated males and females, and response to melatonin did not differ between sexes. Hair follicle regression and shedding during the natural spring molt was also contemporaneous in males and females, but fiber regrowth occurred 4-6 weeks later in males as compared with females, suggesting that reproduction-related factors affect fiber growth initiation, and that fiber growth and shedding are physiologically distinct processes. Melatonin implants in autumn also affected reproduction in spring, advancing oestrus by 3-4 weeks. These results show that interference with photoperiodic and hormonal control mechanisms in ferrets can affect pelage and reproductive cycles for up to 10 months.

*The Journal of Experimental Zoology 272: 435-445, 1995. 1 table, 6 figs., 44 refs. Authors' abstract.*

## Variability in the distribution and composition of adipose tissue in wild arctic foxes (*Alopex lagopus*) on Svalbard

*Caroline M. Pond, Christine A. Mattacks, P. Prestrud*

Adipose tissue was dissected completely from 35 adult and subadult arctic foxes collected between November 1991 and March 1992 in four different areas of Svalbard (latitude 78°5′ to 79°50′ N). The gross mass, lipid, protein and collagen content and mean adipocyte volume were measured in adipose tissue from six superficial, four intra-abdominal, three intermuscular and two cardiac depots homologous to those of other terrestrial mammals. The total adipocyte complement was calculated

from the mass of each depot and its site-specific adipocyte volume. The mean fatness was 14.81±1.3% and sex differences were not significant. All depots except the epicardial enlarged with increasing fatness, but the superficial depots expanded more than the internal depots. The average partitioning of adipose tissue between intra-abdominal and superficial depots was consistent with predictions from allometric equations fitted to data from other Carnivora, but there was much unexplainable variation between individuals. The relative masses of the four intra-abdominal depots were also variable. The mean adipocyte complement was low compared to other continually or seasonally obese arctic mammals, only slightly larger than that predicted from allometric equations relating adipocyte complement to body mass in other carnivorous mammals, but there were large differences between specimens, with some having more than four times the expected number and others only half the expected number. The size of the adipocyte complement was unrelated to age, sex or fatness. Because of such variation in number and size of adipocytes, measurements of adipocyte volume from biopsies of adipose tissue would not provide an accurate estimate of fatness.

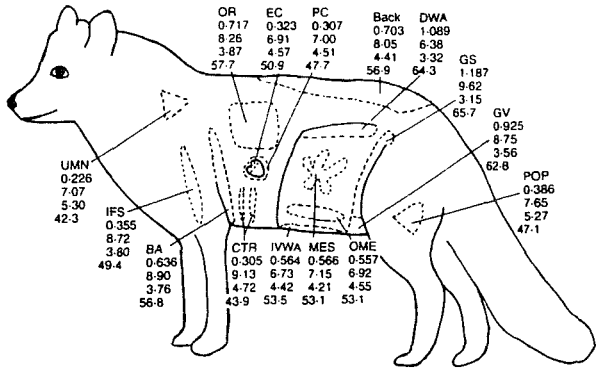



FIG. 6. Average site-specific properties of adipose tissue in 28 arctic foxes, ranging in fatness from 5·9–32·3% dissectible adipose tissue. Top rows of figures: mean adipocyte volume (nl); second rows: collagen ($mg\,g^{-1}$ wet weight adipose tissue); third rows: non-collagen protein ($mg\,g^{-1}$ wet weight adipose tissue); bottom rows: total lipid (acetone extractable lipid as % wet weight adipose tissue). MES = mesenteric; OME = omental; DWA = perirenal and other adipose tissue on dorsal wall of abdomen (retroperitoneal and gonadal); IVWA = inner ventral wall of abdomen; POP = popliteal; UMN = medial to the anterior trapezius and cleidocervicalis muscles in the neck; CTR = between the intercostalis muscles of the ribs; PC = pericardial; EC = epicardial; IFS = in front of shoulder and cranial side of the upper forelimb; BA = behind the upper forelimb around the cutaneous trunci muscle and in the axilla; GS = cranial face of the thigh and outer abdominal wall from the crest of ilium to the knee; GV = between the hindlegs and on the medial surface of the thighs; OR = lateral thorax, over the external oblique and latissimus dorsi muscles.

Almost all the adipose depots found in other terrestrial mammals were present. Site-specific differences in adipocyte volume and the lipid and protein content of adipose tissue were similar to those of other wild mammals and did not change with fatness. The collagen content was highest in superficial and lowest in intra-abdominal adipose depots. The differences of up to 60% in the collagen content of homologous depots of different foxes could not be explained by age or cytologically visible blood vessels and fascia but correlated with adipocyte complement.

*J. Zool., Lond. 236: 593-610, 1995. 8 figs., 49 refs. Authors' summary.*

## Dispersal patterns of red foxes relative to population density

*Stephen H. Allen, Alan B. Sargeant*

Factors affecting red fox (*Vulpes vulpes*) dispersal patterns are poorly understood but warranted investigation because of the role dispersal in rebuilding depleted populations and transmission of diseases. We examined dispersal patterns of red foxes in North Dakota based on recoveries of 363 of 854 foxes tagged as pups and relative to fox density.

Foxes were recovered up to 8.6 years after tagging: 79% were trapped or shot. Straight-line distances between tagging and recovery locations ranged from 0 to 302 km. Mean recovery distances increased with age and were greater for males than females, but longest individual recovery distances were by females. Dispersal distances were not related to population density for males (P=0.36) or females (P=0.96). The proportion of males recovered that dispersed was inversely related to population density (r=-0.94; n=5; P=0.02), but not the proportion of females (r=-0.49; n=5; P=0.40). Dispersal directions were not uniform for either males (P=0.003) or females (P=0.006); littermates tended to disperse in similar directions (P=0.09). A 4-lane interstate highway altered dispersal directions (P=0.001). Dispersal is a strong innate behaviour of red foxes (especially males) that results in many individuals of both sexes travelling far from natal areas. Because dispersal distance was unaffected by fox density, populations can be rebuilt and diseases transmitted long distances regardless of fox abundance.

*J. Wildl. Manage. 57 (3): 526-533, 1993. 3 tables, 38 refs. Authors' summary.*

## Late winter social activity in pine marten (*Martes martes*) - false heat or dispersal?

*J.O. Helldin, Erik R. Lindström*

In late winter (February-March) the social behaviour of the pine marten (*Martes martes*) is intensified (increases scent marking frequency, intersexual tolerance and intrasexual aggression) and the levels of sex hormones are increased, i.e. the same characteristics as for the mating period in July-August (pine marten exhibits delayed implantation). However, in late winter no fertilizations are possible, since males have no spermatogenesis at this time. Here, we review data on these "false heats", including some of our own observations. We suggest that late winter is the start of a dispersal period for pine marten, and that the main function of the social activity is territorial defence. The period coincides with implantation and the beginning of active pregnancy. This change in the female reproductive cycle may start the behaviour of driving out her young from the territory, and by that, the whole dispersal mechanism.

*Ann. Zool. Fennici 32: 145-149, 1995. 1 fig., 32 refs. Authors' summary.*

## Growth, size, and fat reserves of the raccoon dog in Finland

*Kaarina Kauhala*

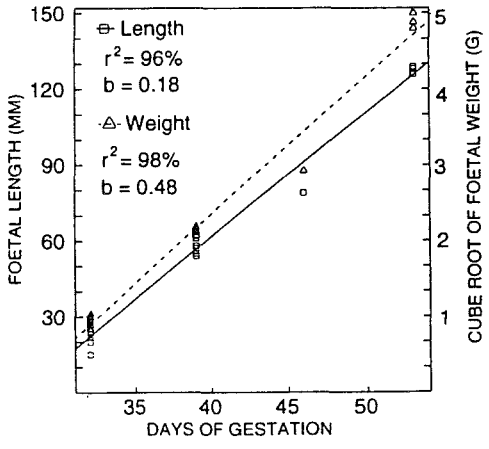



**Fig. 2.** The growth lines of foetuses of raccoon dog females (n=4) raised on a farm.

The growth, size, and fat reserves of the raccoon dog *Nyctereutes procyonoides* (Gray, 1834) were studied in Finland from 1986-1990. There was no sexual dimorphism in mean body size. Juveniles reached the mean adult body length at the age of 5-7 months. The weather in spring seemed to cause both annual and regional variations in the weight and fat reserves of juveniles in late autumn. Some of these differences could be seen as late as the following March, the breeding season of raccoon dogs. The adults had the least fat reserves in May and the most in October-November. The abundance of food, especially that of voles in early spring, seemed to affect the fat reserves of adult females in March.

*Acta Theriologica 38 (2): 139-150, 1993. 1 table, 12 figs., 26 refs. Author's summary.*

## Lead concentrations in frozen and formalin-fixed tissues from raccoons (*Procyon lotor*) administered oral lead acetate

*A.N. Hamir, D.T. Galligan, J.G. Ebel, K.L. Manzell, H.S. Niu, C.E. Rupprecht*

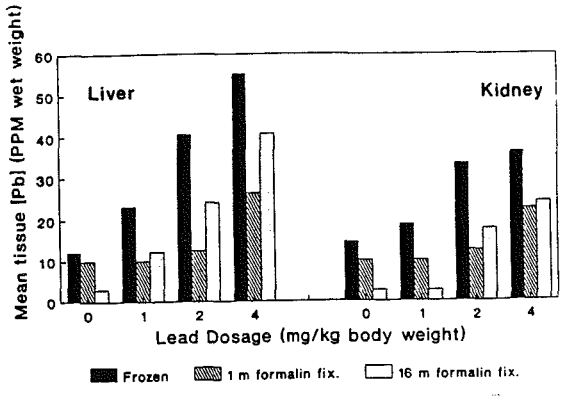



**Fig. 1.** Mean Pb concentrations of frozen and formalin-fixed livers and kidneys of 8 raccoons administered oral Pb acetate.

Based on the present investigation, it is concluded that raccoons appear to be highly resistant to otherwise toxic Pb levels. Additionally, Pb levels derived from formalin-fixed tissues should be interpreted with caution. High levels would support Pb

toxicosis, but low levels in formalin-fixed tissues do not rule out Pb poisoning. Therefore, whenever possible, fresh frozen tissue samples should be the specimen of choice for diagnosis of Pb intoxication.

*J Vet Diagn Invest 7: 580-582, 1995. 1 table, 1 fig., 21 refs. Authors' conclusion.*

## The distributional history and present status of the American mink (*Mustela vison* Schreber, 1777) in Norway

*Kjetil Bevanger, Gunnar Henriksen*

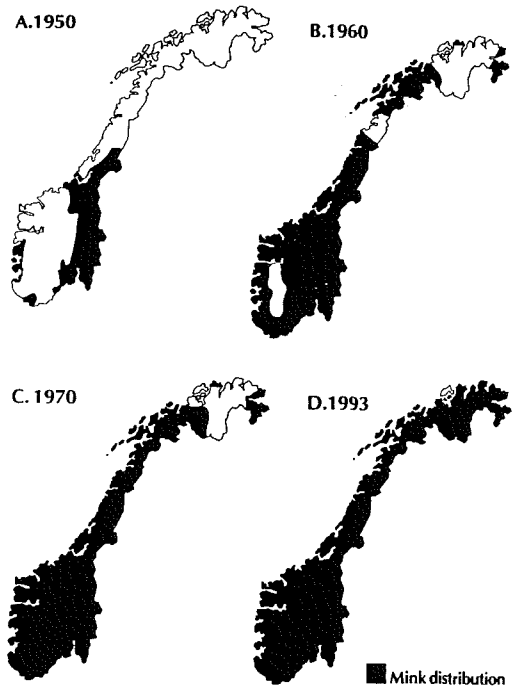



**Fig. 1.** The distribution of mink in Norway about 1950 (A), 1960 (B), 1970 (C), and 1993 (D).

The American mink *Mustela vison* is widely distributed in several European countries, mainly as a result of the escape of animals from mink farms. In 1985, an analysis of Norwegian mink farming history (Bevanger & Albu, 1986a) revealed an excellent correlation between the development of mink farming and the dispersal of feral mink populations in the wild. Up to 1950, mink mainly existed as rather isolated populations in areas where there had been or still were mink farms, but they colonized most of the country in the 1950's and 1960's. Based on questionnaires and other sources of information, the 1985 investigation concluded that only some islands off the coast of central and northern Norway, together with the greater part of Finnmark, were mink-free. In 1993, a questionnaire was sent to every local authority in Troms and Finnmark asking whether mink had been observed. All 25 authorities in Troms and 18 of the 19 in Finnmark confirmed that there were mink populations in their area.

The only one reporting no mink population was Hasvik, which is completely devoid of mainland territory. It is concluded that the Norwegian mainland has now been fully colonized and that only some island areas are mink-free.

*Ann. Zool. Fennici 32, pp. 11-14, 1995. 2 figs., 22 refs. Authors' summary.*

## Danish mink have grown in size

*Iwan Santin*

8,006.557 mink pelts were produced in Denmark in 1993-94. Of pelts from males and females, 86 and 77% respectively were top size vs. 81 and 72% in the previous year, and of 48,034 fox pelts, 86, 89 and 76% of blue, Shadow and silver fox pelts were large vs. 82, 83 and 72%. Details are given of the quality of pelts of mink of different colour types.

*Dansk Pelsdyravl 57, 10, pp. 426-427, 1994. In DANH. 4 tables. CAB-abstract.*

## Profitability of the production of longer pelts

*Ulla Lund Nielsen*

Investigations on 28 male and 28 female mink kits showed that feed intake from 4 July to 18 Nov. was correlated with body weight in Nov. (4.7 and 4.8 g consumed per g increase in body weight for males and females, respectively) and pelt length (increasing by 1 cm per consumption of 31 and 23 g feed). Economic aspects are considered.

*Dansk Pelsdyravl 58, 8, pp. 316, 1995. In DANH. CAB-abstract.*

## How to achieve large pelts

*Ulla Lund Nielsen, Anette Svendsen*

347 male mink kits were weighed, and were scored for pelt size by visual appraisal in a cage or in a trap. The correlations of pelt length with body weight and the 2 types of visual appraisal were 0.91, 0.69, and 0.73, respectively, and the correlations of body weight with the 2 visual appraisal scores were 0.35 and 0.26.

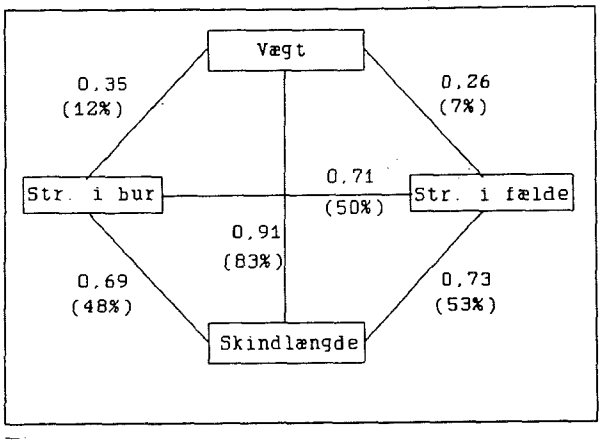



**Fig. 1.** Correlation coefficients ($R^2$ in brackets) between the different methods of measuring skin length.

*Dansk Pelsdyravl 57, 10, pp. 428, 1994. In DANH. 1 fig. CAB-abstract.*

## Fur biting in mink

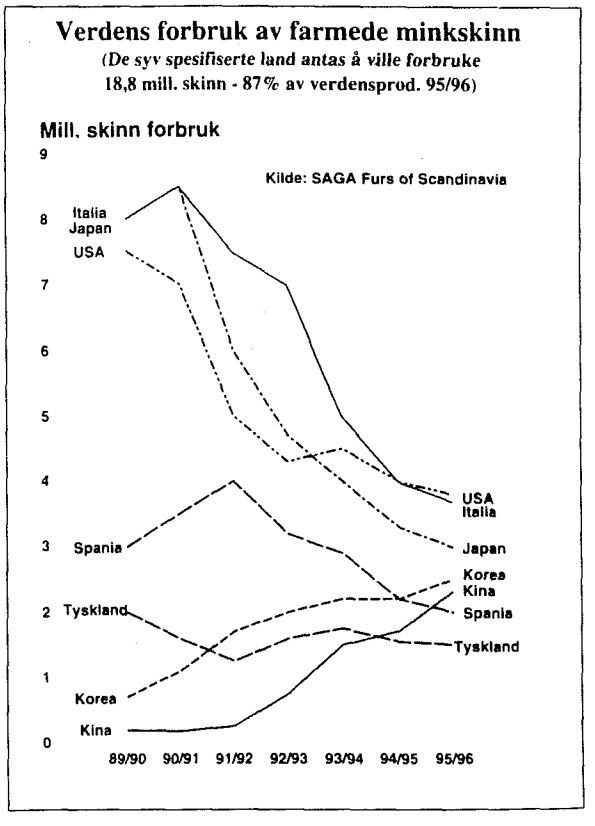
*L.L. Dille*

The effects of sex, colour type, housing density, age, diet, climatic conditions, age at sexual maturity and genetic factors on the incidence of fur biting in mink are discussed, and economic aspects are considered.

*Norsk Pelsdyrblad 69, 9, pp. 12-13, 1995. In NORG. 1 table, 3 refs. CAB-abstract.*

## World consumption of pelts of farmed furbearing animals

*Hans Sørensen*




The projected production of blue fox pelts in Scandinavia in 1995-96 is 2,250.000 vs. a production of 832.000 pelts in 1991-92. The projected world production of fox and mink pelts in 1995-96 is 2.32 and 18.8 million respectively, and it is envisaged that 68% of fox pelts and 87% of mink pelts will be sold to buyers in China, Korea, Japan, Italy, USA, Germany and Spain. Details are given of pelt prices.

*Norsk Pelsdyrblad 69, 9, pp. 8-9, 1995. In NORG. 2 figs. CAB-abstract.*

## Report on the 1995 Annual Meeting of the Norwegian Association of Fur Animal Breeders

*Anonymous*

An account is given of pelt production and prices, shows, information work, reproduction, nutrition,

and animal welfare and of research on fur bearers in Norway in 1995.

*Norsk Pelsdyrblad 69, 7-8, pp. 4-11, 1995. In NORG. CAB-abstract.*

## Placing of kits

*Ulla Lund Nielsen*

From 28 June, kits from 30 mink litters, each comprising at least 3 males and 3 females, were housed in cages with (1) 1 male and 1 female from the same litter, (2) 1 male from the above litters and 1 female from a different litter, (3) 1 female from the above litters and 1 female from a different litter, (4) a single male, or (5) a single female. Kits were weighed at monthly intervals. For males in groups 1, 2, 3, and 4, body weight on 22 Nov. averaged 2386, 2365, 2510 and 2445 g respectively, and for females in groups 1, 2, 3, and 5 averaged 1135, 1097, 1140, and 1161 g, the differences between the housing groups being non-significant. There were no significant differences between the groups in pelt quality or pelt colour score, but purity of colour was poorer in pelts from mink housed in single cages ($P<0.05$) than in pelts from mink housed in pairs. The incidence of neck biting ranged from 0% for males in groups 3 and 4 to 10.7% in group 2, and from 0% for females in group 5 to 10. 7% in groups 1 and 3. Females in groups 1 and 5, 3.6 and 7.1% respectively showed a high incidence of neck biting. Food conversion efficiency was similar in all groups, although it was slightly lower for kits housed singly than for those housed in pairs.

*Dansk Pelsdyravl 58, 6, p 240-241, 1995. In DANH. 4 tables. CAB-abstract.*

## Use of subcutaneous transponders in identification of farmed research foxes

*Liisa Jalkanen*

Traditionally fur animals in farm conditions are identified by their cards placed outside the cage. The same routine is also in use at research farms. However, there is a high risk that an animal's identity can be changed under these conditions so most fur animal researchers admit that more secure means are needed. Tattooing and different ear tags have been used and found mostly to be impractical in farm conditions. During the last 10 years implanted subcutaneous transponders have become commonly used as animal identification tags and were first used for fur animals already 1991 for mink in Denmark.

In Finland individual identification of silver foxes started in reproduction research at the Juankoski fur animal research station before the mating season in 1993. A pet model Indexel-R-transponder was implanted subcutaneously in the middle of the neck of 50 female silver foxes. The transponder is composed of a microchip and an antenna enclosed in a glass tube. With a length of 11 mm and diameter of 2.1 mm the transponder is easily implanted by means of an injector. In each transponder there is a unique 10 digit code which can be read by frequency radio signalling and a receiving device from 10 cm distance.

The routine is to always check the code in connection with insemination or sampling. No wrong codes or lost transponders have been found. Eleven animals were pelted at two months, 24 at eight months and five at 20 months after implantation. In 80% of the cases the transponder was found with the bare eye, in one case of three it was in the fat of the skin, in two cases of three in the body. In some cases the signal reader was needed to locate the transponder. All of them were found from their original implanting area. No tissue reaction could be observed. The transponder can be reused after cleaning and desinfection. Since 1993 97 Indexel capsules have been used by us. Of them 38 have been used twice and 12 three times. Hence, 147 foxes have had a secure identity tag with a tolerable cost reached by means of recycling the transponder. In the future not only experimental animals but also breeding animals will be having a transponder so that risks of changed identity can be eliminated in the breeding programs.

*NJF report no. 106, 1996. In SWED. Poster.*

## Shelves with or without walls

*H. Korhonen, P. Niemela*

Trials with 30 young blue foxes housed in single cages, provided with an enclosed or open shelf, revealed that the latter made more use of the shelf than the former ($P<0.001$). There were no significant differences between the groups in body weight at pelting.

*Finsk Pälstidskrift 29, 5, p 154-156, 1995. 1 table, 3 figs., 5 refs. In SWED. CAB-abstract.*

## Shelf trials with raccoon dogs

*H. Korhonen, J. Asikainen*

For 25 male and 25 female raccoon dogs, housed in pairs in cages with a shelf measuring 195 x 30 cm from weaning in early July, body weight on 4 Oct. averaged 10.6 and 10.2 kg respectively vs. 10.7 and 10.6 for controls in cages without shelves. Only 4.4% of the raccoon dogs made use of the shelves in July vs. 12.5% in Oct. It was concluded that the provision of shelves for raccoon dogs does not improve performance or animal welfare.

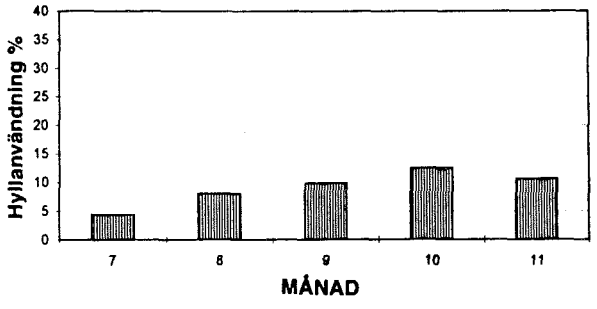



**Fig. 1.** Use of shelves by raccoon dogs (% observations on the shelf) during the growing season.

*Finsk Pälstidskrift 29, 6-7, p 178-179, 1995. 1 table, 1 fig., 4 refs. In SWED. CAB-abstract.*

## More high-quality pelts

*Kaj Thorhauge*

An illustrated account is given of an appliance developed in Denmark for the evaluation of fur quality on the basis of fur density, guard hair length and nap (the difference between the lengths of wool fibres and guard hairs), which can be measured at 250 sites on each pelt. The appliance was used to evaluate 861 pastel pelts, which had previously been evaluated visually.

