

SCIENTIFUR
ISSN 0105-2403
Vol. 20, No. 3
August, 1996

Published by **IFASA**

INTERNATIONAL FUR ANIMAL SCIENTIFIC ASSOCIATION

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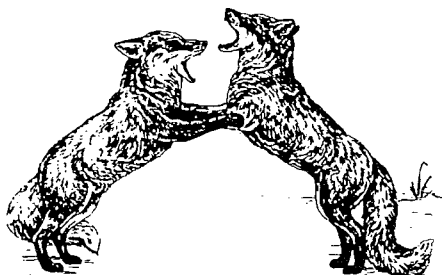
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A panorama of transmissible spongiform. Encephalopathy. *R. Bradley. Cattle Practice 2, 1, pp. 59-72, 1994. 23 refs. Code 9-M-O.*

Generalized eosinophilic myositides with eosinophilia of blood and cerebrospinal fluid in a raccoon (*Procyon lotor*). *Amir N. Hamir, Charles E. Rupprecht, Ellen L. Ziemer. J Vet Diagn Invest 1, pp. 192-194, 1989. 3 figs., 8 refs. Code 3-9-O.*

A trematode (*Phagicola* sp.)-induced mesenteric lymphadenitis and enteritis in raccoons (*Procyon lotor*). *A.N. Hamir, D.E. Snyder, C.A. Hanlon, C.E. Rupprecht. Vet. Pathol. 30, pp. 373-376, 1993. 6 figs., 6 refs. Code 9-O.*

Immunohistochemical test for rabies: identification of a diagnostically superior monoclonal antibody. *A.N. Hamir, G. Moser, Z.F. Fu, B. Diet-schold, C.E. Rupprecht. The Veterinary Record, pp. 295-296, 1995. 3 figs., 9 refs. Code 9-O.*



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With this issue of *SCIENTIFUR* we wish the arrangement committee of the VIth International Congress in Fur Animal Production all the best and welcome all participants to a, no doubt, well arranged as well as a scientifically and socially very valuable Congress.

Based on the pre-registrations, it seems that for the first time the number of participants will exceed 200 and represent more than 20 fur producing countries. Hopefully, this is a good sign for the further development of IFASA and *SCIENTIFUR* that the East European countries incl. Russia seem to be strongly represented.

It is also promising that the Congress takes place in a year when skin prices went up to a reasonable level. Surely, the scientific output from the Congress will stimulate the future fur animal production in many respects.

In the next issue of *SCIENTIFUR*, we will bring abstracts of all reports and posters presented at the VIth IFASA Congress as well as the address where copies of the proceedings can be ordered.

From the limited number of original reports received for this issue of *SCIENTIFUR* we can see that the international scientific fur animal world is reserving important news for the Congress. That is okay, as this has given us room for some of the abstracts which have been waiting but which are also an important part of the information given by *SCIENTIFUR*.

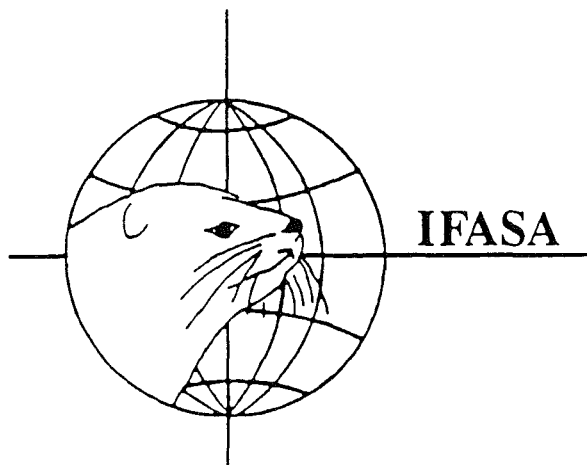
At the Congress, two new members will have to be elected for the Board of IFASA, because Prof. Stanislaw J. Jarosz, Poland, and your editor Gunnar Jørgensen leave the Board. As I continue as editor of *SCIENTIFUR*, I will still participate in the Board meetings of IFASA.