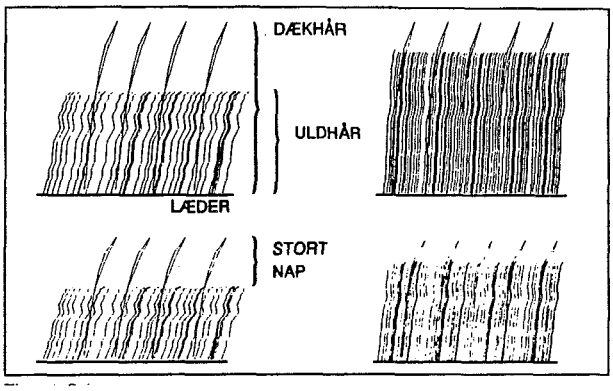
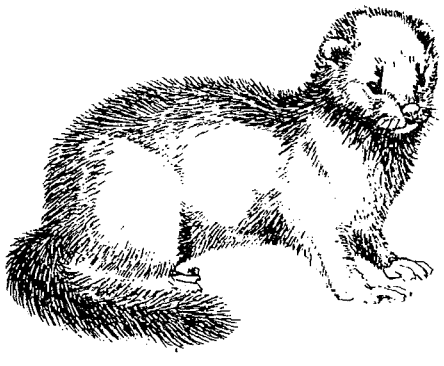



**Fig. 1.** *Cross-section of 4 pelt types.* There are short and few wool fibres, giving a large NAP on the left in the figure. The panel of judges gave only a few points for quality when the pelts had a large NAP and poor wool density. The judges gave up to 12 points for the best pelts, which had a small NAP and high wool density (on the right in the figure).

*Dansk Pelsdyravl 58, 6, p 250-251, 1995. In DANH. 1 fig. CAB-abstract.*



*Original Report*

# Mixed model for ordered categorical data

*C.A. Cappelletti, M.C. Flores, F.M.B. Rozen*

*Faculty of Veterinarian Sciences, University of Buenos Aires*

*Av. Chorroarín 280, CP 1427, Buenos Aires, Argentina*

## Summary

Maximun likelihood procedure can be used to analyse a categorical (nominal) trait with a sire mixed model. The response follows a multinomial probability distribution where the probabilities of each category are expressed with a logistic structure. Breeding values of sires are predicted as probabilities of having future progeny in each category. Previous value of $h^2$ is required.

## Introduction

Linear statistical models are used in animal breeding to analyse the phenotypic expresion of a response variable including genetic and non-genetic factors. When the response is quantitative and follows a mixed linear model, a prediction procedure known as BLUP is suitable for most applications. Since in our prediction problem the response is categorical (nominal) rather than quantitative, we present a procedure, resembling the BLUP, for predicting the breeding value of sires. Our approach is based on the works of Grizzle et al.(1969) for a fixed effects model and in Breslow and Clayton (1993) for a generalized mixed linear model, and is extended to a mixed model including the relationship matrix among sires (sire model).

The Newton-Raphson algorithm is used to maximize the log-likelihood function of s independent multinomial distribution for k mutually exclusive categories, where s is the number of sires.

The results are the predicted frequencies of future descendents in each category for each sire. An application is made with 20 male chinchilla laniger and his 318 kits classified subjectively for general appearence.

## Methodology

Let us assume that a linear mixed model is

$$\underline{Y} = \mathbf{X}\underline{b} + \mathbf{Z}\underline{u} + \underline{e}$$

where

$\underline{Y}$ is the vector of observations
$\underline{b}$ is the vector of fixed effects
$\underline{u}$ is the vector of random effects
$\underline{e}$ is the vector of random residuals and

$\mathbf{X}$ and $\mathbf{Z}$ are the incidence matrices for fixed and random effects, respectively.

Assume also that the variance matrices are

$V(\underline{u}) = \mathbf{G}$
$V(\underline{e}) = \mathbf{R}$
$Cov(\underline{u},\underline{e}) = \mathbf{0}$ and
$V(\underline{Y}) = \mathbf{ZG'Z + R = V}$

Considering the random vector $\underline{u}$ as fixed, the maximum likelihood equations for estimate $\underline{b}$ and $\underline{u}$ are

$$\begin{bmatrix} X'R^{-1}X & X'R^{-1}Z \\ Z'R^{-1}X & Z'R^{-1}Z+G^{-1} \end{bmatrix} * \begin{bmatrix} \underline{b} \\ \underline{u} \end{bmatrix} = \begin{bmatrix} X'R^{-1}\underline{Y} \\ Z'R^{-1}\underline{Y} \end{bmatrix} \quad (2)$$

the BLUE for $\mathbf{X}\underline{b}$ is $X\hat{\underline{b}}$ where

$$\hat{\underline{b}} = (X'V^{-1}X)^{-1}X'V^{-1}\underline{Y}$$

and the BLUP for $\underline{u}$ is

$$GZ'V^{-1}(\underline{Y} - X\hat{\underline{b}})$$

Henderson et al. (1959) developed the so-called mixed model equations maximizing the joint density of $\underline{Y}$ and $\underline{u}$, which have a format like (2) except in the lower-right submatrix which is modified to

$$(Z'R^{-1}Z) + G^{-1}$$

This procedure gives the BLUE for $\mathbf{X}\underline{b}$ and the BLUP for $\underline{u}$ simultaneously.

When the response variable $\underline{Y}$ is not quantitative because the observations are the number of cases generated by s samples from s independent multinomial distributions, each one with k categories mutually exclusive with probabilities

$\{ \pi_{ij}$ :i=1,...,s; j=1,...,k; with $\sum_{j=1}^{k} \pi_{ij} = 1 \}$,

the observations can be coded with 1, 2, ..., k and the likelihood function for the probability function $f(\underline{Y}, \theta)$ with $\theta' = (\underline{b}', \underline{u}')$ and $\underline{Y}$ with multinomial probability function can be written

$$L(\underline{Y},\underline{\theta}) = C * \prod_{i=1}^{s} \left[ \pi_{i1}^{n_{i1}} \ \ldots \ \pi_{ik}^{n_{ik}} \right] \quad (3)$$

where C is a constant not dependent on $\pi_{ij}$ and s is the number of sub-populations (sires in our problem). The estimators of the vector $\underline{\theta}$ are calculated maximizing (3).

Following Cox (1969) it is possible to define the function $F(\underline{\pi})$, for $0 < \pi_{ij} < 1$, to indicate the dependency of a probability with respect to a model like (1), as

$$\pi_{ij} = e^{H_j} / (1 + \sum_{j=1}^{k-1} e^{H_j}) \quad i = 1,...s; \ j = 1,... \ k$$
$$\pi_{ik} = 1 / (1 + \sum_{j=1}^{k-1} e^{H_j}) \quad (4)$$

where $H_j = \underline{X}_i b_j + \underline{Z}_i u_{ij}$ and defining

$\tau_{ij} = lg(\pi_{ij}/\pi_{ik}) = \underline{x}_i b_j + \underline{z}_i u_{ij}$, a logistic transformation of $\theta$, the vector $\underline{\tau} = \mathbf{x}\underline{b} + \mathbf{z}\underline{u}$ is a linear logistic model. From (3) the partial derivation of log(L) produces the vector $\underline{d}$ and the second partial the matrix $\mathbf{D}$. Applying the NewtonRaphson criterion in an iterative process produces the solution for $\theta$. In stage r results

$$\underline{\theta}^r = \underline{\theta}_0^{r-1} + \underline{\delta} \text{ if and only if } D\underline{d} = -\underline{\delta} \quad (5)$$

The system (2) can be written

$$\begin{bmatrix} X'WX & X'WZ \\ Z'WX & Z'WZ+G^{-1} \end{bmatrix}^{(r)} * \begin{bmatrix} \underline{b} \\ \underline{u} \end{bmatrix}^{(r+1)} = \begin{bmatrix} X'W\underline{Y} \\ Z'W\underline{Y} \end{bmatrix} \quad (6)$$

where

$$\underline{Y}^{(r)} = [W^{-1}\, d]^{(r)}\ ,\ W = DIAG\ [n_i p_{ij}(1-p_{ij})]\ ,$$

$$Z = I_{(k-1)} \otimes J_{(s)}\ ,\ G = [I_{(k-1)} \otimes A]\alpha$$

$\mathbf{A}_{(s,s)}$ is the relationship matrix for sires, $\alpha = (\pi^2/3 - h^2)/h^2$ and $h^2$ the trait heritability. ($\otimes$: is the direct product of matrices).

With the solutions for $\underline{b}$ and $\underline{u}$ and with (4) we calculate the probabilities for each combination s by k, sires by categories of kits classifications. These probabilities are the predicted values for each sires of having offspring in each category.

**Data analysis: an application.**

A sample of 20 chinchillas with a total of 318 offspring were used. Each kit was qualified considering the general appearence, a compound trait of fur quality, basic colour, size and body conformation, with the scale 1 = poor-regular, 2 = good, 3 = very good and 4 = outstanding. The frequencies of cases are arranged in a 20 x 4 table, the model used is (1) and the matrix of relationship among sires is calculated with Henderson's rules (1974). The heritability of the trait was estimated with a linear model considering paternal half-sibs with a value of $h^2 = 0.48(\pm 0.09)$, in the underlying scale, (Cappelletti and Rozen, 1995). The criterion of convergence was $\text{Max}(\text{Abs}(p^{(r)} - p^{(r+1)})) < 0.01$ where $p^{(r)}$ indicates probability in stage r. The program was written in Fortran 77.

**Results and discussion**

The results are presented in table 1. The values are the probabilities that each sire has descendants in the categories of classification and can be considered as the prediction of the genetic merit for each of them.

**Table 1.** Probabilities ($x100^{-2}$) of future offspring per category for each sire (categories in rows, sires in columns)

| | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 16 | 10 | 20 | 56 | 02 | 07 | 48 | 05 | 09 | 02 | 08 | 02 | 04 | 04 | 03 | 03 | 06 | 05 | 03 | 04 |
| 24 | 16 | 11 | 12 | 23 | 09 | 23 | 05 | 10 | 11 | 25 | 01 | 05 | 06 | 03 | 16 | 06 | 06 | 27 | 06 |
| 51 | 37 | 34 | 12 | 40 | 69 | 17 | 47 | 63 | 75 | 34 | 89 | 47 | 33 | 83 | 65 | 58 | 73 | 49 | 36 |
| 09 | 37 | 35 | 21 | 34 | 15 | 12 | 44 | 18 | 12 | 32 | 08 | 43 | 58 | 11 | 17 | 29 | 16 | 20 | 55 |

The procedure of estimation (prediction) presented has a certain equivalence with the BLUP procedure that is applied with mixed models to predict the breeding value of sires. The obtained results, the probabilities shown in table 1, allow us to make a plan of genetic improvement for the desired trait, in this case general appearence, by means of the presentation of a criteria which allows discrimination of which sires will remain in service and which will be eliminated.

For example, it can be established that sires from which 60% of the descendants belong to class 3 (very good) or 4 (excellent), and those from which 20% of the total amount of descendants are qualified as excellent, will remain.

It can be concluded from table 1 that sire numbers 2, 3, 5, 8, 11, 13, 14, 17, 19 and 20 are kept as breeders and the rest are eliminated.

**Acknowledgements**

This study was supported by Secretaría de Ciencia y Técnica, Universidad de Buenos Aires, proyect VE006, UBACYT/95. The authors wish to thank Med. Vet. and Mrs. José M. Caride who kindly provided the information from their farm.

## References

Breslow, N.E. and Clayton, D.G. [1993]. Approximate inference in gen-eralized linear mixed models. J. Am. Stat. Ass. 88:9.

Cappelletti, C.A. y Rozen, F.M.B. [1995]. Genetic and phenotypic par-ameters for fur characteristics in Chinchilla lanigera, Scientifur, Vol. 19, No. 2, 125-128.

Cox, D.R. [1969]. The Analysis of Binary Data. Chapman and Hall, London.

Grizzle, J.E., Starmer, C.F. and Koch, G.G. [1969]. Analysis of cate-gorical data by linear models. Biometrics 25:489.

Henderson, C.R. [1974]. Rapid method for computing the inverse of a relationship matrix. J. of Dairy Sc. 58, N° 11:1727.

Henderson, C.R., Kempthorne, O., Searle, S.R. and Von Krosigk, C.M. [1959]. The estimation of environmental and genetic trends from records subject to culling. Biometrics 16:192.

Graybill, F.A. [1969]. Introduction to Matrices with Applications in Statistics. Wadsworth Pub. Co., California.

## Cloning and partial characterization of the cDNA encoding the fox sperm protein FSA-Acr.1 with similarities to the SP-10 antigen

*Sandra Beaton, José ten Have, Andrew Cleary, Mark P. Bradley*

We have isolated and characterized a cDNA, cFSA-Acr.1, encoding a testis-specific fox sperm antigen. The antigen is located on the inner acrosomal compartment, and is expressed during spermatogenesis on the developing acrosome of round and elongating spermatids. Database searches with the deduced amino acid sequence of cFSA-Acr.1 revealed that the clone has high homology to both human and baboon sperm protein SP-10, and the mouse sperm protein, MSA-63. The region of highest homology is within the carboxyl terminus. In the middle of the open reading frame, the fox sequence shows unique sequences absent from both the human, baboon SP-10, and mouse MSA-63 sequences. In addition to cFSA-Acr.1, two other clones were also isolated from the same fox testis cDNA library, and sequence analysis shows that they may represent alternatively spliced mRnAs coding for other FSA-Acr proteins.

*Molecular Reproduction and Development 40: 242-252, 1995. 11 figs., 17 refs. Authors' abstract.*

## Cloning and characterization of a fox sperm protein FSA-1

*Sandra Beaton, Andrew Cleary, José ten Have, Mark P. Bradley*

A monoclonal antibody was raised to a fox sperm protein (FSA-1) which was found to be localized to the inner acrosomal compartment of sperm fixed in methanol. Western blots of testicular germ cell membrane extracts probed with this antibody identified a major protein band with a molecular weight of 36000. Immunofluorescent studies on fox testis sections showed that the antigen is expressed on round and elongating spermatids on a crescent-shaped structure, which probably represents the developing acrosome. An antibody specific for FSA-1 was used to screen a fox testis cDNA library for its cognate gene. An 875-bp cDNA clone was isolated and sequenced revealing an open reading frame. Searches of the GenBank and EMBL databases with the nucleic acid sequence revealed significant homology (86%) of FAS-1 with 406 bases of an unidentified RNA transcript from human fetal brain (EST02625). Northern blot analysis of fox testis RNA samples identified an RNA transcript of approximately 0.9 kb during the months when spermatogenesis is active. Zoo Northern blots (at high stringency) reveal an RNA transcript of a similar size present in testis RNA from dogs and mice. Zoo Southern analysis (high stringency) reveal genomic sequences present in dogs, mice, cattle and sheep. At present, the function of the FSA-1 gene product remains unknown, but it may play a role as a structural protein component of the acrosome.

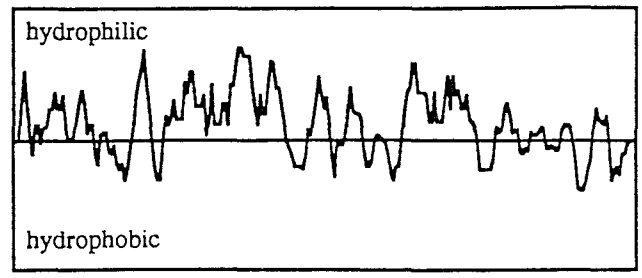



**Fig. 5.** A Hopp-Woods hydropathy analysis of the FSA-1 translated open reading frame sequence.

*Reprod. Fertil. Dev. 6, pp. 761-70, 1994. 10 figs., 15 refs. Authors' abstract.*

## Ectopic expression of the agouti gene in transgenic mice causes obesity, features of type II diabetes, and yellow fur

*M.L. Klebig, J.E. Wilkinson, J.G. Geisler, R.P. Woychik*

Mice that carry the lethal yellow ($A^y$) or viable yellow ($A^{vy}$) mutation, two dominant mutations of the agouti (*a*) gene in mouse chromosome 2, exhibit a phenotype that includes yellow fur, marked obesity, a form of type II diabetes associated with insulin resistance, and an increased susceptibility to tumor development. Molecular analyses of these and several other dominant "obese yellow" *a*-locus mutations suggested that ectopic expression of the normal agouti protein gives rise to this complex pleiotropic phenotype. We have now tested this

hypothesis directly by generating transgenic mice that ectopically express an agouti cDNA clone encoding the normal agouti protein in all tissues examined. Transgenic mice of both sexes have yellow fur, become obese, and develop hyperinsulinemia. In addition, male transgenic mice develop hyperglycaemia by 12-20 weeks of age. These results demonstrate conclusively that the ectopic agouti expression is responsible for most, if not all, of the phenotypic traits of the dominant, obese yellow mutants.

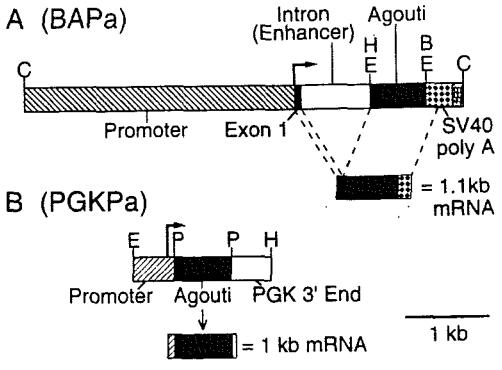



FIG. 1. β-actin promoter–agouti (BAPa) and phosphoglycerate kinase promoter–agouti (PGKPa) transgene expression constructs. (*A*) The components of the 5.3-kb BAPa construct are indicated. All of the components are from the human β-actin gene except the agouti cDNA and the simian virus 40 polyadenylylation signals. The first β-actin exon (78 bp) is untranslated, and the β-actin intron contains the endogenous enhancer and splice acceptor and donor sites. (*B*) The 1.7-kb PGKPa construct consists of the agouti cDNA under the transcriptional control of the promoter/enhancer region of the mouse *Pgk-1* gene from base pair −437 to +65 (24). The polyadenylylation signals are provided by the *Pgk-1* 3′ flanking region. For both constructs, "promoter" refers to the upstream region of the gene that contains the promoter and additional 5′ flanking DNA. The mRNAs expected to be expressed from these constructs are indicated below them. Arrows indicate sites of transcription initiation. C, *Cla* I; H, *Hin*dIII; E, *Eco*RI; B, *Bam*HI; P, *Pst* I.

*Proc. Natl. Acad. Sci., Vol. 92, pp. 4728-4732, 1995. 5 figs., 42 refs. Authors' abstract.*

## The comparison of some breeding traits of polish polar foxes and their crosses $F_1$, $F_2$, and $F_3$ between Norwegian and Polish foxes

*S. Kubacki, J. Zawislak*

The experiment was carried out on the State Farm Zalesie (Suwalki voivodeship) in 1987-1989.

As the result of mating Polish polar foxes to Norwegian ones, the $F_1$, $F_2$, and $F_3$ generations showed higher indices of fertility (%), animals habit evaluation (points), body weight (kg) and pelt quality.

*Zeszyty Naukowe No. 186 - Zootechnika 25, pp. 21-26 1994. In POLH, Su. ENGL. 1 table, 12 refs. Authors' summary.*

## Genetics and statistics in improving fur bearing animals

*Outi Lohi, Peer Berg*

The use of computerized breeding programmes including statistical methods for breeding value estimation is increasing among fur breeders. As the capacity of personal computers has increased, it has become possible to use calculation methods, which utilize most of the available information and thus result in more accurate breeding values. At present, single trait models are used and in most cases the weighting of traits in the final selection and ranking of animals is done on a farm basis.

The accuracy of animal grading greatly depends on the skill of the breeder and affects the possible gain. However, in traits with more objective information, such as litter size and body weight, the computer systems have proved superior to mass selection.

In the future it is important to obtain more accurate knowledge about the heritability of different traits and to develop models which can efficiently treat categoric, not normally distributed data. Furthermore, simulation models should be developed and used to estimate the effect of different strategies.

*Proceedings, 5th World Congress on Genetics Applied to Livestock Production, University of Guelph, Guelph, Ontario, Canada, 7-12 August 1994, Volume 19. Selection and quantitative genetics; growth; reproduction; lactation; fish; fiber; meat; pp. 421-427, 1994. 1 table,, 20 refs. Authors' summary.*

### Current breeding trials

*Niels Therkilsen*

An account is given of recent trials at the Fur Animal Research Station "Syd" in Denmark on line breeding, food conversion, fur biting and selection in 1543 mink breeding females. It is suggested that the $h^2$ of food conversion in wild mink is around 0.3, and that there is a genetic component in fur biting in mink.

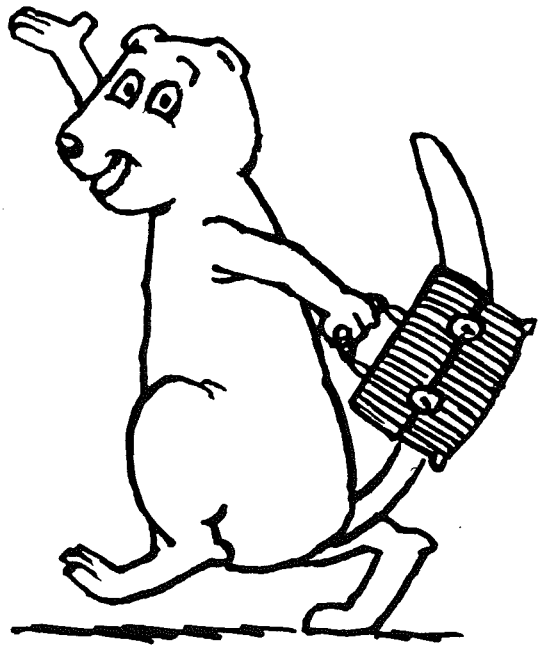
*Dansk Pelsdyravl 58, 6, pp. 242-243, 1995. In DANH. 1 table. CAB-abstract.*

### Selection for more trusting foxes. Coordination for Nordic projects

*Einar J. Einarsson*

An account is given of some recent and current attempts in Finland, Norway, Sweden and Denmark to select farmed silver and blue foxes for an equable temperament and against fear of humans.

*Norsk Pelsdyrblad 69, 10, pp. 26, 1995. In NORG. CAB-abstract.*



# See you in Warsaw

## Recovery and *in vitro* maturation of mink oocytes

*Yuichi Kameyama, Ryoichi Hashizume, Yoshiro Ishjima*

At 0, 1, 2 and 4 days after coitus, ovaries were obtained from female mink treated with or without PMSG at breeding season. The mean number of oocytes recovered per ovary were 2.0-10.0 by puncture of follicles with needle and 7.9-32.7 by mince of ovary with razor. About 70% of oocytes recovered by mincing were classified by types of morphology as no surrounding layer of cumulus cells or abnormal. Oocytes without dispersed cumulus cells did not resume meiosis. At 48 hr of culture, maturation rate of oocytes with thick and tight cumulus cells were 31.4 and 21.4% for TYH and TCM199, respectively.