At the Congress, IFASA and *SCIENTIFUR* will be present at the Congress Secretariat and will be pleased to inform you further about all activities and demonstrate the electronic *SCIENTIFUR INDEX* to those who might be interested. Sample copies of *SCIENTIFUR* as well as *INDEXES* and books will be available at the congress in a limited number.

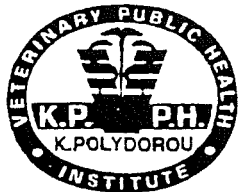
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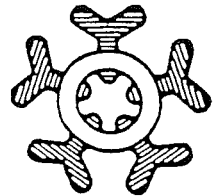
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**XV INTERNATIONAL SYMPOSIUM
OF SALMONELLOSIS – BRUCELLOSIS**
CYPRUS, 16–21 FEBRUARY 1997



XV International Symposium

of the World Association of Microbiologists, Immunologists and Specialists in Infectious Diseases (W.A.V.M.I.).

The above Symposium will be held in Cyprus from 16 - 21 February 1997 with the theme: SALMONELLOSIS - BRUCELLOSIS As World Health Problems For Humans and Animals.

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Yours faithfully

K. Polydorou
Chairman of the XV Symposium



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W.A.V.M.I.



Original Report

Effect of the star gene on potential fertility and embryonic mortality in silver foxes

A.I. Zhelezova

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

Summary

The values of potential fertility for silver foxes marked with the *star* in heterozygous or homozygous condition were compared with those for females not bearing the gene. Slight differences in the number of ovulated egg cells were observed for females of the group (3 years and older), the differences being in favour of silver foxes not carrying the star gene. The differences are, in all probability, due to those in hormonal status causing premature ageing of *star* bearers.

Differences in the values of embryonic mortality during the pre- and postimplantation periods of pregnancy were found.

Postimplantation embryonic mortality in *star* bearers were mainly from days 20-26 of pregnancy, i.e., during the period of organogenesis.

Embryonic death is not selective, determined by the genotype of the embryo; it rather depends on the hormonal status of the female.

Introduction

Selection for domesticated behaviour has brought about disruption of physiological systems in most tame foxes. Effects were found in the functional activity of the pituitary adrenal system, the hormonal activity of the gonads (Trut *et al.*, 1972; Osadchuk *et al.*, 1978; Naumenko *et al.*, 1987), there appeared evidence for destabilization of seasonal reproduction (Trut *et al.*, 1970; Trut, 1980; Belyaev *et al.*, 1983), and there was an acceleration of early postnatal development of the endocrine function of the gonads (Logvinenko *et al.*, 1980). There also appeared morphological changes, such as changes in coat colour patterns, piebald and mottling, dog-like tail carriage and shape of ears (Trut, 1967). One such change is a specific depigmented area called the "*star*".

The star is under the control of the dominant autosomal gene (*S*) with incomplete manifestation. Foxes heterozygous for the *Ss* gene are "marked" with a characteristic depigmentation on the head, the "*star*" (fig. 1, a). In contrast, homozygotes have

strongly depigmented areas over the face, the neck ("collar"), hind feet and groin (fig. 1, b). As a rule, such individuals show heterochromia of the iris of the eye and they are deaf.



Fig. 1. Heterozygous (a) and homozygous (b) for the *star* gene silver foxes

Cryptorchism is frequently observed in star bearers. The star gene also affects fertility manifested as distorted ratio of pups in offspring from crosses between "star" bearers, i.e., as a deficiency in individuals of the homozygous class (Belyaev *et al.*, 1970; Ruvinsky, 1987; Trut, 1991). The authors believe that the distorted ratio of mutants of homozygous to heterozygous classes is due to activation-reactivation of the mutant gene and eliminations of the effect of selective embryonic mortality of homozygotes for the *star* gene. It is known, however, that

in mammalian species there are many mutant genes causing depigmentation, piebald patterns on the head, and ventral aspects of the body and feet. These genes have pleiotropic effects. It has been shown that viability and fertility are often reduced in individuals in which the dominant genes have a stronger effect. Thus, fertility is reduced in mice heterozygous for the gene *Wand SI* (Mintz, 1960). In mink and polar foxes, the mutant genes "Shadow" and "Stewart" causing lighter background colour exert a pleiotropic effect on viability and fertility (Venge, 1959; Nes, 1964, 1965, 1975; Zhelezova, 1987). It therefore appeared of interest to study the effect of the *star* gene on potential fertility and embryonic mortality, because precisely these characteristics determine actual fertility in animals.