*J. Mamm. Ova Res., Vol. 9, No. 1, pp. 1-6, 1992. In JAPN, Su. ENGL. 3 tables, 13 refs. Authors' summary.*

## Recovery and *in vitro* maturation of mink oocytes during the pelting period

*Yuichi Kameyama, Hidekazu Takeda, Ryoichi Hashizume, Yoshiro Ishjima*

The recovery of mink oocytes and *in vitro* maturation of the recovered oocytes were examined for the effective use of the mink ovary at pelting. The mean numbers of oocytes recovered per ovary were 18.9 for the mink without PMSG treatment (2.4 by puncturing follicles with needle and 16.5 by mincing of ovary with razor) and 18.2 for the ones with PMSG treatment (6.3 by puncturing follicles with needle and 12.0 by mincing of ovary with razor). These mean numbers of the recovered oocytes were about the same as those of the oocytes recovered from the ovary during the breeding season. Among the recovered oocytes, the proportions of oocytes with cumulus cells were about 80% when they were recovered by puncturing follicles with needle and about 40% when they were recovered by mincing of ovary with razor. Except for some degenerated oocytes, these recovered oocytes were all in the germinal vesicle stage. When the oocytes with cumulus cells (A-C types) recovered by puncture of follicles with needle were cultured for 48 hours by TYH and TCM 199, 31.7% and 48.8% of the oocytes matured to metaphase II, respectively. Although these maturation rates were a little lower than the scores in the breeding season (59.4% for TYH and 60.4% for TCM 199), no significant difference was found. These results suggested that the oocytes recovered from the mink ovary during the pelting period could also be used for *in vitro* fertilization.

*Reprinted from Journal of Agricultural Science, Tokyo Nogyo Daigaku, Vol. 38, No. 4, pp. 268-274, 1994. 3 tables, 9 refs. Authors' summary.*

## Levels of alpha2 pregnancy-associated glycoprotein in maternal circulation during pregnancy in the mink

*J. Hau, Lise Lotte I. Andersen, H. Bohn*

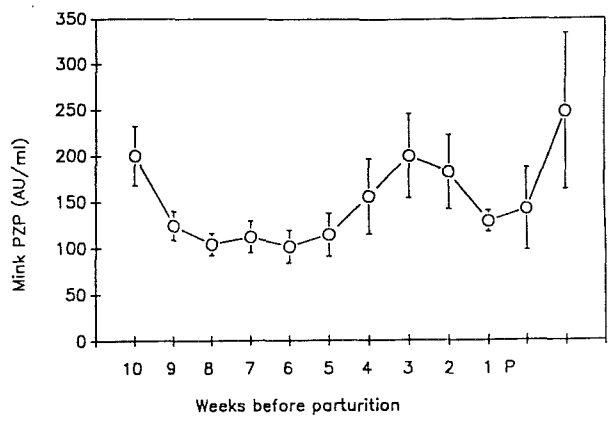



**Fig. 1. Rocket immunoelectrophoretic measurements of mink α2-PAG in 130 heparinized plasma samples from 12 female mink during breeding season and pregnancy.** One hundred arbitrary units (AU) refers to the concentration of protein in a pool of heparin plasma from late pregnant mink ($n = 10$). Values represent means ± 1 standard deviation.

This is the first demonstration of α2-pregnancy-associated glycoprotein (α2-PAG) in the mink. Mink α2-PAG exhibits complete immunological cross reaction with dog α2-PAG when analysed in assays employing antisera against canine α2-PAG raised in rabbits. Alpha2-PAG was quantitated by rocket immunoelectrophoresis in heparin plasma samples obtained from the peripheral circulation of mink during the breeding season. The plasma levels recorded in male mink were significantly lower (23 AU/ml) than the levels recorded in

females at any stage of the breeding period. Very early in the breeding season and 2 weeks after delivery the α2-PAG levels were high (>200 AU/ml) in the circulation of the female mink. Like α2-PAG in the pregnant bitch, mink α2-PAG concentrations reach a local maximum in mid-pregnancy, and a local minimum at term.

*Laboratory animals 27, pp. 161-163, 1993. 1 fig., 20 refs. Authors' summary.*

### Seasonal variations of pulsatile luteinizing hormone release in mink (*Mustela vison*)

*M. Jallageas, N. Mas, J. Boissin, D. Maurel, G. Ixart*

The pulsatile secretion of the hypophyseal luteinizing hormone (LH) is induced by the pulsatile secretion of the hypothalamic neurons secreting gonadotrophin-releasing hormone (GnRH). Seasonal variations in the pulsatility of LH were studied in the adult male mink (*Mustela vison*), reared under natural environmental conditions. Twenty-one animals were studied according to five critical phases in the breeding season: (1) the terminal phase of sexual quiescence, which precedes renewal of gonadal activity (October-November); (2) renewal of gonadal activity (December); (3) maximum gonadal activity at the height of the breeding season (February); (4) reduction of testicular activity (April); and (5) the initial phase of testicular quiescence (June). Levels of gonadal growth and activity were used to define each phase. A second animal group was studied after being reared for 2 months in an experimental gonado-inhibitory photoperiod, which, necessarily for the mink, was of the "long-day" type: 20L:4D regimen in the present study. The results, obtained with fully conscious animals, provide evidence for the pulsatile secretion of gonadotrophic hormone in this species. In spite of inter-individual differences in pulse patterns, particularly in phases 1 and 2, the pulsatile character of LH secretion is seen to vary markedly as a function of gonadal activity. The variations reflect an increase of hypophyseal activity as early as the preparative phase to the breeding season, and a decrease of activity during the testicular regression phase, which is followed by the onset of gonadotrophic quiescence in June. The main parameter affected statistically by these seasonal fluctuations is pulse frequency; variations in pulse frequency correlated with variations in mean plasma concentrations of LH. In the experimental gonado-inhibitory photoperiod, which led to a severe reduction in gonadal activity, all hormonal pulsatility parameters were statistically reduced; this confirms the importance of photoperiodic control of reproduction in *Mustela vison*. Several possible mechanisms are proposed for photoperiodic control.

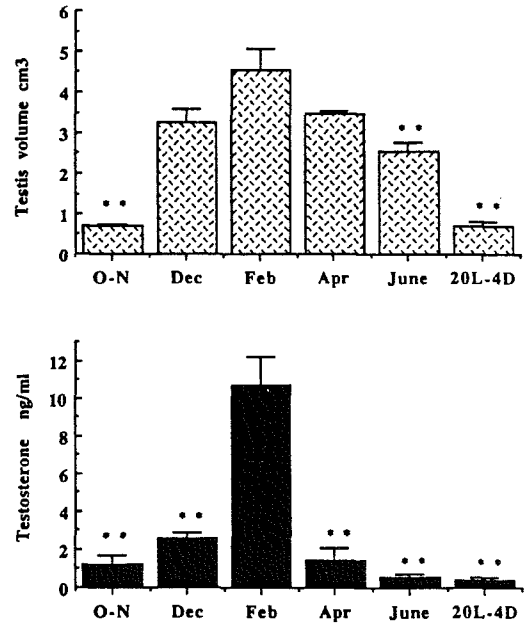



**Fig. 3.** Mean (±SEM) testis volumes ($cm^3$) (□) and mean plasma testosterone concentrations (ng/ml) (■) for male mink exposed to natural seasonal conditions or to long days (L-D 20:4). Two asterisks represent a significant result ($P<0.01$) vs February.

*Comp. Biochem. Physiol., vol. 109C, No. 1, pp. 9-20, 1994. 6 figs., 38 refs. Authors' summary.*

### The dependence of fertility and litter size on age of silver fox females

*Janusz Kuzniewicz, Zbigniew Olszewski*

The investigations done in 1989 at the Lubiechow breeding farm covered a two year period from 1986 till 1988. The sources of information were: well-kept breeding books, farm notebooks, certifi-

cate block and personal observations by the authors. The data obtained are as follows:

- the year of female fertilization,
- the number of pups in the litter together with the number of survivings pups,
- the number of males and females in the litter.

607 females of silver fox were investigated. The total of litters was 523. All together within the 523 litters 2702 pups were born and 2528 were kept for further breeding. From the obtained data the following conclusions are presented:

- there is an essential relationship between the age of the female and her reproduction. Most of the one-year-old females are sterile, able to abort or destroy their pups,
- the age of females has no essential influence on the pregnancy expectancy time.

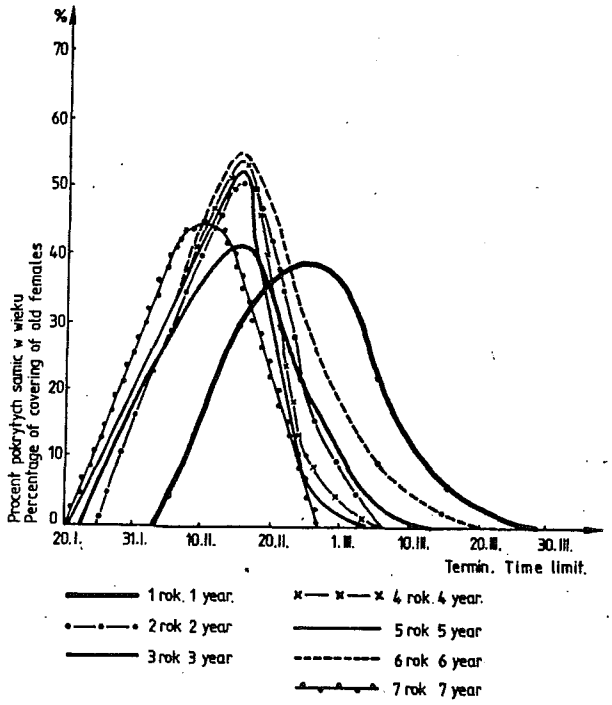



**Fig. 1.** Interdependence of heat and age of silver foxes - 1986-88.

*Zeszyty naukow Akademii Rolniczej we Wroclawiu - Zootechnika XXXV, No. 206. IN POLH, Su. ENGL. 1 table, 4 figs., 6 refs. Authors' summary.*

**Reproductive result, semen quality and willingness to mate in two mink lines selected for high and low percentages of sterility.**

*Ulla Lund Nielsen*

In lines selected for high and low percentages of sterility in the fathers, the result was that the lines had divergent levels of sterility. The result suggests that the trait may be heritable. The lines were also tested for differences in willingness to mate, period of interest prior to mating, length of copulation and semen quality. Willingness to mate was greatest in the line selected for a low percentage of sterility in the fathers. Otherwise, there were no differences between the lines. The test for semen quality can be used to find sterile males. It cannot, however, be used to predict the reproductive result.

*Technical year Report 1995, pp. 27-36. Danish Fur Breeders Research and Advisory Service, Herningvej 102C, DK-7500 Holstebro. In DANH. 10 pp, 9 tables. 1 ref. Authors' abstract.*

**Knowledge of the number of matings may produce more kits**

*Michael Sønderup*

Data on matings of mink females in Denmark in 1991-94 (50,000-60,000 females per year) were analysed. In 1994, 81, 81 and 84%, respectively, of adult, 2-year-old and young females were mated twice, and a 2nd mating increased litter size by 0.5, 0.5 and 1.4 kits respectively in the 3 age groups compared with a single mating. Data are presented in 5 tables.

*Dansk Pelsdyravl 58, 4, pp. 174-175, 1995. In DANH. 5 tables. CAB-abstract.*

**Information on previous kit losses of females may produce larger litters**

*Michael Sønderup*

Data obtained in 1992, 1993 and 1994 on mink females at 30, 37 and 45 farms respectively were

analysed. For 9696 females which lost no kits in 1992, the incidence of kit mortality in 1993 and 1994 was 0 and 3.1% respectively vs. 24 and 5.3% respectively for females losing kits in 1992. The incidence of kit mortality of daughters of dams which lost kits the previous year exceeded that of daughters of dams with no losses by 8-10%.

*Dansk Pelsdyravl 58, 5, pp. 206, 1995. In DANH. 2 tables. CAB-abstract.*

## Accelerated whelping after early use of artificial light on the farm

*Michael Sønderup*

Data on 5973 mink at 8 farms subjected to artificial light for approximately 5 h in the evening for 18-31 days from the middle of March (group 1) and on 22,103 mink females at 23 farms with no artificial light (group 2) were compared. Additional light during late gestation advanced parturition by 2 days (45 24% respectively of females in the 2 groups whelping by 28 April and 100 and 97% by 8 May) but had no significant effect on litter size or the percentage of females failing to produce a litter.

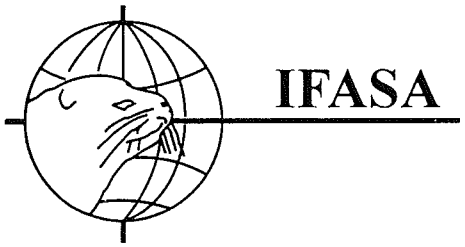
*Dansk Pelsdyravl 58, 3, pp. 134-137, 1995. In DANH. 1 table. CAB-abstract.*

## Large mink produce fewer kits

*Michael Sønderup*

Data on 100,086 mink kits born at 31 farms in Denmark were analysed. The correlations of body weight in Nov. with pelt quality and litter size were -0.18 and -0.13 respectively, and that of pelt quality with litter size as -0.02.

*Dansk Pelsdyravl 58, 8, pp. 317, 1995. In DANH. CAB-abstract.*




## Whelping results in 1989-1994

*Per Clausen*

For 1,746,646 mink females mated in Denmark in 1994, litter size per mated female averaged 5.72 at birth and 5.26 at weaning, and 8.0% of females failed to produce a litter. For an unspecified number of blue and silver foxes, litter size at weaning per mated female averaged 5.55 and 3.20 respectively, and 16.3 and 15.4% did not produce a litter. Data are tabulated by colour type, farm size and district, and results are compared with those in the previous 4 years.

*Dansk Pelsdyravl 57, 10, pp. 434-435, 1994. In DANH. 8 tables. CAB-abstract.*

## Breeding results in 1990-95

*Per Clausen*

In 1995, in Denmark, 8.0% of mated mink females failed to produce a litter, and litter size and weaning averaged 5.22 kits. Data are presented by colour type, district and farm size, and results are compared with those in the previous 4 years. Of blue fox and silver fox females, 16.2 and 16.3% respectively produced no litter, and the number of cubs born per mated female averaged 5.54 and 3.98. Data are presented in 9 tables.

*Dansk Pelsdyravl 58, 9, pp. 352-353, 1995. In DANH. 9 tables. CAB-abstract.*

## Insemination of foxes in 1994

*Erik Smeds*

For 11,000 and 76,000 blue fox females inseminated with silver and blue fox semen respectively and 13,000 silver foxes inseminated with silver fox semen in Finland in 1994, the CR was 87, 87 and 84% respectively, and the number of cubs born per inseminated female averaged 5.43, 6.0 and 2.78. Results are compared with those in 1993.

*Finsk Pälstidskrift 28, 12, pp. 288, 1994. In SWED. 1 table. CAB-abstract.*

## Breeding information on fur bearers

*Anonymous*

In 1995, in Norway, the number of young weaned per mated mink, silver fox and blue fox female averaged 5.4, 3.1 and 5.4, respectively. The results are compared with those in previous years.

*Norsk Pelsdyrblad 69, 7-8, pp. 14-15, 1995. In NORG. 1 table. CAB-abstract.*

## Record results for mink

*K.R. Johannessen, H.A. Kulbotten*

In 1995, in Norway, the number of progeny produced per mated female averaged 2.7 for silver foxes, 4.7 for blue foxes and 5.1 for mink. The number of cubs per inseminated female averaged 2.8 and 4.9, respectively, for silver and blue foxes vs. 3.3 and 5.5 for naturally mated females. Data are tabulated by district, and results are compared with those in 1993 and 1994.

*Norsk Pelsdyrblad 69, 9, pp. 10-11, 1995. In NORG. 2 tables. CAB-abstract.*

## Fur bearer performance recording statistics in 1994

*Anonymous*

For 9579 mink, 5693 silver fox, 14,702 blue fox and 1226 silver x blue fox females recorded in Norway in 1994, litter size at birth averaged 6.4, 4.6, 8.6 and 8.5 respectively, and litter size at 3 weeks 6.0, 4.4, 7.6 and 7.0 per litter and 5.3, 3.4, 5.8 and 5.5 per female mated or inseminated. The percentage of females failing to produce a litter was 8.0, 11.5, 12.0 and 5.9, respectively, and the incidence of preweaning mortality was 10.0, 15.3, 21.1 and 26.15. For naturally mated silver and blue fox females, litter size at weaning per female averaged 3.6 and 6.3 respectively vs. 3.1 and 5.2 for inseminated females.

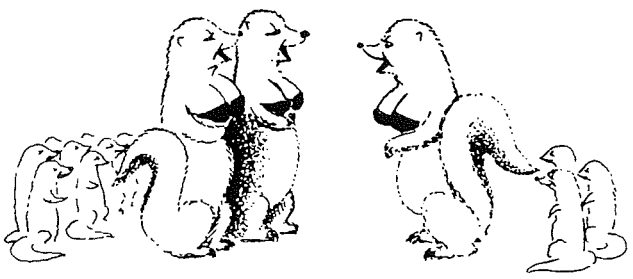
*Norsk Pelsdyrblad 68, 10, pp. 18-19, 1994. In NORG. 1 table. CAB-abstract.*

## Whelping performance of recorded females

*Anonymous*

For 8659 mink, 5740 silver fox, 20,624 blue fox and 436 crossbred fox females participating in the litter recording scheme in Norway in 1995, the percentage of females failing to produce a litter was 9.5, 12.7, 12.8 and 10.8 respectively, and litter size at birth averaged 6.6, 4.4, 8.4 and 8.1. The number of young weaned per mated female averaged 5.4, 3.1, 5.3 and 4.9, representing a decrease of 9.6% for mink compared with 1994 and an increase of 0.8 and 40.3%, respectively, for silver and blue foxes. For inseminated silver and blue fox females, the number of cubs weaned per mated female averaged 2.8 and 4.8, respectively, vs. 3.4 and 5.9 for naturally mated females.

*Norsk Pelsdyrblad 69, 10, pp. 10-11, 1995. In NORG. 1 table. CAB-abstract.*



*Original Report*

# Protein digestion in the digestive tract of polar foxes

***Roman Szymeczko, Katarzyna Burlikowska***

*Department of Animal Physiology,*

*Academy of Technology and Agriculture in*

*Bydgoszcz, Mazowiecka Str. 28, 85-084 Bydgoszcz, Poland*

## Abstract

The objective of the study was to investigate the apparent nitrogen and amino acids digestibilities in the different parts of the digestive tract of adult polar foxes fed a diet with highly digestible protein. Hake fillet and lean beef were applied as dietary protein sources. The experimental animals were sacrificed 3 hours after a test diet and digesta from stomach, three equal sections (63 cm long) of the small intenstine, caecum and colon/rectum was collected. Apparent digestibilities of nitrogen and amino acids were positive in the stomach and slightly negative in the first segment of the small intenstine, reflecting the dilution of exogenous proteins by endogenous secretions. The digestibilities increased rapidly in the next two segments of the small intenstine. Compared with the terminal section of the small intenstine, decline of the digestibility of the investigated nutrients in the caecum was observed. Fecal analysis method revealed the highest digestibilities of nitrogen and amino acids in the whole digestive tract. In feces the highest digestibilities were for methionine, lysine, glutamic acid, and leucine, the least for glycine, arginine, and threonine.

## Introduction

To estimate apparent or true digestibility of nutrients in the digestive tract of foxes and mink the fecal analysis method is commonly used (*Bieguszewski & Lewicki, 1969; Bieguszewski & Szymeczko, 1979; Skrede, 1979; Kiiskinen et al., 1985; Szymeczko & Skrede, 1991; Faulkner et al., 1992; Szymeczko & Podkówka, 1994*). Determinations of the protein and amino acids digestibilities by this method is often questioned in pigs, especially in the case of poor-quality protein, because of the endogenous secretion of digestive enzymes and because of the activity of microflora in the caecum and colon (*Payne et al., 1968; Zebrowska, 1975; Zebrowska et al., 1978; Low, 1979b; Sauer et al., 1980*).

Digestibility of amino acids, estimated by fecal analysis method, informs about the final effect of protein digestion but does not give any picture on the changes in amino acid absorption appearing in the respective parts of the alimentary canal in different species of animals.

The objective of the present investigation was to study the apparent digestibility of nitrogen and amino acids in the individual parts of the digestive tract in adult polar foxes fed a highly digestible protein diet.

## Material and methods

*Animals*

The experimental animals were twelve 8-month-old polar fox males of average body weight 7.9 kg ± 0.6 kept individually in metabolic cages equipped for quantitative feeding and collection of feces.

*Diet and feeding*

The composition of the experimetnal diet and its amino acid composition are shown in Tables 1 and 2, respectively. The diet contained 40, 35, and 25% of energy from protein, fat, and carbohydrate, respectively. In the diet the amounts of protein coming from hake fillet and lean beaf were equal, and amounted to 50%. The diet containing 0.5% chromic oxide as a marker, was given to the foxes for 14 days in one meal per day at 10.00. The pH of the diet was 6.87. Water was available ad libitum.

**Table 1.** Composition of experimental diet (%)

| Ingredients | |
|---|---|
| Hake fillet | 28.90 |
| Lean beef | 22.50 |
| Maize starch (precooked) | 6.50 |
| Soybean oil | 2.30 |
| Cellulose powder | 1.10 |
| Vitamin-mineral mix[1] | 0.20 |
| Water | 38.50 |
| | |
| Approximate composition | |
| Dry matter (%) | 24.67 |
| Nitrogen (% of dry matter) | 6.57 |

[1]: Vitamin - mineral mixture "Ewomix fur 0.05%" for fur bearing animals, made by Ewos Polfarm Comp., Grodzisk Mazowiecki, Poland

**Table 2.** Amino acid composition of experimental diet

| Amino acid | g/16 g N |
|---|---|
| Arginine | 4.96 |
| Phenylalanine | 4.48 |
| Histidine | 4.56 |
| Isoleucine | 4.53 |
| Leucine | 7.57 |
| Lysine | 9.63 |
| Methionine | 2.99 |
| Threonine | 3.87 |
| Valine | 5.02 |
| Alanine | 5.73 |
| Aspartic acid | 9.00 |
| Glutamic acid | 15.87 |
| Glycine | 3.95 |
| Proline + Cystine | 6.49 |
| Serine | 3.18 |
| Tyrosine | 4.17 |

*Collection of feces and digesta*

After 7 days of preliminary feeding feces were collected during the last 7 days of the experiment. During the last day of the experiment all the polar foxes were fed half of their daily ration, and then sacrificed by electrocution after 3 hours. All the activities connected with digesta collection from different fragments of the digestive tract of the experimental polar foxes and pH measurements were carried out according to the method developed by Szymeczko & Skrede, 1990. The measurements of the length of the digestive tract of polar foxes are shown in Table 3.

The samples of the experimental diet, feces and digesta of each animal were stored at -18°C, then freeze-dried and ground and, in the case of feces, sifted to remove hair.

*Analysis*

Samples of experimental diet, digesta and feces were analysed for dry matter, nitrogen, chromium oxide content and amino acid composition in the

laboratory of the Technology and Agriculture Academy in Bydgoszcz.

**Table 3.** Length measurements of the digestive tract of foxes (cm)

| | Mean ± SD |
|---|---|
| Total digestive tract | 212.8±9.7 |
| Small intestine | 189.7±11.4 |

## Results and discussion

The experimental diet was very well accepted by all the polar foxes, and the entire daily rations were consumed within a short time. Table 4 shows the pH value, dry matter, and nitrogen contents in digesta from different parts of the digestive tract and in feces of the investigated animals. The lowest pH value was recorded in the stomach 4.17±1.52, and then the pH of digesta increased towards the distal section of the small intestine. Our results are similar to those of Szymeczko & Skrede (1990), who estimated pH values in different parts of the alimentary canal in mink. Dry matter content increased as digesta passed through the digestive tract of all the experimental polar foxes. Compared with the diet the amounts of nitrogen and most of amino acids declined in the stomach (Table 4; Fig. 1,2). Thus, the decline caused the positive apparent digestibility values of these nutrients in this part of the tract of polar foxes (Table 5). This effect has been also reported previously by Szymeczko & Skrede (1990) in mink.

**Table 4.** Average pH, dry matter and nitrogen values in digesta and feces (mean ± SD)

| Parameters | Stomach | Small intestine section | | | Caecum | Colon + rectum | Feces |
|---|---|---|---|---|---|---|---|
| | | I | II | III | | | |
| pH | 4.17 ±1.52 | 5.93 ±0.23 | 6.65 ±0.14 | 6.78 ±0.19 | - | - | - |
| Dry matter (%) | 14.20 ±4.64 | 15.25 ±1.18 | 16.91 ±1.31 | 18.77 ±0.91 | 21.01 ±1.17 | 22.05 ±2.16 | 35.68- ±1.19 |
| Nitrogen (% of dry matter) | 6.09 ±0.09 | 6.88 ±0.28 | 4.45 ±0.34 | 2.71 ±0.37 | 5.09 ±0.47 | 3.53 ±0.51 | 3.24 ±0.34 |

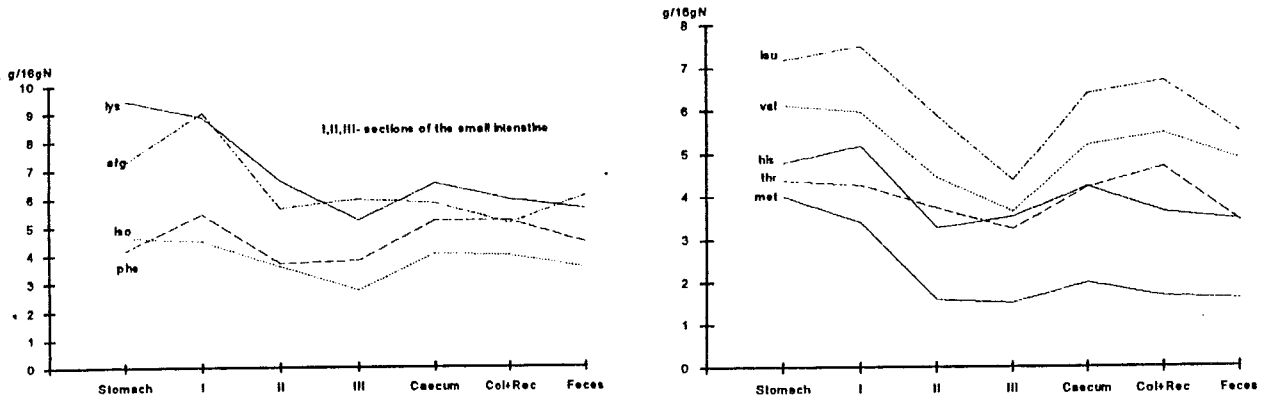



**Fig. 1.** Composition of essential amino acids in digesta and feces (g/16 N)

So high apparent nitrogen digestibility in the stomach of foxes was rather unexpected. However, it is known that pepsin of pigs is capable of protein digestion in vitro and in vivo (*DeCufere et al., 1981; Zebrowska et al., 1983*).

The obtained results can indicate that some nitrogen was probably absorbed from the stomach and also that a small quantity of chromic oxide left the stomach faster than the particulate fraction of digesta.

The highest contents of nitrogen and some of the amino acids were in the digesta from the first section of the small intestine, which includes the duodenum (Table 4; Fig. 1,2). The negative apparent digestibilities of nitrogen and amino acids (arginine, phenylalanine, histidine, methionine, valine, proline + cystine, serine) in the first (63 cm long) segment indicate little dilution of exogenous protein by endogenous protein in the form of digestive secretions and disquamated mucosal cells (Table 5). These observations on nitrogen dilution are in agreement with those reported previously by Szymeczko & Skrede (1990, 1991) in mink and in foxes and with the results obtained by Nasset and Ju (1961); Nasset (1965); Buraczewska et al. (1975); Low (1979a); Buraczewska (1979) and Leibholz (1982) working with rats, dogs and pigs.

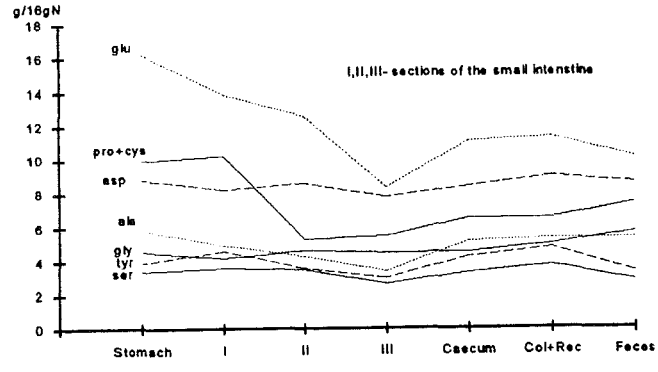



**Fig. 2.** Composition of nonessential amino acids in digesta and feces (g/16 g N).

There was a gradual reduction in the levels of nitrogen and amino acids from the next two sections of the small intestine (Table 4, Fig. 1,2). Apparent nitrogen and amino acids digestibilities increased as digesta moved from the first to the third segment of the small intestine (Table 5). The present data are similar to the trend of changes of the protein digestion and amino acids absorption reported by Szymeczko & Skrede (1990) in the three sections of the small intenstine in mink. The average digestibilities of nitrogen and all amino acids in the terminal segment of the small intestine in our experiment amounted to 93.73±2.06 and 90.56%, respectively. From among essential and nonessential amino acids the digestibilities of methionine, glutamic acid, lysine, leucine and alanine were the highest while the apparent digestibilities of arginine and glycine were the least. The present results are similar to those of Szymeczko et al. (1992), who examined ileal and fecal digestibilities of amino acids in fistulated polar foxes.

Three hours after feeding the increase of nitrogen and amino acids amounts reduced the apparent digestibilities of these nutrients in the caecum of all the examined polar foxes (Table 4, 5; Fig. 1,2). This was probably caused by accumulation of the intestinal digesta containing undigestible proteins, peptides and also free amino acids (*Buraczewski, 1970; 1980*).

The apparent digestibilities estimated in the whole intestinal tract were for nitrogen 95.67%±0.61 and for all amino acids 92.55%. The highest digestibility coefficients in the feces were for methionine, lysine, glutamic acid and leucine, the least for glycine, arginine and threonine (Table 5). These results are similar to those of Szymecxko & Skrede (1991); Szymeczko et al. (1992) and Szymeczko & Podkówka (1994), who examined protein digestion and amino acid absorption in polar foxes in different experimental arrangements.

The differences between apparent nitrogen and amino acid digestibilities measured in the third section of the small intestine and in feces were small and amounted to about 3%. They were probably caused by microbial activity during digesta passage through the large intestine of the experimental polar foxes as shown by Michael (1966) and Mason et al. (1976) in pigs. From the results obtained for the terminal ileum and for the whole digestive tract, we concluded that in the case of highly digestible protein the fecal analysis method is exact enough for determining the availability of dietary amino acids in polar foxes.

**Table 5.** Apparent ileal and fecal digestibility of nitrogen and amino acids (%)

| Amino acid | Stomach | Small intestine section | | | Caecum | Colon + rectum | Feces |
|---|---|---|---|---|---|---|---|
| | | I | II | III | | | |
| Nitrogen | 33.89 ±6.35 | -0.47 ±29.29 | 80.21 ±3.33 | 93.73 ±2.06 | 88.30 ±1.26 | 94.01 ±1.76 | 95.67 ±0.61 |
| Arg | -3.61 | -63.36 | 66.98 | 85.06 | 82.39 | 88.68 | 89.15 |
| Phe | 34.15 | -9.58 | 75.96 | 89.55 | 82.40 | 87.11 | 91.29 |
| His | 25.30 | -2.56 | 79.14 | 90.43 | 86.15 | 91.11 | 93.33 |
| Iso | 27.02 | 10.84 | 77.11 | 92.43 | 86.57 | 90.36 | 93.11 |
| Leu | 32.58 | 10.39 | 77.42 | 92.78 | 87.32 | 90.21 | 93.61 |
| Lys | 30.28 | 17.33 | 80.08 | 93.28 | 89.80 | 93.20 | 94.90 |
| Met | 4.70 | -2.35 | 84.59 | 93.73 | 90.09 | 93.73 | 95.30 |
| Thr | 19.56 | 0.40 | 72.18 | 89.52 | 83.67 | 86.69 | 89.92 |
| Val | 13.20 | -6.83 | 74.39 | 90.99 | 84.32 | 87.89 | 91.46 |
| Ala | 27.35 | 21.77 | 78.23 | 92.65 | 86.39 | 89.66 | 91.70 |
| Asp | 30.33 | 17.76 | 72.36 | 89.34 | 85.96 | 88.99 | 91.59 |
| Glu | 25.75 | 21.47 | 77.10 | 93.51 | 89.48 | 92.14 | 94.35 |
| Gly | 17.39 | 4.74 | 65.81 | 85.97 | 82.61 | 85.97 | 87.15 |
| Pro+Cys | -9.01 | -41.59 | 75.36 | 89.54 | 84.74 | 88.82 | 89.90 |
| Ser | 24.51 | -1.22 | 67.89 | 89.71 | 84.31 | 87.01 | 92.16 |
| Tyr | 33.46 | 0.37 | 74.95 | 91.03 | 84.49 | 87.29 | 92.90 |

## References


Bieguszewski, H. & Lewicki, Cz. 1969. Protein metabolism in furbearing carnivore animals. IV. The influence of the different composition of daily ration and differential protein level in it, on the digestibility, nitrogen balance and some hematological indicies in polar foxes. Rocz. Nauk rol. B-91-4, 603-613 (Polish).

Bieguszewski, H. & Szymeczko, R. 1979. Effect of growth hormone and tyroxine on body weight gain, digestibility of nutrients, nitrogen balance and development of hair coat in growing arctic foxes. Rocz. Nauk rol. B-99-3, 45-52 (Polish).

Buraczewska, L., Buraczewski,S., Horszczaruk, F., Jones, A. & Zebrowska, T. 1975. An attempt to estimate the endogenous nitrogen content in the digesta of pigs fed on diets with proteins containing hydroxyproline. Rocz. Nauk rol. B-96-4, 105-114.

Buraczewska, L. 1979. Secretion of nitrogenous compounds in the small intestine of pigs. Acta Physiol. Pol. 30, 2, 319-326.

Buraczewski, S. 1970. Influence of the diet on the composition of chyme and blood levels of free amino acids in the rat. Rocz. Nauk rol. D-134, 70 pp (Polish).

Buraczewski,S. 1980. Digestion of proteins and absorption of amino acids in the digestive tract of pigs. Arch. Tierernahrung 30, 1-3, 29-40.

DeCuyfere, J.A., Knockaret, P. & Henderickx, H.K. 1981. In vitro and in vivo protein digestion in pigs fed diets containing soybean protein isolates with different physical properties. J. Anim. Sci. 53, 1297-1308.

Faulkner, W.L., Egan, L.A. & Anderson, D.M. 1992. Apparent and true digestibility of dry matter, crude protein and amino acids in diets for mature silver foxes. Norw. J. Agric. Sci. 9, 268-274.

Kiiskinen, T., Huida, L., Pastuszewska, B. & Berg, H. 1985. digestibility of nitrogen and amino acids of some dry feedstuffs for mink. Annales Agriculturae Fenniae 24, 107-114.

Leibholz, J. 1982. The flow of endogenous nitrogen in the digestive tract of young pigs. Br. J. Nutr. 48, 509-517.

Low, A.G. 1979a. Studies on digestion and absorption in the intestines of growing pigs. 5. Measurements of the flow of nitrogen. Br. J. Nutr. 41, 137-146.

Low, A.G. 1979b. Studies on digestion and absorption in the intestines of growing pigs. 6. Measurements of the flow of amino acids. Br. J.Nutr. 41, 147-156.

Mason, V.C., Just, A. & Bech-Andersen, S. 1976. Bacterial activity in the hind-gut of pigs. 2. Its influence on the apparent digestibility of nitrogen and amino acids. Z. Tierphysiol., Tierernahrg. u. futtermittelkde. 36, 310-324.

Michael, M.C. 1966. Metabolisme de la flore intenstinale du porc. Degradation des fermes L et D des amines. Annls Biol. Anim. Biochim. Biophys. 6, 33-46.

Nasset, E.S. & Jin soon Ju. 1961. Mixture of endogenous and exogenous protein in the alimentary tract. J. Nutrition 74, 461-465.

Nasset, E.A. 1965. Role of the digestive system in protein metabolism. Fed. Proc. 24, 953-958.

Payne, W.L., Combs, G.F., Kifer, R.R. & Snyder, D.G. 1968. Investigation of protein quality-ileal recovery of amino acids. Fed. Proc. 27, 1199-1203.

Sauer, W.C., Just, A., Jørgensen, H.H., Makonnen Fekadu & Eggum, B.O. 1980. The influence of diet composition on the apparent digestibility of crude protein and amino acids at the terminal ileum and overall in pigs. Acta Agric. Scand. 30, 449-459.

Skrede, A. 1989. Utilization of fish and animal byproducts in mink nutrition. IV. Fecal excretion and digestibility of nitrogen and amino acids by mink fed cod (Gadus morrhua) fillet or meat-and-bone emal. Acta Agric. Scand. 29, 241-257.

Szymeczko, R. & Skrede, A. 1990. Protein digestion in mink. Acta AGric. Scand. 40, 189-200.

Szymeczko, R. & Skrede, A. 1991. Protein digestion in fistulated polar foxes. Scientifur 15, 3, 227-232.

Szymeczko, R., Jørgensen, G., Bieguszewski, H. & Børsting, Ch. 1992. The effects of protein source on digesta passage and nutrient digestibility in polar foxes. Norw. J. Agric. Sci. 9, 275-281.

Szymeczko,R. & Podkowka, Z. 1994. Duration of preliminary and specific period in digestibility experiments in polar foxes. Zesz. Nauk. PTZ 15, 99-107.

Zebrowska, T. 1975. The apparent digestibility of nitrogen and individual amino acids in the large intestine of pigs. Rocz. Nauk rol. B-97-1, 117-123.

Zebrowska, T., Buraczewska, L. & Buraczewski,S. 1978. The apparent digestibility of amino acids in the small intestine and in the whole idgestive tract of pigs fed diets containing different sources of protein. Rocz. Nauk rol. B-99-1, 87-98.

Zebrowska, T., Low, A.G. & Zebrowska, H. 1983. Studies on gastric digestion of protein and carbohydrate, gastric secretion and exocrine pancreatic secretion in growing pigs. Br. J. Nutr. 49, 401-410.

## The nutritive value of decorticated mill fractions of wheat. 3. digestibility experiments with boiled and enzyme treated fractions fed to mink

*C.F. Børsting, K.E. Back Knudsen, S. Steenfeldt, H. Mejborn, B.O. Eggum*

The nutritive value of boiled and enzyme treated whole grain wheat and six mill fractions prepared by successive decortication of wheat kernels was studied in 15 digestibility trials with mink. The decortication process yielded mill fractions varying considerably in morphological and in chemical composition. The whole kernels (WK) and each of the six mill fractions (F1-F6) were provided to five adult black male mink either raw (only WK), boiled with water (15 min) or after treatment with cell wall degrading and proteolytic enzymes and mixed into complete diets to comprise 450-500 g wheat dry matter (DM) $kg^{-1}$ DM: Diet composition was (g $kg^{-1}$): cod meat 750, wheat fractions 190, lard 40, soya oil 10, vitamin mixture 5 and mineral mixture 5. The amount of starch in the diets based on boiled fractions ranged from 85 g $kg^{-1}$ DM in the diet prepared from the outer fraction enriched in pericarp/testa (F1) to 300 g $kg^{-1}$ DM in the diet containing the endosperm enriched inner fraction (F6). Total non-starch polysaccharides (NSP) ran conversely, constituting 213 g $kg^{-1}$ DM in diet F1 vs. 50 g $kg^{-1}$ DM in diet F6. Enzyme treatment resulted in a significant depolymerisation and solubilisation of cell wall NSP and of starch. The digestibility of energy was significantly higher (~3 absolute units) in the diets with enzyme-treated wheat fractions compared to the corresponding diets with boiled products in which energy digestibility of the carbohydrates and to a lesser extent to higher protein digestibility in the enzyme-treated fractions. The digestibility of crude carbohydrates (calculated by difference) was consistently higher in enzyme-treated fractions compared to boiled fractions, the differences varying from 13.4 absolute units (37.4% vs. 24.0%) in F1 to 5.4 absolute units (80.7% vs. 75.3%) in F6. Starch digestibility was about 90% for both boiled and enzyme-treated fractions showing slightly, but significantly lower values in enzyme-treated diets. Therefore, the higher digestibility of crude carbohydrates in enzyme-treated fractions could not be ascribed to higher starch digestibility but to depolymerisation of NSP and to higher digestibility of the remaining NSP in enzyme-treated fractions (28.1-34.9%) compared with boiled fractions (12.4-25.3%). A significant positive digestibility of NSP in both boiled and enzyme-treated fractions combined with substantial amounts of short-chain fatty acids in faecal material suggest that microbial degradation of cell wall NSP can occur in mink despite the high rate of passage and the relatively low microbial activity in the gastrointestinal tract.

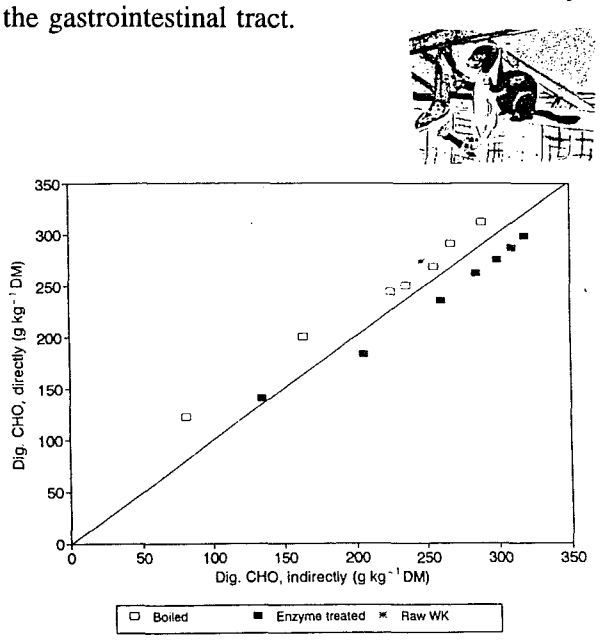



**Fig. 1.** The amount of digested crude carbohydrates (CHO) (g $kg^{-1}$ DM) estimated by difference or directly as the sum of digested LMW sugars (exclusive glucose and malto-oligosaccharides), starch and NSP.

*Animal Feed Science and Technology 53, pp. 317-336, 1995. 7 tables, 1 fig., 31 refs. Authors' abstract.*

## Digestible energy in feed for chinchilla and rabbits determined by the EDOM-method

*C.F. Børsting, J. Nordholm, A. Petersen, P. Sørensen*

In the legislation regarding feedstuff trading put into power in 1992, the required declaration of composition in compound feeds was abolished. Therefore, it is no longer possible to calculate the energy content in compound feeds from table values for the individual feedstuffs.

The aim of the present study was to develop equations for evaluation and control of energy content in compound feeds for chinchilla and rabbits and to examine the digestibility of protein, fat, and carbohydrates in chinchilla and rabbits as well as to describe these digestibilities by means of analyses performed on the mixtures.

The digestibilities of energy and individual nutrients were determined in 25 experimental mixtures for both chinchilla and rabbits, as well as in 2 control mixtures for chinchilla and 3 control mixtures for rabbits. All mixtures were analysed for the content of dry matter (DM), ash, crude protein, crude fat, crude fibre, ADF, NDF, and gross energy. Furthermore, all mixtures were analysed by the EDOM-method (enzyme digestible organic matter) developed for compound feeds for pigs (Boisen & Fernandez, 1992). The digestibilities of crude protein and crude fat could be estimated with high precision from the content of crude protein and crude fat, respectively, in both chinchilla and rabbits. Likewise, the digestibility of crude carbohydrates could be estimated from the proportion of NDF in crude carbohydrates.

A set of equations was developed for each of the two species for calculation of the energy value of compound feeds. For both species, the content of gross energy (BE, MJ/kg feed) is derived from the equation:

BE = 0.237 * crude protein + 0.389 * crude fat
+ 0.175 * crude carbohydrates,

as all analyses are stated as % of feed, and

crude carbohydrates =
DM - (crude protein + crude fat + ash).

The energy digestibility (FKENG, %) is derived from EDOM with separate equations for the two species:

**Chinchilla**:
FKENG = 0.659 * EDOM + 23.3

**Rabbit**:
FKENG = 0.769 * EDOM + 14.5,

as EDOM is % enzyme digestible organic matter measured according to the same method as used for pig diets. For both species, the content of digestible energy is derived from the equation:

Digestible energy = FKENG * BE/100.

The equations were also used to calculate the content of digestible energy in 38 feedstuffs for which the EDOM-value was known. However, the advantage of the new energy evaluation system is that a real analysis of the digestible energy content can now be achieved quickly and reasonably cheaply, and with much higher precision than by use of table values.

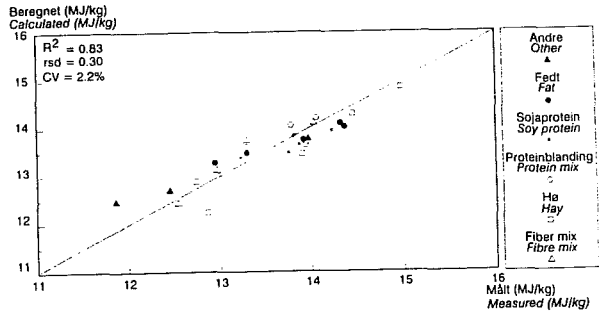



**Fig. 7.** Measured and calculated content of digestible energy in chinchilla mixtures (MJ/kg).

*Forskningsrapport - DIAS (Research report) no. 43, 1995. In DANH Su. + Table Text in ENGL. 47 pp. 15 tables, 8 figs., 18 refs. Authors' summary.*

## Requirements of essential amino acids for mink

*C.F. Børsting, T.N. Clausen*

In three series of experiments it was attempted to establish whether AA composition in mink diets influences performance and to find the requirements of individual EAA in order to reduce the very high protein content in mink diets.

The following conclusions were made:

- 30% of ME from protein of "modern" composition is needed during the growing-furring period.

- Dietary AA composition is very important for the health and fur quality of mink despite the high protein intake compared to protein retention (~8% of intake).
- MET is by far the most limiting AA regarding fur quality with a requirement per unit ME 2.7-fold higher than for pigs.
- The supply of CYS, THR, LYS, and TRP had only little influence on fur quality.
- The requirements of CYS, THR, LYS, and TRP per unit ME were measured to be only 17, 10, 13, and 25% higher than those for pigs.
- The supply of HIS, PHE, TYR, LEU, ILE, and VAL are not limiting for mink performance under practical conditions. The requirements set for these AA can be considered only as maximal requirements which can probably be reduced if further experiments are undertaken.

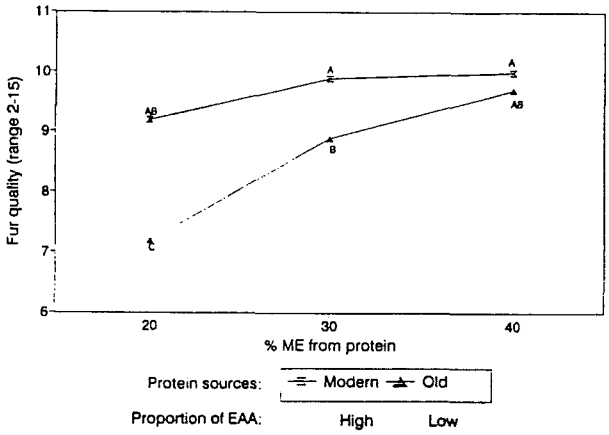



**Fig. 1.** Fur quality, scanblack males.

*VII Symposium on Protein Metabolism and Nutrition, EAAP Estacao Zootécnica Nacional - 24-27 May 1995. 2 tables, 3 figs., 1 ref. Authors' summary.*

## The pregnant mink (*Mustela vison*) - energy metabolism, nutrient oxidation and metabolic hormones

*Anne-Helene Tauson, Jan Elnif*

Energy metabolism, pattern of nutrient oxidation and some metabolic parameters were studied in 10 pregnant mink females from mating until close to parturition. In addition, 8 non-mated females were blood sampled for the metabolic parameters. Heat production (HE) was not significantly affected by stage of gestation, whereas intake of metabolizable energy (ME) was highest after implantation and decreased in the true pregnancy, resulting in low or even negative retained energy (RE). The pattern of nutrient oxidation reflected ME intake and RE, with high protein oxidation when ME intake was high, and a high level of fat oxidation in periods of low ME intake and negative RE. Thyroid hormone concentrations differed between non-mated and pregnant females, in which total thyroxine and free thyroxine decreased in the true gestation.

*Proceedings of the 13th symposium, Mojácar, Spain 18-24 September 1994 (EAAP Publication No. 76, 1994, pp. 79-82). 3 tables, 4 refs. Authors' summary.*

## Energy metabolism and nutrient oxidation in the pregnant mink (*Mustela vison*) as a model for other carnivores

*Anne-Helene Tauson, Jan Elnif, Niels Enggaard Hansen*

The mink is a strict carnivore and a seasonal breeder, which may be used as an experimental model for other carnivores. The present investigation comprised a total of 44 balance experiments, each including a 24-h measurement of heat production by indirect calorimetry, carried out from mating until close to parturition. For observations with a nonprotein respiratory quotient between 0.7 and 1.0 (n=42), quantitative oxidation of nutrients was calculated. The weight gain of the uterus during pregnancy was studied in 41 females killed either before mating, before implantation, after implantation or in mid or late true gestation, and energy retention was calculated. Heat production did not increase with advancing stage of gestation. Mean energy retention was low and in some individuals with repeated measurements even negative, indicating that part of the energy requirement for pregnancy may be supplied by mobilization of body reserves. This was reflected by a high level

(42%) of fat oxidation in relation to total heat production. Protein oxidation accounted for 38% of heat production. The weight gain of the uterus during pregnancy could be described by logarithmic functions. Energy deposition in fetal tissue was low and only averaged ~ 350 kJ 47 d after mating.

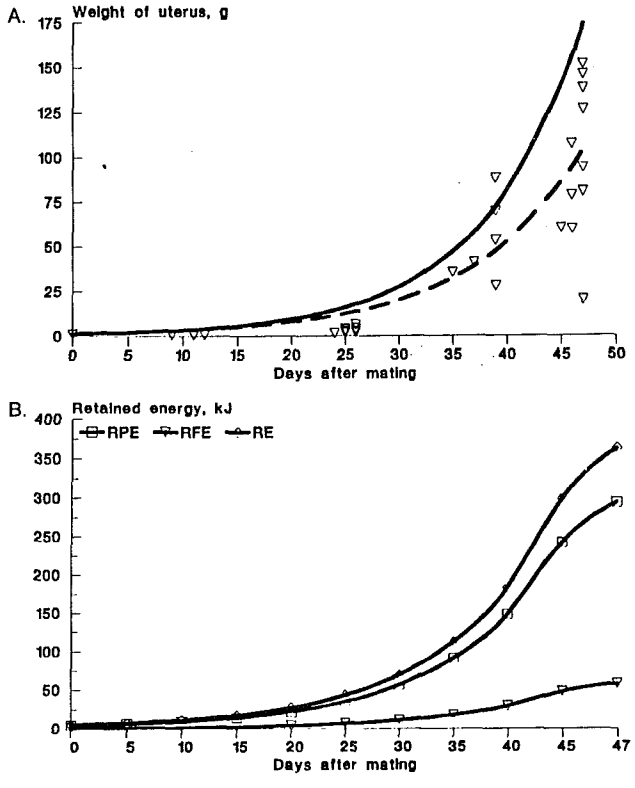



**Fig. 1.** [A] weight of the uterus in mink females in different stages of gestation. ∇, measured weights; ____, estimated from Equation 1 $y=0.3855 + e^{0.1097t}$ ($P<0.001$; $R^2=0.83$), where t denotes day after mating; - - -, estimated from Equation 2 $y=0.6074 + e^{0.0987t}$ ($P<0.001$; $R^2=0.83$), where t was defined as 0 for females that had not implanted. [B] □ retained protein energy (RPE), ∇ fat energy (RFE) and ◊ total retained energy (RE) in uterine and fetal tissues in mink at various stages of gestation. Data calculated according to Equation 2.

*J. Nutr. 124, pp. 2609S-2613S, 1994. 1 table, 1 fig., 16 refs. Authors' abstract.*

## Vitamin E enhances the lymphatic transport of ß-carotene and its conversion to vitamin A in the ferret

*Xiang-Dong Wang, Robert P. Marini, Xavier Hebuterne, James G. Fox, Norman I. Krinsky, Robert M. Russel*

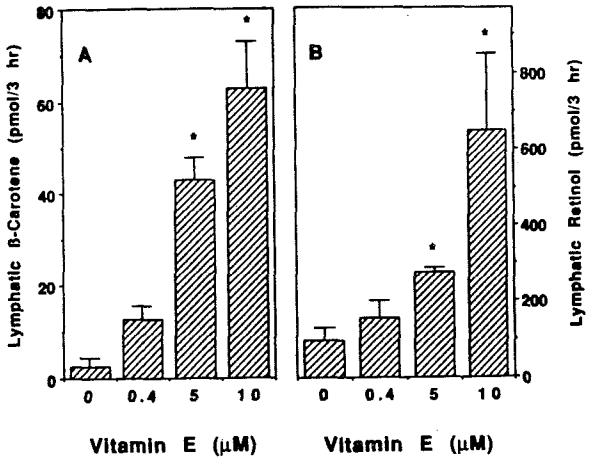



**Figure 3.** (*A*) The effect of varying the concentration of α-T on the transport of β-C into ferret mesenteric lymph during intestinal perfusion of 5 µmol/L β-C. (*B*) The effect of varying the concentration of α-T on the transport of retinol into ferret lymph during intestinal perfusion of 5 µmol/L β-C. Results are expressed in pmol/3 h and are mean ± SEM. *$P < 0.05$ compared with when no α-T was perfused.

ß-Carotene and α-tocopherol may have either antagonistic or synergistic effects on eachother's absorption and metabolism. The effects of both physiological and pharmacological concentrations of α-tocopherol on the absorption and metabolism of ß-carotene in ferret intestine were determined. *Methods*: A high concentration of ß-carotene was perfused through the upper portion of the small intestine of ferrets in vivo with varying levels of α-tocopherol. The effluent of a mesenteric lymph duct cannulation, the intestinal mucosa scraping, and portal vein blood were sampled and analyzed by high-performance liquid chromatography. *Results*: The lymphatic transport of ß-carotene was enhanced 4-fold by α-tocopherol at a physiological dose and 12-21-fold at a pharmacological dose. The lymphatic transport of α-tocopherol was linearly ($r=0.8$; $P<0.05$) related to the luminal α-tocopherol concentration even in the presence of a high concentration of ß-carotene. Furthermore, α-

tocopherol increased the conversion of ß-carotene into retinol in the intestine in a dose dependent manner. Conclusions: α-Tocopherol has a positive effect on the intestinal absorption of intact ß-carotene and may modulate the metabolic conversion of ß-carotene into retinoids.

*Gastroenterology 198, pp. 719-726, 1995. 3 tables, 3 figs., 31 refs. Authors' abstract.*

## The use of trace elements in dogs and fur animals

*Jens Arnbjerg*

Supplementation of a commercial product of trace elements was given to 173 dogs and 360 mink in the growing period. The radiological status of hip dysplasia (Hd) at the age of 1 year was the endpoint for the effect of the supplement in dogs. The evaluation was made blindly by the Evaluation Committee of the Danish Kennel Club. The findings were compared with the average findings made by the Danish Kennel Club for the specific breeds in the years 1992 and 1993.

The mink were divided into 3 groups - one being the control without any supplement. The supplement was given from about 12 weeks of age until the animals were slaughtered for pelting.

The growth rate, fur maturation, fur condition and the length of the animals were evaluated during the study and at the time of slaughtering. Significant differences in body length, fur maturation and fur condition were found between the groups given the supplement, and the control group.

It is concluded that the supplement indicated a possible effect for prevention of HD, but the statistical material was questionable in the dogs. In the mink, the length of the body and the maturation of the hair was significantly better in the groups being supplemented whereas the number of bites was significantly higher in the high dose group.

*Dansk Veterinærtidsskrift 78, 1, 1/1, pp. 12-15, 1995. In DANH, Su. ENGL. 2 tables, 13 refs. Author's summary.*

## Effects of technical PCB preparations and fractions thereof on vitamin A levels in the mink (*Mustela vison*)

*Helen Håkansson, Ellu Manzoor, Ulf G. Ahlborg*

A variety of biochemical and toxic effects are caused by polychlorinated biphenyls (PCBs) and toxicity varies considerably between animal species. No explanation is available for this variation and the precise mechanism of PCB action is unknown. Altered metabolism of vitamin A has been suggested to be involved in the toxicity of coplanar PCBs and related dioxin-like compounds. The results presented here are part of an extensive study aimed at assessing the effects of PCB congeners, differing in numbers of chlorines in the *ortho*-positions, on the reproduction in mink (*Mustela vison*). This paper reports the effects of two technical PCB preparations (Clophen A50 and Aroclor 1254), fractions thereof and a synthetic mixture of coplanar PCBs, on the hepatic, renal, and pulmonary vitamin A content in adult mink. The non- and 1-*ortho*-CBs in Clophen A50 reduced hepatic and pulmonary vitamin A concentrations in adult mink. Effects of the synthetic mixture on non-*ortho*-CBs were similar to those of the fraction from Clophen A50 containing non-*ortho*-CBs. Thus, the three coplanar congeners in the synthetic mixture, together with certain 1-*ortho*-CBs appeared to be largely responsible for the effects of Clophen A50 observed in this study. Data presented in this study also show that, similar to more commonly used experimental animals, the mink respond to PCB exposure with reduced tissue vitamin A content.

*AMBIO Vol. 21, No. 8, pp. 588-590, 1992. 3 tables, 28 refs. Authors' summary.*

## Field trial with vitamin injections for blue fox females

*Øystein Ahlstrøm*

For 71 blue fox females injected with 3 ml water-soluble vitamin B complex plus 2 ml fat-soluble vitamin A, D and E (ADEsan) in early Jan., the number of cubs born per mated female averaged 4.77 vs. 5.17 for 82 untreated controls. It was

concluded that whelping performance is not significantly affected by administration of vitamins in the early stages of the reproductive cycle.

*Norsk Pelsdyrblad 69, 11, pp. 23, 1995. In NORG. 1 table. CAB-abstract.*

### Use of large amounts of poultry offal for mink

*Tove N. Clausen*

In a 2-year study during winter and the lactation period, groups of 114 female wild mink were given diets containing 4 or 6 different levels of cooked poultry offal ranging from 8 or 11 to 38%. The offal had no effect on litter size or sterility rate. On the basis of kit weaning weight at 42 days and female weight loss during lactation, a maximum of 30% poultry offal was recommended. During the growing period of year 2, young mink, in groups of 152, received, until pelting, diets containing 10, 20, 40 or 60% cooked poultry offal. Use of up to 40% offal had no adverse effect on mink size or pelt quality. With a higher level pelt length remained about the same, but quality was poorer.

*Dansk Pelsdyravl 58, 8, pp. 314, 1995. In DANH. 2 tables. CAB-abstract.*

### Use of fatty fish products for mink in the growing period

*Tove N. Clausen*

From weaning to pelting 6 groups of 76 male and 76 female wild mink were fed diets containing 16% fish as sprats, herring scraps or salmon scraps supplemented with fish oil from the appropriate species so that fish fat supplied 30 (for salmon 36) or 60% of total fat. Feed intake was satisfactory throughout, faecal consistency normal and mortality low. Weight gain did not differ significantly according to fish species or fish fat level but for sprats and herring, growth was better with the lower level. Pelt length was not affected by fish fat type, but pelts were short with the 60% level, except for salmon. Pelt quality, which showed no effect of fat level, was highest with sprats/sprat oil and poorest with salmon/salmon oil. On the basis of this preliminary investigation, pending the outcome of a large-scale project, some provisional recommendations have been made.

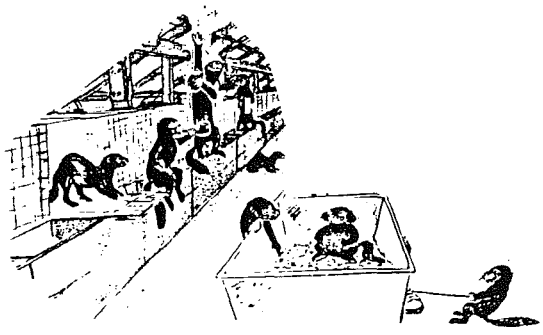
*Dansk Pelsdyravl 58, 9, pp. 357, 1995. In DANH. 2 tables. CAB-abstract.*

### Carcass offal from fattening chickens in mink rearing trial

*Eva Aldén*

For 5 months groups of standard mink, with 58 of each sex caged in pairs, were fed freely on diets containing 33-39 (control) or 45-50% mixed chicken offal. Other ingredients were fish offal and Baltic herring, also heat-treated cereal mixture, steamed oats, dried potato and vitamin mixture, plus potato protein for group 2. Pelting weight was similar for both groups, but variability was greater and average condition slightly poorer in the experimental mink. Female pelt length was the same for both groups, but experimental male pelts, at 74.8 cm, were 1 cm longer than the control. Severe bite damage was commoner in the experimental group. Pelts from that group, silkier and with thinner leather were judged to be of superior quality and texture, which would be partly due to increased intakes of linoleic acid. Apparent digestibility of proteins and fat from poultry offal reached 80 and 91%.

*Vara Pälsdjur 66, 6, pp. 131-135, 1995. In SWED. 4 tables. CAB-abstract.*



*Original Report*

# Observations on lesions in lung and in lymph nodes of experimentally Aleutian mink disease parvovirus-infected pregnant adult mink.

*Susanne Broll[1], Søren Alexandersen[1,2]*

*[1] Laboratory of Molecular Pathobiology, Department of Pharmacology and Pathobiology, The Royal Veterinary and Agricultural University of Copenhagen, DK-1870 Frederiksberg C, Denmark*

*[2] Danish Veterinary Institute for Virus Research, Lindholm, DK-4771 Kalvehave, Denmark*

Running title: **Pathogenesis of ADV-infection in adult mink**

## Abstract

During an experimental study for the investigation of transplacental transmission of Aleutian mink disease parvovirus (ADV), one-year old female black mink were infected with the virus strain ADV- United. Lung, spleen, lymph nodes at different locations, liver and kidney of the adult females were examined for histopathological changes and targets for virus infection and replication by in situ hybridization with strand-specific RNA probes. Without showing clinical signs, acutely infected adult mink developed focal lung lesions associated with perivascular lympho-plasmacellular infiltrations and hypertrophy of alveolar type II cells. Inclusion bodies were present at post-inoculation day (PID) 12 and virus replication in the interalveolar septae of the lung was detected at PID 12 and 15. In chronicly infected adult mink nodular accumulation of partly foamy, sometimes multinucleated macrophage-like cells in the alveoli were found representing the features of lipid pneumonia. Lymph nodes developed marked germinal centers at PID 9 to 28, where a high rate of virus replication was found. In pregnant animals infected for two to three months, a depletion of lymphocytes and the presence of macrophage-like cells in the germinal centers were found. The animals did not show a marked plasmacytosis by that time. The findings are compared with earlier studies.

## Introduction

Aleutian mink disease parvovirus (ADV) in adult mink caused a persistent infection usually followed by a chronic, progressive disease associated with a disorder of the immune system (*Alexandersen, S. et al., 1988; Hadlow, W.J. et al., 1983; Porter, D.D. et al. 1969; Porter, D.D. et al., 1973; Porter, D.D. et al., 1980; Trautwein, G., 1970*). In adult mink histopathological changes include the development of a plasmacytosis, immune complex arteritis and glomerulonephritis (*Trautwein, G., 1970; Porter, D.D. et al., 1980*) in the chronic stage of the disease. Virus replication at high levels was demonstrated in lymph nodes in germinal centers of the

lymph node follicles during acute infection being most pronounced 10 days after infection, but had decreased markedly 20 days after infection and at 60 days after infection virus replication was not detectable any more by using in situ hybridization (*Alexandersen, S. et al., 1988*). An acute interstitial pneumonia with a high level of virus replication in alveolar type II cells has been described in mink kits (*Alexandersen, S., 1986; Alexandersen, S. et al., 1987; Viuff, B. et al., 1994*), but not in adult mink. Recently macrophages have been considered as in vivo and in vitro targets of restricted viral replication (*Kanno, H. et al., 1992; Kanno, H. et al., 1993*).

The present paper describes the histopathological changes and the results of the in situ hybridization of organs in female adult mink, that had been infected before or during pregnancy in order to study the transplacental transmission of the virus (*Broll, S. and Alexandersen, 1995, submitted for publication*).

## Material and Methods

**Virus.** For experimental infections the virus strain ADV-United obtained from United Animal Division (Middleton, Wis.) was used. The preparation of the inoculum has been described previously (*Alexandersen, S. et al., 1994*). The inoculum contained $10^7$ adult mink 50% infective doses per ml.

**Negative inoculum.** As a negative control a 10% tissue suspension, prepared from lungs, spleens and livers from newborn ADV-negative mink kits was used (*Alexandersen, S., 1986*).

**Animals.** Twenty-seven one year old female black mink (non-Aleutian genotype A/A) obtained from an AD-negative farm were used in this study. The mink were housed in commercial mink cages and fed a standard mink diet. The mink were divided in three groups consisting of nine animals in each group. One group was infected intraperitoneally before mating on February 15, 1994 with 0.1 ml of virus inoculum and the female mink were killed between PID 66 and PID 83 (persistently infected dams).

One group was infected with 0.1 ml virus inoculum after mating in March on April 13, 1994 and the animals were killed at PID 9, 12, 14, 15, 19 and 28 after infection (acutely infected dams). One group served as a control group and was inoculated with 0.1 ml of the negative inoculum and was kept in a separate, closed shed on the same farm. Animals of the control group were killed at PID 8, 13, 15 and 16.

**Fixation of tissues.** The females were exsanguinated under pentobarbital anaesthesia. Samples of lung, liver, kidney, spleen, mesenteric lymph node, ovary, lymphocentrum ileosacrale, mammary gland (if present) and mammary lymph node of the adult females were fixed about 3 to 5 hours at 4° C and then 6 hours at room temperature in a freshly mixed fixative containing periodatelysine-paraformaldehyde-glutaraldehyde (PLPG). The preparation of the fixative has been described previously (*Alexandersen, S. et al., 1987).*

**Light microscopy and in situ hybridization**. The PLPG fixed tissue samples were routinely processed for light microscopy and in situ hybridization. Histopathological examinations were done on sections stained with hematoxylin and eosin (HE). Four females at PID 69, 70, 71, and 72 and five females at PID 9, 12, 14, 15, and 28 were selected for the in situ hybridization using plus- and minus-sense $^{35}$S-labeled RNA probes specific for the detection of virion DNA (plus-sense probe) or RF DNA (plus- and minus-sense probe) and mRNA (minus-sense probe) of ADV. As an additional negative control, selected tissues of infected animals were hybridized with a plus-sense $^{35}$S-labeled RNA probe for the detection of the canine parvovirus or mink enteritis virus genome (*Uttenthal, Å. et al., 1990*). Two animals of the control group (PID 13 and 16) were examined histopathologically and with in situ hybridization. The in situ hybridization technique was carried out as previously described (*Alexandersen, S. et al., 1987*) with a slight modification, which was the refixation of the slides after proteinase K digestion in 5% neutral buffered paraformaldehyde for 30 min. instead of 2 hours.

**Preparation of probes**. The in situ hybridization was performed by using strand-specific RNA-probes radiolabeled with [alpha-$^{35}$S]UTP (Amersham, Birkerod, Denmark) using a commercial available kit (Promega, Bie & Berntsen, Rodovre,

Denmark). The preparation of the probes has been described previously (*Bloom, M.E. et al., 1987; Alexandersen, S. et al., 1987; Uttenthal, Å. et al., 1990*).

## Results

**Gross pathology**. All acutely infected females were or had been pregnant and were in a good general condition. The spleen was enlarged to various degrees and sometimes showed multifocal subcapsular hemorrhages, which is seen after barbiturate anesthesia. A slight enlargement of lymph nodes - especially the mesenteric lymph node - was found in animals at PID 9, 12, 14, 19. One animal at PID 15 had focal yellowish coloured areas on the lung surface.

Two females of the persistently infected which were killed 69 days after infection were not pregnant and were in a poor general condition having a bad nutritional state. Most animals in this group appeared to be thinner with less subcutaneous fat than acutely infected or control animals, except for one at PID 70 which was in a good condition. Like in acutely infected and control animals all persistently infected mink had an enlarged spleen due to congestion. Macroscopical changes consisted of multifocal yellowish areas mainly on the lung, surface in all persistently infected mink and small red spots in the cranial lobes of two mink. Consolidated small areas to larger nodules were found in the lung of two mink, the corresponding lung lymph nodes were severely enlarged.

Lymph nodes appeared slightly enlarged in all mink of this group but interpretation often was difficult, kidneys sometimes appeared pale, with fine depressed or sometimes hemorrhagic foci on their surface, but were of normal size. Other organs did not show any significant macroscopical changes.

All control mink were pregnant. The most prominent finding was the enlargement of the spleen following barbiturate anesthesia. Three animals had few yellowish areas on the lung surface. One animal died at PID 13 and necropsy revealed a yellowish-brown discoloured liver, stomach ulcera and diarrhea which is presumably due to stress.

**Histopathology and in situ hybridization.** Histopathology and in situ hybridization were performed on selected females as described in material and methods.

Lung: Changes in the lung were observed as early as PID 12, when a slight perivascular lymphoplasmacellular infiltration and occasionally eosinophilic to amphophilic intranuclear inclusion bodies in cells of the interalveolar septae were present, which also showed hypertrophy and proliferation of cells resembling alveolar type II cells. These cells were partly detaching into the alveoli. The alterations were multifocally distributed over the lung, parenchyma. Furthermore, focal, mainly subpleural accumulations of partly foamy and sometimes multinucleated macrophage-like cells were detected. At PID 15 accumulations of those large foamy cells were most prominent (Fig. 1), but a few areas also showed a hypertrophy of alveolar type II cells, whereas inclusion bodies could not be detected. The female at PID 28 showed accumulations of foamy macrophage-like cells besides perivascular mononuclear infiltrations.

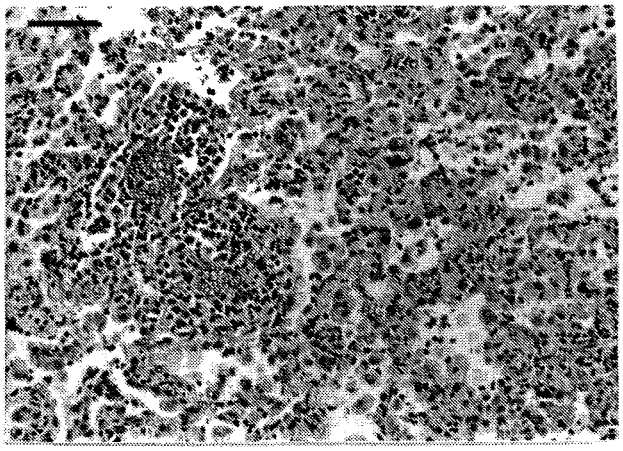


**Fig. 1.** Lung of an acutely ADV infected adult mink at PID 15. Perivascular mononuclear infiltrations, hyperplasia of alveolar type II cells, multinucleated and partly foamy macrophage-like cells in the alveoli are present. HE-staining. Bar=60µm.

Animals at PID 9 and 14 did not have marked changes in the lung. The in situ hybridization revealed that macrophage-like cells in the alveoli were strongly positive with the plus-sense probe

(Fig. 2), but only very weakly positive with the minus-sense probe (Fig. 3), where the signal was mainly over the cytoplasm of the cells. The lung was negative for minus-sense probe at PID 28. Cells of the interalveolar septae in alterated areas at PID 12 and 15 were positive at high levels for the plus- and minus-sense probe, also over the nucleus of the cell (Fig. 2 and 3). The number of cells positive for minus-sense probe was higher at PID 12 than at PID 15. Cells positive for plus- and minus-sense probe were also found in the bronchus-associated lymphoid tissue at PID 9 to PID 15.

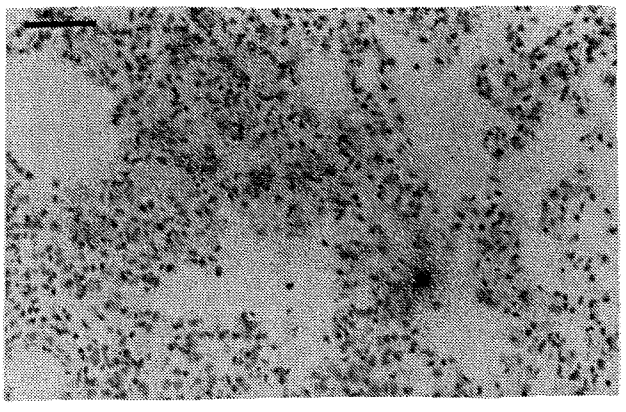


**Fig. 2.** Same lung as shown in Fig. 1 after in situ hybridization with $^{35}$S-radiolabeled plus-sense RNA probe indicating the presence of virion DNA in cells within the alveoli or in interalveolar septae. Single cells show a very strong signal, especially over the nucleus. Counterstained with hematoxylin. Bar=60µm.

Lung lesions in animals infected for about 2½ months consisted of slight to moderate perivascular mononuclear infiltrations and focal accumulations of foamy, partly multinucleated macrophage-like cells in the alveoli especially subpleural, which were most severe in one female that also had marked macroscopical changes. In two animals a hypertrophy of the alveolar epithelium with cuboidal shaped epithelial cells was present in some parts of the lung. A hyperplasia of the bronchus-associated lymphoid tissue was also conspicuous. In lungs with marked changes a high signal for the plus-sense probe but not for the minus-sense probe was present in macrophage-like cells within the alveoli.

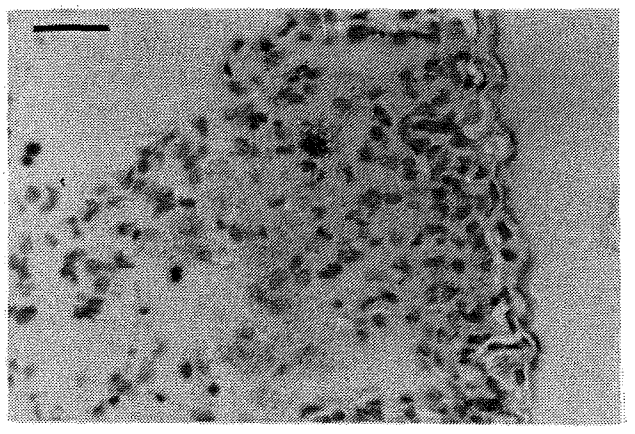


**Fig. 3.** Same lung as shown in Fig. 1 after in situ hybridization with $^{35}$S-radiolabeled minus-sense RNA probe showing the presence of viral replicative forms. Few cells have a strong signal over the nucleus indicating productive replication, whereas in other cells the signal is much weaker and mainly confined to the cytoplasm. Bar=30µm.

Liver: Only one female of the acutely infected group at PID 14 showed alterations in the liver consisting of randomly distributed necrotic foci with infiltration of inflammatory cells. These foci were strongly positive for in situ hybridization with the plus-sense probe and sometimes weakly positive for in situ hybridization with the plus-sense probe and sometimes weakly positive with the minus-sense probe. In the other animals cells positive for the plus-sense probe were located randomly distributed in the liver lobules representing Kupffer cells and were detectable up to PID 15. With the minus-sense probe single positive cells were only detectable at PID 9 and 12.

In persistently infected females changes in the liver were confined to slight perivascular mononuclear infiltrations with plasma cells in the portal areas. The in situ hybridization was negative with both plus- and minus-sense probe, except for one animal, where a weak signal with the plus-sense in single cells of the liver was detected.

Kidney: There were no histopathological changes in the kidney of acutely infected females, which was also negative in the in situ hybridization. All persistently infected females had a very mild inter-

stitial nephritis with a slight infiltration of lymphocytes and plasma cells. The in situ hybridization was negative in all cases.

Lymph nodes and spleen: In the acutely infected group the development of germinal centers in the lymph node follicles which were most obvious at PID 28 was the most prominent finding in the lymph nodes. At PID 28 a thin follicle cortex compared with the germinal center was conspicuous. In the in situ hybridization germinal centers, often the marginal zone of the germinal center and sinus of the medulla were very strongly positive with the plus-sense probe and also in a less intensity with the minus-sense probe. Lymph nodes of the female at PID 14 also showed accumulations of cytoplasm rich, macrophage-like cells with a round to avoid, loose-structured nucleus mainly in the cortex of the lymph node follicles (Fig. 4), which were strongly positive for the plus-sense probe and in much less intensity also with the minus-sense probe. Lymph nodes of two animals at PID 14 and 15 were additionally hybridized with a plus-sense RNA probe for the detection of mink enteritis virus genome and were negative. Lymph follicles of the spleen had the same features as the lymph nodes. Cells positive in the in situ hybridization were mainly confined to the lymph node follicle of the white pulp.

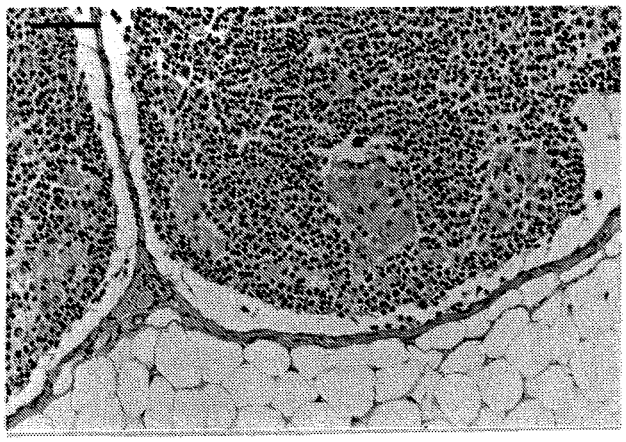


**Fig. 4.** Mesenteric lymph nodes of an acutely infected adult mink at PID 14 showing clusters of macrophages in the cortex of lymph node follicles. HE-staining. Bar=60μm.

In the persistently infected group changes in the lymph nodes consisted of a depletion of lymphocytes in their germinal center and the presence of nuclear debris and large cytoplasma-rich, macrophage-like cells to various degrees (Fig. 5). Sometimes the cortex of the follicles appeared rather thin. Only in one animal did the number of plasma cells seem to be enlarged and a depletion of lymphocytes was not present. Hybridization with the plus-sense probe revealed a positive signal over their germinal center and sometimes over the sinus of the medulla, where mainly the cytoplasm of large macrophage-like cells was positive. The signal was much lower than in acutely infected females. In three out of four animals single macrophage-like cells in the germinal center were also positive with the minus-sense probe, but the signal was slightly weaker. One lymph node showing a marked depletion of lymphocytes was hybridized with a plus-sense RNA probe, which detects genomic DNA of mink enteritis virus and was negative. Lymph follicles of the spleen appeared similar to those of the lymph nodes. One animal had an increased number of plasma cells in the spleen, some of them with Russel bodies in their cytoplasm.

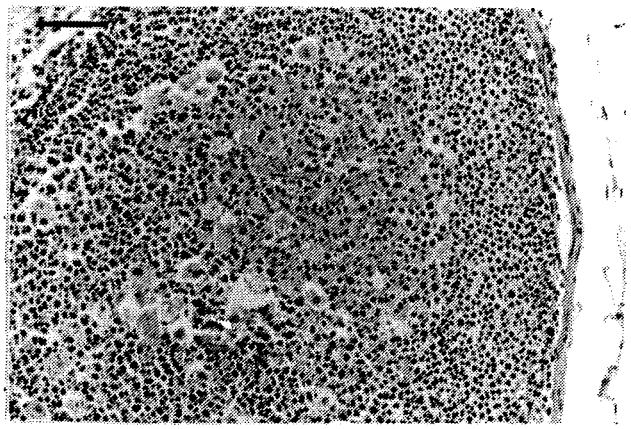


**Fig. 5.** Mesenteric lymph node of a persistently ADV-infected pregnant adult mink at PID 71 showing a depletion of lymphocytes in the germinal center and the presence of macrophage-like cells partly phagocytizing nuclear debris. HE-staining. Bar=60μm.

Control group: Two animals at PID 13 and 16 were examined histopathologically and with in situ hybridization. Lung: Few macrophage-like cells were detected subpleurally in the alveoli. Other areas of the lung were not affected and both lungs were negative with the in situ hybridization. Lymph nodes: Lymph nodes in both animals developed marked germinal centers probably as a response to the negative inoculum, which contained a 10% tissue suspension and serves as an antigen. The medullae of the lymph nodes contained numerous plasma cells. There were no changes in other organs and all tissues examined with the in situ hybridization were negative.

## Discussion

In the present paper we have shown that ADV can replicate under certain circumstances also in the lung of adult mink, producing inclusion bodies, hypertrophy and proliferation of alveolar type II cells in early stages of infection, which is similar to the early lesions observed in infected mink kits (*Alexandersen, S., 1986; Alexandersen et al., 1987a; Alexandersen et al., 1994a; Viuff, B. et al., 1994*). The lung lesions did not spread out over the whole lung but were focally distributed. In contrast to acutely infected mink kits hyaline membranes followed by a respiratory distress syndrome did not develop in adult mink, where the infection remained subclinical. Whereas in mink kits the number of cells with inclusion bodies increased up to 14 days after infection (*Alexandersen et al., 1987a*), when the kits died, only a low number of inclusion bodies were detectable in the adults 12 days after infection and virus replicating cells located in the interalveolar septae could be detected up to 15 days after infection. Two to three months after infection the lung lesions resembled the features of a lipid pneumonia with accumulation of large foamy macrophage-like cells in the alveoli, which often is associated with AD in chronicly infected adult mink (*Alexandersen et al., 1994a; Trautwein, G. 1970*) and mink kits which survived the acute disease (*Alexandersen et al., 1994a*). The findings suggest that ADV infection of adult mink with a strain of high virulence can support the development of a lipid pneumonia after a short acute phase with replication of virus in the lung which decreases rapidly after antibody response.

Since replication of ADV in the lung of adult mink was not observed in earlier experimental studies with the same virus preparation (*Alexandersen et al., 1988*) or with a different virus strain (*Haas, L. et al., 1990*), ADV might cause lung lesions in the adult in association with other factors like pregnancy, stress situations like moving to a different farm, climate, hormonal changes before and during breeding time, which might lead to a suppression of the immune response. Two non-pregnant animals, one of which was killed 10 days after infection and the other two months after infection had similar lung lesions to the pregnant females (data not shown) showing that lung lesions occur not only in pregnant adult animals. Single cases of acute lung lesions in adult mink associated with AD have also been observed under field conditions (*Alexandersen, S., personal observation*).

A depletion of lymphocytes in the lymph nodes has been reported in the late stages of AD after 5 to 12 months of infection (*Trautwein, G., 1970*) when already a moderate to severe plasmacytosis and glomerulonephritis was present and in Aleutian mink, which died about 50 and 80 days after infection (*Hass, L. et al., 1990*) and were in a poor general condition showing bleeding in the alimentary tract, plasmacytosis and glomerulonephritis. In pregnant non-Aleutian mink, but not in the non-pregnant animal killed two months after infection, a depletion of lymphocytes in the germinal centers of the lymph node follicles was observed about 2½ months after infection without the occurrence of a marked plasmacytosis and glomerulonephritis. There is no evidence for other infections like mink enteritis virus, which could cause similar changes due to a lysis of lymphocytes. It is well known that pregnancy influences the immune system and leads to the suppression of cell-mediated immunity (reviewed by Weinberg, E.D., 1984), resulting in an enhanced susceptibility and a more severe course of viral and also other infections. Furthermore, morphological changes in peripheral lymphatic tissues consisting of an increased number of plasma cells in spleen, mesenteric and iliac lymph nodes were observed in mice during normal pregnancy (*Sasaki, K. and T. Ito, 1980*). Interestingly, a depletion of lymphocytes in lymph nodes was reported in cytomegalovirus infected pregnant guinea pigs, whereas the infected non-pregnant

group had a prominent lymphoproliferation in the lymph nodes at that time (*Griffith, B.P. et al., 1983*). These observations indicate altered reactive patterns of lymphatic organs during pregnancy. Therefore, pregnant mink might react differently to ADV-infection than non-pregnant animals leading to morphological changes, which are normally observed in AD, although the role of the cell mediated immunity in ADV-infection has not yet been clarified. A replication of virus in placentae and fetuses at very high levels in all gestational stages occurred (*Broll, S. and S. Alexandersen, 1995,* submitted for publication). Placentae and fetuses could therefore play a role as virus reservoirs resulting in high virus levels also in the adult causing an altered pattern in response to the infection. An appropriate non-pregnant control group was not available which only allows a very speculative interpretation of the results. However, in our extensive experience with ADV studies in non-pregnant mink we have not observed similar findings (*Alexandersen, S. and M. Bloom, 1987a; Alexandersen, S. et al., 1988; Alexandersen, S., 1990, Alexandersen, S. et al., 1994a*).

In this study it was observed that ADV-replication in the lung followed by typical early alterations can occur also in acutely infected adult mink, but does not lead to a severe pneumonia as observed in mink kits. A depletion of lymphocytes in the germinal center of lymph node follicles without the presence of a marked plasmacytosis and glomerulonephritis after about 2½ months of infection was observed in pregnant females. Because an appropriate non-pregnant control group is not available, these results can only be discussed as an interesting observation, which might be in conjunction with pregnancy, but further studies would be necessary to investigate the influence of pregnancy on the progression of AD.

## References


Alexandersen, S. 1986. Acute interstitial pneumonia in mink kits. Experimental reproduction of the disease. Vet. Pathol. 23: 579-588.

Alexandersen, S., M.E. Bloom, J. Wolfinbarger & R.E. Race. 1987. In situ molecular hybridization for detection of Aleutian mink disease parvovirus DNA by using strand-specific probes: identification of target cells for viral replication in cell cultures and in mink kits with virus-induced interstitial pneumonia. J.Virol. 61: 2407-2419.

Alexandersen, S. & M.E. Bloom. 1987a. Studies on sequential development of acute interstitial pneumonia caused by Aleutian disease virus in mink kits. J. Virol. 61: 81-86.

Alexandersen, S., M.E. Bloom & J. Wolfinbarger. 1988. Evidence of restricted viral replication in adult mink infected with Aleutian disease of mink parvovirus. J. Virol. 62: 1495-1507.

Alexandersen, S. 1990. Pathogenesis of disease caused by Aleutian mink disease parvovirus. Acta Pathol. Microbiol. Immunol. Scand. 98 (suppl. 14), 1-32.

Alexandersen, S., T. Storgaard, N. Kamstrup, B. Aasted & D.D. Porter 1994. Pathogenesis of Aleutian mink disease parvovirus infection: Effects of suppression of antibody response on viral mRNA levels and on development of acute disease. J. Virol. 68: 738-749.

Alexandersen, S., S. Larsen, B. Aasted, Å. Uttenthal, M.E. Bloom & M. Hansen. 1994a. Acute interstitial pneumonia in mink kits inoculated with defined isolates of Aleutian mink disease parvovirus. Vet. Pathol. 31: 216-228.

Bloom, M., R.E. Race & J.B. Wolfinbarger. 1987. Analysis of Aleutian disease of mink parvovirus infection using strand-specific hybridization probes. Intervirology 27: 102-111.

Griffith, B.P., H.L. Lucia, J.L. Tillbrook & G.D. Hsiung. 1983. Enhancement of cytomegalovirus infection during pregnancy in guinea pigs. J. Infect. Dis. 147: 990-998.

Haas, L., P. Wohlsein, G. Trautwein, B. Stolze & O.-R. Kaaden. 1990. Violet mink develop an acute disease after experimental infection with Aleutian disease virus (ADV) isolate ADV SL3. J. Vet. Med. Ser. B 37: 106-117.

Hadlow, W.J., R.E. Race & R.C. Kennedy. 1983. Comparative pathogenicity of four strains of Aleutian disease virus for pastel and sapphire mink. Infect. Immun. 41: 1016-1023.

Porter, D.D., A.E. Larsen & H.G. Porter. 1969. The pathogenesis of Aleutian disease of mink. I. In vivo viral replication and the host antibody response to viral antigen. J. Exp. Med. 130: 575-589.

Porter, D.D., A.E. Larsen & H.G. Porter. 1983. The pathogenesis of Aleutian disease of mink. III. Immune complex arteritis. Am. J. Pathol. 71: 331-344.

Porter, D.D., A.E. Larsen & H.G. Porter. 1980. Aleutian disease of mink. Adv. Immunol. 29: 261-286.

Sasaki, K. & T. Ito. 1980. Effects of pregnancy and lactation on the peripheral lymphatic tissue in the mouse: Qualitative and quantitative morphology. Arch. histol. jap. 43: 423-436.

Trautwein, G. 1970. Untersuchungen über die Pathogenese der Aleutenkrankheit der Nerze. III. Pathomorphologie der Organveränderungen. Zentralbl. Veterinaermed. Reihe B 17: 262-285.

Uttenthal, Å., S. Larsen, E. Lund, M. Bloom, T. Storgaard & S. Alexandersen. 1990. Analysis of experimental mink enteritis virus infection in mink: In situ hybridization, serology, and histopathology. J. Virol. 64: 2768-2779.

Viuff, B., B. Aasted & S. Alexandersen. 1994. Role of alveolar type II cells and of surfactant-associated protein C mRNA levels in the pathogenesis of respiratory distress in mink kits infected with Aleutian mink disease parvovirus. J. Virol. 68: 2720-2725.

Weinberg, E.D. 1984. Pregnancy associated depression of cell-mediated immunity. Rev. Infect. Dis. 6: 814-831.

## Purification and characterization of the major nonstructural protein (NS-1) of Aleutian mink disease parvovirus

*Jesper Christensen, Michael Pedersen, Bent Aasted, Søren Alexandersen*

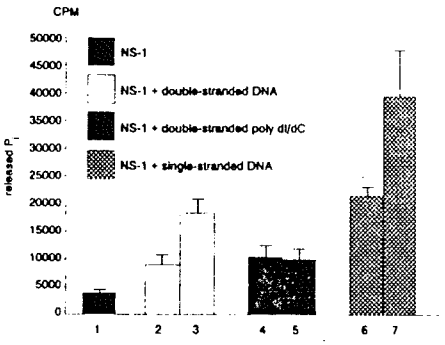



FIG. 4. ATPase activity of NS-1 is stimulated by DNA. A total of 200 ng of NS-1 was incubated under ATPase assay conditions, as described in Materials and Methods, in the presence of the indicated amount of dsDNA or ssDNA. Bars: 1, NS-1 alone; 2, and 3, 50 and 250 ng of dsDNA (pCat-Basic vector, Promega); 4 and 5, 50 and 250 ng of dspoly(dI)-poly(dC) (Pharmacia); 6 and 7, 50 and 250 ng of M13 ssDNA. The specific activity of the ATP was 0.67 mCi/mmol. The assays were performed in triplicate and corrected for the background by subtracting released counts without the presence of NS-1. The values are the means of triplicate determinations represented with 1 standard deviation.

We have previously described the expression of the major nonstructural protein (NS-1) of Aleutian mink disease parvovirus (ADV) in insect cells by using a baculovirus vector. To study its biochemical properties, ADV NS-1 was expressed in Sf9 insect cells and purified to apparent homogeneity with a combination of nuclear extraction, $Zn^{2+}$ ion chromatography, and immunoaffinity chromatography on monoclonal antibodies.

The purified protein showed ATP binding and ATPase- and ATP- or dATP-dependent helicase activity requiring either $Mg^{2+}$ or $Mn^{2+}$ as a cofactor. The ATPase activity of NS-1 was efficiently stimulated by single-stranded DNA and, to a lesser extent, double-stranded DNA. We also describe the expression, purification, and characterization of a mutant NS-1 protein, in which a lysine in the putative nucleotide binding consensus sequence of the molecule was replaced with serine. The mutated NS-1 was expressed at 10-fold higher levels than wild-type NS-1, but it exhibited no ATP binding, ATPase, or helicase activity.

The availability of large amounts of purified functional NS-1 protein will facilitate studies of the biochemistry of ADV replication and gene regulation leading to disease in mink.

*Journal of Virology, vol. 69, No. 3, pp. 1802-1809, 1995. 8 figs., 53 refs. Authors' summary.*

## Fatty liver in chinchilla (*Chinchilla velligera*) males

*B. Egri, J. Egri, B. Hajnovics*

From February 1991 to February 1992 50 chinchilla males were examined, after pelting, for the presence of fatty liver. Macroscopical and light microscopical changes in the liver were observed in 47 animals. In 24 cases the histological changes were physiological (steatosis). In the remaining 23 cases histopathological changes were found. Only two of the pelts of the 17 animals which had serious histopathological findings were fully mature. The other pelts were either immature or were over mature. Further investigations of this condition are recommended.

*Tierärztl. Umschau 49, pp. 42-47, 1994. In GERM, Su. ENGL. 1 table, 5 figs., 7 refs. Authors' summary.*

## Observations on the composition of microflora in the respiratory and reproductive organs of fur animals using a newer sampling device

*B. Egri, Á. Szeness, A. Gordos*

Microflora of respiratory and reproductive organs were studied by means of Transwab® (Medical Wire) transport medium (modified *Amies* medium) and sampling device in certain fur animal species: in 5 raccoon dogs, 5 silver foxes, 6 chinchillas and 2 German shepherd dogs.

Of the 39 sampling tubes with medium 53 bacterium colonies grew. Of them, 10 bacterium species were identified. Of the samples taken from the nasal mucosa, *Escherichia coli* were isolated in almost half of the cases (49.39%), as well as *Proteus mirabilis, P. vulgaris, Streptococcus faecalis* and *Klebsiella oxytoca.* Of the samples taken from

the vaginal mucosa, *Pseudomonas aeruginosa, S. faecalis* and *P. vulgaris* (17.65 to 16.67%) were isolated, as well as *E. coli* and *P. mirabilis*. In almost one third (30.47%) of the samples taken from the surface of prepuce, *E. coli*, as well as *S. faecalis, K. oxytoca, P. mirabilis, Staphylococcus epidermidis, Micrococcus, S. aureus, P. aeruginosa* and *Citrobacter freundii* were identified. Further investigations are required partly to repeat the earlier investigations, partly to determine the microflora of the respiratory and reproductive organs of another fur animal species.

*Magyar Aliatorvosok Lapja 48, 5, pp. 289-292, 1993. In HUNG, Su. ENGL, GERM, RUSS. 2 tales, 19 refs. Authors' summary.*

**Immobilization of captive pine martens (*Martes martes*) with medetomidine-ketamine and reversal with atipamezole**

*Jon M. Arnemo, Randi O. Moe, Nils E. Søli*

Six captive pine martens (*Martes martes*) were immobilized with a combination of medetomidine hydrochloride (MED) and ketamine (KET) in three experiments (Experiment 1, July 1991; Experiment, 2, November 1991; Experiment 3, january 1992) to establish a dose range for field use and to assess potential seasonal influence on drug effects. The mean ± SD i.m. doses (range) used in these three experiments were 0.19 ± 0.03 (0.14-0.24 mg/kg MED + 9.3 ± 1.5 (7.1-11.8) mg/kg KET, 0.17 ± 0.04 (0.14-0.24) mg/kg MED + 8.6 ± 1.8 /7.1-11.8) mg/kg KET, and 0.15 ± 0.01 (0.13-0.17) mg/kg MED + 7.6 ±0.8 (6.5-8.9) mg/kg KET, respectively. These doses induced complete immobilization with good muscle relaxation and loss of both the corneal and pedal withdrawal reflexes in all animals. The induction times were 4.3 ± 1.6 (2.0-6.0) min, 2.8 ± 0.8 (3.0-5.0) min, and 4.5 ± 1.9 (3.0-8.0) min, respectively. Side effects included hypothermia, bradycardia, and bradypnea, but all animals recovered completely without clinical complications. Blood samples were drawn from immobilized animals and sera were analyzed for 24 different measurements (enzymes, metabolites, minerals, and electrolytes). Hyperglycaemia occurred in all animals, but there were no clinically important differences in serum chemistry values among the experiments. Forty minutes after administration of MED-KET, the animals in Experiments 1 and 2 were given atipamezole hydrochloride (ATI) i.m. at five times the MED dose. In Experiment 3, the animals received saline i.m. for comparison. Immobilization was rapidly reversed by ATI, and side effects such as muscle rigidity and incoordination were of short duration. The mean time from ATI injections to mobility in Experiments 1 and 2 was 7.7 ± 2.3 (4.8-10.0) min. and 3.8 ± 1.6 (2.0-5.8) min., respectively. The mean mobility time was 31.7 ± 21.8 (11.0-59.0) min. in the saline-treated animals, and recovery was accompanied by prolonged sedation, incoordination, and motor impairment. MED in combination with KET and reversed with ATI at a dose ratio of 5:1 relative to MED was a safe and effective immobilization protocol for captive pine martens.

*Journal of Zoo and Wildlife Medicine 25 (4), pp. 548-554, 1994. 3 tables, 23 refs. Authors' summary.*

**Cataracts in a laboratory colony of ferrets**

*Paul E. Miller, Annajane B. Marlar, Richard R. Dubielzig*

Cataracts were found by use of slit-lamp biomicroscopy in two genetically unrelated ferret populations (A and B). When they were initially examined at the age of 11 to 12 months, 34 of 73 ferrets (46.6%) in population A had lens opacities, which could be categorized into one of three groups. Group-1 ferrets (n=25) manifested a continuum of lens changes ranging from fine, multifocal, punctate opacificatin of the superficial posterior lens cortex (n=3), to changes in both the anterior and posterior cortex (n=13), to immature (n=1), or mature/hypermature cataracts (n=8). Group-2 ferrets (n=7) had bilateral microphthalmia and cataracts. Group-3 ferrets (n=2) had minor lens changes involving the nucleus or cortex that were not typical of either group 1 or 2. By the age of 18 months, 41 of the remaining 42 animals in population A had developed fine, multifocal, punctate opacities of the posterior cortex. In group-1 animals, histologic changes in the lens ranged from several 80 x 40-µm, punctate, spheroidal lesions in

the posterior cortex, to posterior migration of the lens epithelium, Morganian granules, and a complete mature/hypermature cataract. One group-2 ferret had microphthalmia, filling of the lens capsule with a cell-poor, periodic acid-Schiff stain-positive membranous material, and retinal detachment. Population B consisted of 15 adult and 47 6-month-old juvenile ferrets. Eleven adults had multifocal, fine, punctate, posterior cortical opacities, and one adult had a nuclear cataract. Ten juveniles had nuclear cataracts (often in a multifocal punctate pattern); two had fine, multifocal, punctate, posterior cortical opacities; one had multifocal nuclear and posterior cortical opacities; and three had multifocal nuclear opacities that also involved both the anterior and posterior cortices. The ferret may be a potentially useful new animal model for studying mechanisms of cataractogenesis and microphthalmia. Caution should be used when interpreting for ocular toxicity of test compounds in this species.

*Laboratory Animal Science, Vol. 43, No. 6, pp. 562-568. 3 tables, 5 figs., 26 refs. Authors' abstract.*

## Full protection in mink against mink enteritis virus with new generation canine parvovirus vaccines based on synthetic peptide or recombinant protein

*Jan P.M. Langeveld, Søren Kamstrup, Aase Uttenthal, Bertel Strandbygaard, Carmen Vela, Kristian Dalsgaard, Nico J.C.M. Beekman, Rob H. Meloen, J. Ignacio Casal*

Two recently developed vaccines - one based on synthetic peptide and one based on recombinant capsid protein - fully protected dogs against heavy experimental canine parvovirus (CPV) infection. The high sequence homology (>98%) and antigenic similarity between CPV and mink enteritis virus (MEV), feline panleukopenia virus, and raccoon parvovirus, suggest that both vaccines could protect mink, cats and raccoons against these respective host range variants. This was tested in mink and turned out to be the case. The two vaccines were fully protective and as effective as a conventional commercial vaccine based on inactivated virus. Surprisingly, this protection was obtained after only a single injection. Furthermore, the vaccinal dose of 150 µg of conjugated peptide or 3 µg of recombinant VP2 particles per animal, are sufficiently low to be cost-effective and applicable on a large scale.

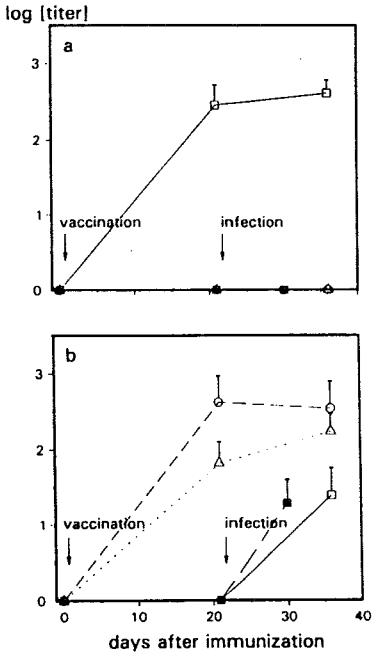



**Figure 2** Antibody titers in mink sera before and after vaccination. Panels: (a) antipeptide antibody titers in indirect ELISA; (b) anti-MEV antibody titers in blocking ELISA. Symbols indicate values in the four different groups (Table 1): □ peptide group, ○ recVP2/CPV group, △ inactivated MEV group, ■ sham vaccinated control group; each point represents mean of log titer values ± $S.D._{n-1}$ from a group of 3–6 animals in (a), and 6 animals in (b). Animals in the control group were euthanized eight days after infection

*Vaccine, Vol. 13, No. 11, pp. 1033-1037, 1995. 2 figs., 36 refs. Authors' summary.*

## Distemper in wild carnivores: An epidemiological, histological and immunocytochemical study

*P. van Moll, S. Alldinger, W. Baumgärtner, M. Adami*

Brain tissue from 236 carnivores, 146 mustelids and 90 foxes, originating from the same geographical area in southwest Germany was collected over a 2 year period between may 1989 and May 1991 and studied for the presence of canine distemper virus (CDV) antigen by immunohistochemistry. CDV antigen was found in the brains of

54 (37%) mustelids, predominantly in the cerebellar grey matter. Interestingly, no CDV infection was observed in foxes. An increasing number of CDV infections among mustelids was noted between November 1989 and November 1990, peaking in summer 1990. Histological brain lesions, demonstrated only in 45% of the CDV positive mustelids, were characterized by non-purulent encephalitis predominantly in the cerebrum and focal vacuolation of the cerebellar white matter, whereas demyelination was only rarely observed. Histological and immunocytochemical CNS findings indicate an early stage of distemper infection in these mustelids and the high percentage of CDV positive animals together with the seasonal prevalence are suggestive of a CDV epizootic among mustelids.

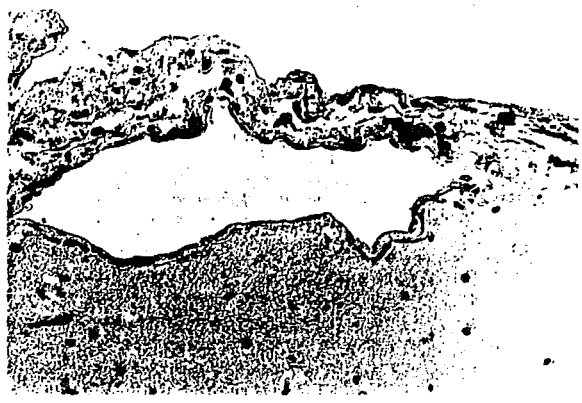


**Fig. 2.** CDV antigen in the cerebral leptomeninx of a stone marten. Immunocytochemical demonstration of CDV antigen in vascular endothelium and/or pericytes. ABC-method, x350.

*Veterinary Microbiology 44, pp. 193-199, 1995. 4 figs., 27 refs. Authors' abstract.*

## Transmission of a chronic lymphoproliferative syndrome in ferrets

*Susan E. Erdman, Keith A. Reimann, Frances M. Moore, Phyllis J. Kanki, Qian-Chun Yu, James G. Fox*

BACKGROUND: Lymphomas and leukemias are caused by transmissible viruses in a wide variety of species, including humans, cattle, and cats. Features of lymphma in ferrets suggest that it, too, may have an infectious etiology. No agent has been identified.
EXPERIMENTAL DESIGN: Cells or cell-free inocula from a ferret with spontaneous malignant lymphoma were administered i.p. to six recipient ferrets. Two ferrets received fresh cells, two received frozen cells, and two received cell-free culture supernatant. The recipients were monitored routinely clinically and hematologically, and lymphoma was confirmed histologically. The lymphomas were characterized using cytology, cytochemistry, immunophenotyping, and histology. Cultivated cells from the donor and recipients were examined using reverse transcriptase assay, microscopy, and electron microscopy.
RESULTS: All of the six recipient ferrets developed mild sustained lymphocytosis within 6 weeks of the inoculation. Two of six were euthanized 14 to 18 months after inoculation. Lymphoma was later diagnosed in three of the four remaining ferrets at 24 to 36 months after inoculation. All developed a chronic indolent syndrome featuring profound splenomegaly, lymphocytosis with atypia, and histologically polymorphous lymphoma. Two of the three who developed lymphoma had received fresh donor lymphoma cells, and the third had received supernatant from donor cell cultures with elevated reverse transcriptase activity. Cultivated cells from the affected ferrets demonstrated reverse transcriptase activity and retrovirus-like particles.
CONCLUSIONS: This study demonstrates horizontal transmission of malignant lymphoma in ferrets using cell or cell-free inocula. Clinical and pathologic features of this syndrome in ferrets resembled virally induced lymphomas in other species.

*Laboratory Investigation, Vol. 72, No. 5, pp. 539-546. 1 table, 4 figs., 34 refs. Authors' summary.*

## Simultaneous occurrence of different genital diseases in two female ferrets

*K.O. Weber, H.F. Willimzik*

This is a report on the simultaneous appearance of different genital diseases in two female ferrets housed together. The course of illness in both animals was characterized by an increasing, painless abdominal swelling. Large accumulations of

fluid with multiple relapses following successful symptomatic therapy could be demonstrated by ultrasonography. The respective diagnoses could be confirmed by necropsy after lethal course and by laparotomy and histopathological examination. Etiology and pathogenesis of the findings are discussed with respect to the particularities of reproductive physiology and their implication for husbandry of female ferrets.

*Kleintierpraxis 39, Heft 10, pp. 727-735, 1994. In GERM, Su. ENGL, FRAN. 6 figs., 15 refs. Authors' summary.*

## A contribution to the Helminth-Faune of the stone marten (*Martes foina Erxleben 1777*)

*G. Schoo, K. Pohlmeyer, M. Stoye*

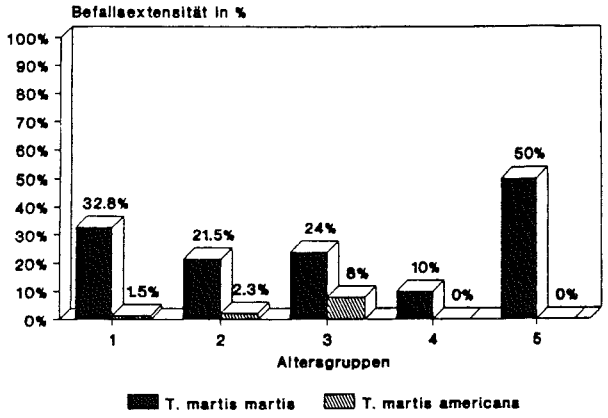



**Fig. 5.** Befallsextensitäten der Marder verschiedener Altersgruppen mit Taenien.

Nasal cavity and frontal sinus, muscle samples, kidney, stomach and intestine from 259 stone martens were examined for helminths. 40.2% of the studied martens were females, 59.8% were males. 25.9% of the studied population was less than one year old, 50.2% was two years old and 23.9% was older.
The nasal cavities and frontal sinuses and the kidneys were not affected by helminths. Two species of nematodes and two species of cestodes were found in the stomachs and intestines with the following extent of infection: Capillaria putorii was detected in 86.9% of the stone-martens, Molineus europaeus was found in 10.4% of the animals. 24.75 of the examined martens were infected with Taenia martis martis, 2.3% with Taenia martis americana. There was no correlation between the extent of infection and the age or sex of the martens. No larvae of Trichinella spiralis were found. Larvae of the genus Toxocara were detected in the muscle of seven stone-martens which all came from the town area of Hannover.

*Thesis, 92 pp. Institut für Wildtierforschung und Parasitologie and der Tierärztlicher Hochschule Hannover, 1993. In GERM, SU. ENGL. 14 tables, 5 figs., 81 refs. Authors' summary.*

## Aleutian disease in laboratory ferrets

*Wendy Rudling, Nichola Gent*

This paper describes how the discovery was made that an endemic disease was present in a colony of laboratory ferrets which had previously shown no signs of illness or given cause for concern.

It catalogues events starting from the first signs of ill-health through to the serological evidence and diagnosis of the disease.

*Animal Technology, Vol. 45, No. 3, pp. 149-159, 1994. 11 figs., 3 refs. Authors' summary.*

## Serologic survey for Leishmaniasis in free-living red foxes (*Vulpes vulpes*) in Italy

*Francesca Mancianti, Walter Mignone, Fabiola Galastri*

Sera from fifty free-ranging red foxes (*Vulpes vulpes*) from the Imperia province, Liguria, Italy, were examined for antibodies against *Leishmania* spp. by both immunofluorescence assay (IFA) and enzyme linked immunosorbent assay (ELISA), from January to May 1992. Nine of 50 animals (18%) had antibodies against *Leishmania* spp. utilizing both IFA and ELISA tests.

*Journal of Wildlife Diseases, 30 (5), pp. 454-456, 1994. 10 refs. Authors' abstract.*

## A light microscopical ultrastructural and immunohistochemical study of spindle-cell adrenocortical tumors of ferrets

*J.M. Cliatto, J. Alroy, S.H. Schelling, S.J. Engler, Y. Dayal*

Twelve adrenocortical tumours with a variable spindle-cell component in ferrets (six spayed females, three intact females, two castrated males, and one intact male) were examined by light microscopy.

One tumour with a moderate spindle-cell component was examined ultrastructurally, and three tumours were studied immunohistochemically. Light microscopy revealed a spindle-cell component in the tumours that varied from a few such cells occupying the stroma between packets of adrenocortical cells to cells in such large numbers that they formed almost the entire substance of the tumour.

By light microscopy these spindle cells resembled smooth muscle cells, and the ultrastructural findings, particularly the presence of thin contractile filaments, suggested that the spindle cells were of smooth muscle origin. Immunohistochemical staining revealed that the spindle cells were negative for cytokeratins and S-100 protein but positive for smooth muscle actin.

Desmin was readily demonstrated in two tumours but not in the other examined. Vimentin was variable, generally producing a small to moderate amount of reaction product.

*J. Comp. Path., Vol. 113, pp. 175-183, 1995. 2 tables, 8 figs., 14 refs. Authors' summary.*

## Herpesvirus-like infection in a raccoon (*Procyon lotor*)

*A.N. Hamir, G. Moser, M. Kao, N. Raju, C.E. Rupprecht*

During March 1990, a subadult raccoon found dead in northeastern Pennsylvania (USA) had gross lesions of multifocal hepatitis. Microscopically, multifocal random distributed areas of acute necrosis with intranuclear viral inclusions were seen in liver, spleen, adrenal glands, and tongue. Ultrastructural and immunoperoxidase results of formalin fixed liver were compatible with herpesvirus infection. This virus could be unique to the raccoon or may have been acquired from another species.

*Journal of Wildlife Diseases, 31 (3), pp. 420-423, 1995. 4 figs., 11 refs. Authors' abstract.*

## Ischemic encephalopathy in raccoons (*Procyon lotor*)

*A.N. Hamir, C.E. Rupprecht*

An acute and chronic case of cerebral infarction syndrome in two raccoons (*Procyon lotor*) respectively is described. The raccoon with an acute form of the condition had clinical neurologic signs whereas the raccoon with a chronic form of the condition had no evident clinical signs. In neither raccoon were significant vascular lesions seen. This is the first report of cerebral infarctions in raccoons.

*Journal of Wildlife Diseases, 30 (4), pp. 609-611, 1994. 2 figs., 7 refs. Authors' abstract.*

## Experimental strategies for the development of an immunocontraceptive vaccine for the european red fox, *Vulpes vulpes*

*Mark P. Bradley*

The development of an immunocontraceptive vaccine to control fox populations in Australia would confer considerable advantages in controlling the long-term impact of this predator on native and endangered species. Studies are currently under way to identify sperm antigens that might be used in such a vaccine, and some of these studies are described. It is proposed that such a vaccine would be delivered orally in a bait, thereby stimulating a mucosal immune response to the foreign antigen(s). Such a vaccine requires a detailed understanding of reproductive-tract mucosal immunity in foxes, and

selection of the most effective form of antigen delivery. Those under consideration include viral or bacterial vectors and microencapsulated antigens.

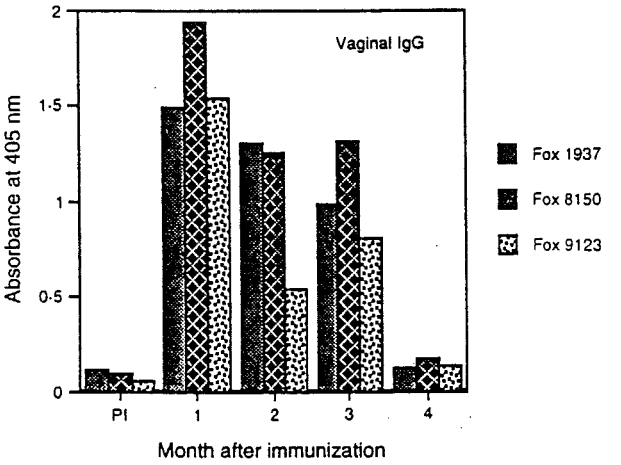



**Fig. 5.** Vaginal IgG antibody responses to maltose binding protein in three female foxes (number of each fox indicated in the legend) after a single intra-Peyer's patch immunization. PI indicates the pre-immune level. The responses were monitored over a period of four months. Vaginal lavages used in these ELISA were undiluted.

*Reprod. Fertil. Dev., 6, pp. 307-317, 1994. 1 table, 7 figs., 36 refs. Author's abstract.*

## Resistance and disease in *Brugia malayi* infection of ferrets following prior infection, injection of attenuated infective larvae and injections of larval extracts

*R. Crandall, C. Crandall, J. Nayar, T. Doyle*

A partial resistance expressed by a 53% to 78% reduction in lymphatic filariae from a challenge infection was induced in ferrets (*Mustela putorius furo*) by a prior infection and by injection of radiation attenuated infective larvae (L3) but not by injections of lyophilized microfilariae (mf) or L3. Equivalent acquired resistance was demonstrated with and without overt filarial disease. A prior infection resulted in periphral lymphoedema in approximately one-third of the amicrofilaraemic resistant ferrets following challenge infection and injection of attenuated larvae resulted in inflammatory responses characteristic of a hyper-responsive syndrome in one-half of the amicrofilaraemic ferrets. Injections of lyophilized mf inhibited microfilaraemia and promoted development of lymphostatic disease. A limited examination of immune responses and histopathology suggested that disease in partially resistant ferrets was associated with high TH2 dependent responses directed, at least in part, to mature filariae and to mf. Mechanisms of resistance were not identified.

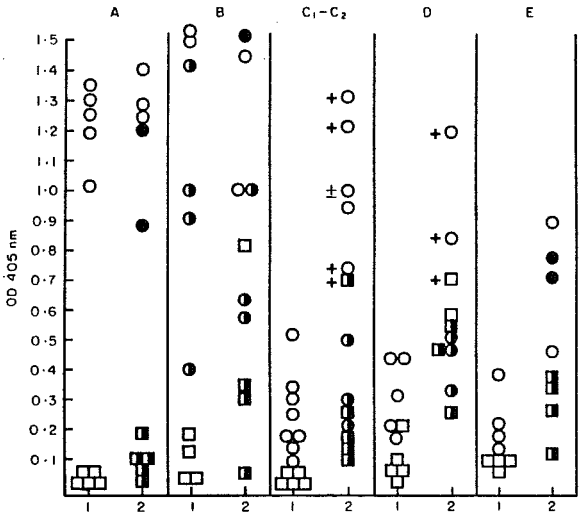



**Fig. 3.** Antibody responses measured by ELISA at challenge infection (lane 1) and at necropsy (lane 2) in ferrets subjected to different immunization procedure. Experimental groups described in text: Groups A and B reinfected; Groups $C_1$-$C_2$ injected with attenuated infective larvae; Group D injected with lyophilized infective larvae and group E injected with lyophilized microfilariae. Antibody response measured by OD at 405 nm with an extract of adult *Brugia* at antigen. Circles are the responses of experimental ferrets and squares are control ferrets. Open circles and squares indicate amicrofilaraemia and half-closed indicate microfilaraemia. Closed circles indicate lymphoedema. + indicates numerous (>200= visible liver lesions characteristic of hyper-responsive syndrome (MK syndrome); ± indicates >50 liver lesions.

*Parasite Immunology 16, pp. 425-433, 1994. 2 tables, 3 figs., 17 refs. Authors' summary.*

## A seroepidemiological survey for orthopox virus in the red fox (*Vulpes vulpes*)

*Klaus Henning, Claus-Peter Czerny, Hermann Meyer, Thomas Müller, Matthias Kramer*

703 blood samples from red foxes (*Vulpes vulpes*) were investigated to determine the prevalence of antibody against an orthopox virus (vaccinia virus strain Elstree). A blocking-ELISA based on a neutralizing monoclonal antibody was used. In this assay 46 sera (6.5%) were positive with titers of 1:2 to 1:16. ELISA-results were confirmed by the plaque reduction test with 44 of the 46 sera reacting positively. The specificity of antibodies in 21 selected sera was also demonstrated by Western blot analysis.

*Veterinary Microbiology 43, pp. 251-259, 1995. 1 table, 3 figs., 12 refs. Authors' abstract.*

## Pathogenicity of morbilliviruses for terrestrial carnivores

*Max J.G. Appel, Brian A. Summers*

Many different species of the order *Carnivora* are susceptible to canine distemper and the mortality rate varies greatly between species, *Ailuridae, Canidae, Hyaenidae, Mustelidae, Procyonidae, Ursidae, Viverridae* and now *Felidae* have been reported to be susceptible to canine distemper virus infection. Although distemper outbreaks in dogs, fur farms and in zoo carnivores have been greatly reduced in recent years due to vaccination, there are still regular outbreaks in free-living carnivores. Unexpected outbreaks of canine distemper have occurred in exotic felids in a California wildlife park and in the Serengeti in Tanzania as well as in javelians (collared peccaries, *Tayassu tajacu*) in Arizona. Although safe and efficacious in dogs, modified live canine distemper virus vaccines may be dangerous for a variety of zoo and wildlife carnivores, especially red pandas (*Ailurus fulgens*) and black footed ferrets (*Mustela nigripes*).

*Veterinary Microbiology 44, pp. 187-191, 1995. 26 refs. Authors' abstract.*

## Acute disseminated toxoplasmosis in a red fox (*Vulpes vulpes*)

*J.P. Dubey, A.N. Hamir, C.E. Rupprecht*

A red fox (*Vulpes vulpes*) with signs of neurological disease was captured in Fairmount Park, Philadelphia, Pennsylvania (USA). The animal died in captivity and was examined because of suspected rabies. The liver had pale foci up to 4 mm in diameter. Foci of necrosis were associated with *Toxoplasma gondii* tachyzoites in several organs including liver, lungs and adrenal glands. Rabies antigen and distemper virus inclusions were not detected. The diagnosis of acute disseminated toxoplasmosis was confirmed by immunohistochemical staining.

*Journal of Wildlife Diseases, 26 (2), pp. 286-290, 1990. 4 figs., 13 refs. Authors' abstract.*

## Experimental *Toxoplasma gondii* infection in raccoons (*Procyon lotor*)

*J.P. Dubey, A.N. Hamir, S.K. Shen, P. Thulliez, C.E. Rupprecht*

Six raccoons (*Procyon lotor*) without detectable *Toxoplasma gondii* antibodies were used. Four raccoons were inoculated orally (2 with oocysts and 2 with tissue cysts) with ME49 strain of *T. gondii* and 2 raccoons were not inoculated with *T. gondii*. All raccoons remained clinically normal. The raccoons were killed between 59 and 61 days after inoculation and portions of their hearts, skeletal muscles, and brains were digested in pepsin solution, and homogenates were bioassayed in mice. *Toxoplasma gondii* was isolated from all 4 inoculated raccoons; from the heart of 3, skeletal muscles of 2 and the brain of none. All 4 inoculated raccoons developed antibody titers $\geq$ 1:1,600 in the modified direct agglutination test (MAT) using whole formalinized tachyzoites. *Toxoplasma gondii* antibody titers of the raccoons not inoculated with *T. gondii* remained >1:25, and *T. gondii* was not isolated from their tissues. It was concluded that muscle tissue from multiple sites including the heart was the tissue of choice for conducting parasitologic surveys for *T. gondii* in raccoons.

Evaluation of the sera of the experimentally infected raccoons in the Sabin-Feldman dye test, latex agglutination test, and the indirect hemagglutination tests indicated that the MAT detected antibodies faster and in higher titers than did the other serological tests.

*J. Parasitol. 79 (4), pp. 548-552, 1993. 3 tables, 21 refs. Authors' abstract.*

### *Dirofilaria immitis* in a raccoon (*Procyon lotor*)

*Daniel E. Snyder, Amir N. Hamir, Cathleen A. Hanlon, Charles E. Rupprecht*

A single juvenile male raccoon (*Procyon lotor*) was found naturally infected with *Dirofilaria immitis*. Two immature female worms were found in the heart of this raccoon at necropsy. Lesions attributable to the presence of these parasites were not found. Histopathologic examination of various tissues did not reveal any microfilariae. The raccoon may serve as an aberrant definitive host for this parasite, however, patent infections have not been reported.

*Journal of Wildlife Diseases, 25 (1), pp. 130-131, 1989. 13 refs. Authors' abstract.*

### Absence of rabies encephalitis in a raccoon with concurrent rabies and canine distemper infections

*A.N. Hamir, C.E. Rupprecht*

Concurrent infection of a raccoon by rabies and canine distemper viruses is described. Fluorescent antibody (FA) test demonstrated rabies antigen in the brain of this animal, however, histologically only lesions characteristic of canine distemper infection were seen. We recommend testing tissues for rabies of animals that histologically are positive for canine distemper.

*Cornell Vet. 80, pp. 197-201, 1990. 2 figs., 6 refs. Authors' abstract.*

### Urolithiasis in a chinchilla

*R.J. Jones, R. Stephenson, D. Fountain, R. Hooker*

A 3-year-old chinchilla fed on a proprietary pellet and presented with a vague history of irritation around the preputial orifice was found to have a red and slightly swollen prepuce. Attempts to insert a urinary catheter were blocked by a urethral obstruction approximately 2 cm behind the os penis. Radiography revealed a radiodense opacity in the urethra and urolithiasis was diagnosed; no calculi were seen in the bladder or the kidneys. General anaesthesia was induced and a 3 mm x 2 mm stone and cast were removed through a urethrostomy incision made directly over the calculus; the wound was left to heal by secondary intention. The chinchilla made a complete recovery. The calculus was predominantly calcium carbonate.

*Veterinary Record 136, 15, pp. 400, 1995. 1 ref. CAB-abstract.*

### Incidence of greasy kits in the Mid-Jutland Fur Farming Association

*Hans-Jørgen Risager*

In 1994, the incidence of mink litters in Jutland containing greasy kits was 0, 0-5, 5-10 and >10% on 41, 25, 10 and 24% of farms investigated. The incidence of greasy kits increased with increasing size of farm, 4.2% of farms with fewer than 200 breeding females having >10% of litters containing greasy kits vs. 55.6% of farms with >1400 breeding females.

*Dansk Pelsdyravl 58, 4, pp. 172-173, 1995. In DANH. 3 tables. CAB-abstract.*

## Biology of martens, sables and fishers

*Andrzej Zalewski*

New methods in ecology open the opportunity to answer more and more questions but still we know little about some genera. Representatives of the genus *Martes* belong to this kind of animals; it contains one of the shyest, and most difficult to study animals. Although the literature on these animals is quite large, it includes predominantly short notes about the food, home range and natrual history. The book tries to summarize our knowledge about the martens, sables and fishers. Fifty seven authors contributed to this volume, presenting 30 both review and original papers. The part about marten begins with "Introduction to genus *Martes*" by S.W. Buskirk, who gave a short review about the phylogeny, morphology, ecology and biogeography of marten species of the World. The book consists of 7 chapters, each with 2-7 papers. Besides the reviews papers such as: "Reproduction in *Martes*" (R.A. Mead) or "Structure and spacing of *Martes* population" (R.A. Powell), the book contains the original papers e.g. "Habitat use and spatial organization by the stone marten" (M. Herrmann) or "The effect of trapping on a newly exploited American marten population" (C. Fortin and M. Cantin). Interesting methodological articles can be found in chapter III (Management and population). One of them described the age and sex determination (K.G. Poole et al.), another one reviewed the techniques of monitoring of marten population (M. Raphael). Among 30 papers in this book, 3 were ablut all *Martes* species, only 4 were about two European marten species (pine and stone marten), 2 about sable and 1 about Tsushima marten (*Martes melampus tsuensis*). The remained articles were about the American marten and fisher. Literature, with about 1070 citations, and useful index complete the book.

Biologists who are interested in genus *Martes* should not overlook this book. I hope this volume would be the first book of the series about the martens. The 2nd symposium on the Biology and Management of Martens and Fishers would be a good occasion to publish the next book about these interesting animals.

*From: Acta Theriologica 39 (3): 410. PL ISSN 0001-7051.*

**Biology of martens, sables and fishers**

Martens, Sables, and Fishers. Biology and conservation. Ed. S. W. Buskirk, A. S. Harestad, M. G. Raphael, and R. A. Powell. Cornell University Press, Ithaca and London, 1994, 484 pp. ISBN 0-8014-2894-7.

SEE YOU IN WARSAW

## List of addresses

Ahlstrøm, Øystein. Department of Animal Science, Agricultural University of Norway, P.O. Box 5025, N-1432 Ås, Norway

Alden, Eva. Pälsdjursavdelningen, Inst. för husdjurens utfodring och vård, Sveriges Landbruks-universitet, Box 7073, Funbo-Lövsta, 75007 Uppsala, Sweden.

Alexandersen, Søren. Danish Veterinary Institute for Virus Research, Lindholm, DK-4771 Kalvehave, Denmark

Allen, Stephen H. North Dakota Game And Fish Department, 100 North Bismarck Expressway, Bismarck, ND 58501

Appel, Max J.G. James A. Baker Institute for Animal Health, College of Veterinary Medicine, Cornell University, Ithaca, New York 14853, USA

Arnbjerg, Jens. The Royal Veterinary and Agricultural University, Bülowsvej 13, DK-1870 Frederiksberg C., Denmark

Arnemo, Jon. Center of Veterinary Medicine, N-9005 Tromsø, Norway

Beaton, Sandra. Cooperative Research Centre for the Biological Control for Vertebrate Pest Populations, CSIRO Division of Wildlife & Ecology, Canberra, Australia

Bevanger, Kjetil. Norwegian Institute for Nature Research, Tungasletta 2, N-7005 Trondheim, Norway

Bradley, Mark P. Cooperative Research Centre for Biological Control of Vertebrate Pest Populations, CSIRO Division of Wildlife and Ecology, P.O. Box 84, Lyneham, ACT 2602, Australia

Brainerd, Scott M. Department of Biology and Nature Conservation, Box 5014, Agricultural University of Norway, N-1432 Ås-NLH, Norway

Børsting, Christian F. National Institute of Animal Science, Research Centre Foulum, Department of Fur Animals, P.O. Box 39, DK-8830 Tjele, Denmark

Cappelletti, C.A. Faculty of Veterinarian Sciences, University of Buenos Aires, Av. Chorroarín 280, CP 1427, Buenos Aires, Argentina

Christensen, Jesper. Laboratory of Virology and Immunology, Department of Veterinary Micorbiology, The Royal Veterinary and Agricultural University, Bülowsvej 13, DK-1870 Frederiksberg C., Denmark

Clausen, Tove N. Research and Advisory Units of the Danish Fur Breeders Association, Herningvej 112C, Tvis, DK-7500 Holstebro, Denmark

Clausen, P. Danish Fur Breeders Association, Langagervej 60, DK-2600 Glostrup, Denmark

Crandall, R. Department of Immunology and Medical Microbiology and Department of Pathology and Laboratory Medicine, University of Florida, Gainesville, Florida, USA

Dille, Liv Lønne. Norwegian Fur Breeders Association, P.O. Box 145, Økern, N-0509 Oslo, Norway

Dubey, J.P. Zoonotic Diseases Laboratory, Livestock and Poultry Sciences Institute, Agricultural Research Service, U.S. Department of Agriculture, Beltsville, Maryland 20705, USA

Egri, B. Univ. Agric. Sciences, Animal Phys. and Health, Var 4, H-9201 Mosonmagyarovar, Hungary

Einarsson, Einar J. National Institute of Animal Science, Research Centre Foulum, Department of Fur Animals, P.O. Box 39, DK-8830 Tjele, Denmark

Erdman, Susan E. Division of Comparative Medicine, Massachusetts Institute of Technology, Cambridge, Massachusetts, USA

Gliatto, J.M. Department of Veterinary Pathology, Tufts University School of Veterinary Medicine, 200 Westboro Road, North Grafton, MA 01536, USA

Hamir, A.N. Department of Pathobiology, School of Veterinary Medicien, University of Pennsylania, New Bolton Center, Kennett Square, PA 19348, USA

Harri, M. University of Kuopio, Department of Applied Zoology and Veterinary Medicine, Box 1627, SF-70211 Kuopio, Finland

Hau, J. Department of Veterinary Pathology, Laboratory Animal Science Unit, The Royal Veterinary College, University of London, Royal College Street, London NW1 0TU, UK

Helldin, J.O. Grimsö Wildlife Research Station, Dept. of Wildlife Ecology, Swedish Univ. of Agricultural Sciences, S-730 91 Riddarhyttan, Sweden

Henning, Klaus. Federal Research Center for Virus Diseases of Animals, Seestr. 55, D-16868 Wusterhausen/Dosse, Germany

Håkansson, Helen. Institute of Environmental Medicine, Unit of Toxicology, Bo 60208, S-104 01 Stockholm, Sweden

Il'ina, T.N. Institute of Biology, Karelian Scientific Centre RAS, 185610, Petrozavodsk, Pushkinskaya 11, Russia

Jalkanen, Liisa. University of Kuopio, Department of Applied Zoology and Veterinary Medicine, Box 1627, SF-70211 Kuopio, Finland

Jallageas, M. Laboratoire de Neurobiologie Endocrinologique, URA 1197-CNRS, Université de Montpellier II, place E. Bataillon, F-34095 Montpellier Cedex 5, France

Johannessen, K.R. Norwegian Fur Breeders Association, P.O. Box 145, Økern, N-0509 Oslo, Norway

Jones, R.J. Pool House Veterinary Hospital, Dam Street, Lichfield, Staffordshire WS13 6AA, UK

Kameyama, Yuichi. Faculty of Bioindustry, Tokyo University of Agriculture, 196 Yasaka Abashiri-shi, Hokkaido, Japan

Kauhala, Kaarina. Finnish Game and Fisheries Research Institute, Game Division, P.O. Box 202, SF-00151 Helsinki, Finland

Kjærgård, Bente. Department of Environment, Technology and Social Studies, Roskilde University Centre, P.O. Box 260, DK-4000 Roskilde, Denmark

Korhonen, Hannu. Agricultural Research Centre of Finland, Fur Farming Research Station, SF-69100 Kannus, Finland

Krzywiecki, Stanislaw. Department of Animal Feeding and Feed Management, University of Agriculture, Wroclaw, Poland.

Kubacki, Stanislaw. Koni i Zwierzat Futerkowych, Wydzial Zootechniczny ATR, ul. Mazowiecka 28, 85-084 Bydgoszcz, Poland

Kuzniewicz, Janusz. Department of Sheep and Fur Animal Breeding.

Langeveld, Jan. Institute for Animal Science and Health (ID-DLO), Edelhertweg 15, P.O. Box 65, NL-8200 AB Lelystad, The Netherlands

Lee, J.H. College of Veterinary Medicine, Kyungpook National University, Taegu, Korea

Lohi, Outi. National Institute of Animal Science, Research Centre Foulum, Department of Fur Animals, P.O. Box 39, DK-8830 Tjele, Denmark

Mancianti, Francesca. Dipartimento di Patologia animale - Universitá di Pisa, I-56124 Pisa, Italy

Maran, Tiit. Tallinn Zoo, Paldiski mnt. 145, EE-0035 Tallinn, Estonia

Miller, Paul E. Department of Surgical Sciences, School of Veterinary Medicine, University of Wisconsin-Madison, Madison, WI 53706, USA

Moll, van P. Institut für Veterinär-Pathologie, Justus-Leibig-Universität Giessen, Frankfurter Str. 96, D-35392 Giessen, Germany

Mäkelä, Jaakko. Finnish Fur Breeders' Association, Box 5, SF-06101 Vantaa, Finland.

Niedzwiadek, Stanislaw. National Research Institute of Animal Production, Sarego 2, 32-083 Balice k. Krakow, Poland.

Nielsen, U.L. The Research and Advisory Unit of the Danish Fur Breeders Association, Tvis, Herningvej 112, DK-7500 Holstebro, Denmark

Nixon, A.J. AgReseach, Ruakura Research Centre, Private Bag 3123, Hamilton, New Zealand

Oskina, I.N. Institute of Cytology and Genetics, Siberian Division of the Russian Academy of Sciences, Lavrentyev Ave. 10, Novosibirsk 630090, Russia.

Pond, Caroline M. Department of Biology, The Open University, Milton Keynes, MK7 6AA, UK

Riis, Bent. Danish Institute of Animal Science, Department of Product Quality, Research Centre Foulum, P.O. Box 39, DK-8830 Tjele, Denmark

Risager, H.J. The Fur Breeder Association of Mid-jutland, Herningvej 112, Tvis, DK-7500 Holstebro, Denmark

Rose, Jack. Department of Biological Sciences, Idaho State University, Pocatello, Idaho 83209, USA

Rudling, Wendy. Institute of Ophthalmology, 11-43 bath Street, London EC1V 0EL, UK

Santin, I. Danish Fur Breeder Association, Langagervej 60, DK-2600 Glostrup, Denmark.

Schoo, G.

Smeds, Kerstin.

Snyder, Daniel E. U.S. Department of Agriculture, Agricultural Research Service, Animal Parasite Research Laboratory, P.O. Box 952, Auburn, Alabama 36831, USA

Sønderup, Michael. Funen and South Jutland Fur Breeder Association, DK-6650 Brørup, Denmark

Sørensen, Hans. Norwegian Fur Breeders Association, P.O. Box 145, Økern, N-0509 Oslo, Norway

Tauson, A-H. Dept. of Animal Science & Animal Health, Division of Nutrition and Production, Royal Vet. and Agric. University, Bülowsvej 13, DK-1870 Frederiksberg C., Denmark.

Therkildsen, Niels. The Research and Advisory Unit of the Danish Fur Breeders Association, Tvis, Herningvej 112, DK-7500 Holstebro, Denmark

Thorhauge, Kaj. Danish Institute of Animal Science, Department of Research in Small Farm Animals, Research Centre Foulum, P.O. Box 39, DK-8830 Tjele, Denmark

Valtonen, M. University of Kuopio, Department of Applied Zoology and Veterinary Medicine, Box 1627, SF-70211 Kuopio, Finland

Vidal, Sergio. University of Santiago, Faculty of Veterinary Sciences, Department of Anatomy and Histology, Lugo, Spain

Wang, Xiang-Dong. Gastrointestinal Nutrition Laboratory, U.S. Department of Agriculture Humun Nutrition Research Center, Boston, USA

Weber, K.O. Tierarzliche Klinik für Kleintiere, In den Siefen 3-5, D-66346 Püttlingen, Germany

Woychik, R.P. Biology Division, Oak Ridge National Laboratory, P.O. Box 2009, Oak Ridge, TN 37831-8080, USA

Xiao, Y. University of Kuopio, Department of Applied Zoology and Veterinary Medicine, Box 1627, SF-70211 Kuopio, Finland

Zimmermann, H. Gerdingstrasse 23, D-17489 Greifswald, Germany