Material and methods

This study was performed at the experimental fur farm of this Institute. Heterozygotes and homozygotes for *star* gene were used in the crosses. Vixens not marked with the *star* mutation were used as controls. All the foxes were maintained under standard conditions. Potential fertility was determined by counting the number of corpora lutea forming at the site of ovulated follicles in the ovaries of females sacrificed after a single mating during the breeding season (January, February) or at laparotomy after delivery.

Preimplantation embryonic mortality was expressed as the difference between the number of corpora lutea and implantation sites, while postimplantational mortality was expressed as the difference between the number of implantation sites and living normally developing embryos at sacrifice during pregnancy or after delivery; when setting up groups, behaviour was taken into account because it has been shown that it affects potential and actual fertility of females (Trut, 1980). The number of foxes is given in the corresponding tables.

Results and discussion

Potential fertility

Table 1 presents the values for potential fertility in females heterozygous and homozygous for the *star* gene in comparison with the respective values for potential fertility in foxes without the *star* gene.

Age was discounted in this table. As the data show, the differences in the values of potential fertility are significant only between females heterozygous for the *star* gene and the standard silver black foxes. No differences were found between homozygotes and heterozygotes for the *star* gene. It is of interest that while silver foxes which differ in behaviour, significantly differ in the number of ovulated egg cells, as previously demonstrated (Trut, 1980) and

follows from the data given in Table 2, the differences between the two behavioural groups are not manifest in both heterozygous and homozygous mutant females. With reference to the aim of the present study, it is worthy to note that negative pleiotropic effects of the gene on potential fertility are not affected in females of the commercial population, but there is an increasing tendency with age (Table 2).

Table 1. Values for potential fertility in females heterozygous and homozygous for the *star* gene

Female genotype	Behaviour type	N of females	N of corpora lutea
Ss	Domesticated	40	7.08 ± 0.27*
	Undomesticated	28	7.00 ± 0.26
SS	Domesticated	10	7.20 ± 0.53
	Undomesticated	7	7.28 ± 0.42
ss	Domesticated	68	**7.85 ± 0.24*
	Undomesticated	70	**6.63 ± 0.23

* P>0.95 Differences between Ss and SS females

** P>0.999 Differences between domesticated SS and undomesticated ss females

Table 2. Values for potential fertility in females homozygous for the *star* gene related to age

Female genotype	Behaviour type	1-2 year old		3 years and older	
		N females	N corpora lutea	N females	N corpora lutea
Ss	Domesticated	22	7.22 ± 0.34	26	6.96 ± 0.21**
	Undomesticated	22	7.41 ± 0.27	6	5.50 ± 0.22***
ss	Domesticated	26	8.00 ± 0.34	42	7.76 ± 0.19**
	Undomesticated	30	6.47 ± 0.24	40	6.75 ± 0.23***

* Differences between domesticated and undomesticated older females

** Differences between domesticated SS and ss older females

*** Differences between domesticated ss and Ss females aged 3 years and older

The data in the table clearly show that there is a tendency to a decrease in the number of ovulated egg cells, particularly in 3 year old and older females heterozygous for the *star* gene. On the background of this decrease, there appear differences in potential fertility between *star* bearers differing in behaviour.

In undomesticated older females, ovulation level is significantly lower than in domesticated of the same age, i.e., the same relations are manifested in this age group as in standard silver foxes. Comparison of *star* bearers with standard silver foxes of the same age revealed no significant differences in potential fertility of young (1-2 year old) domesticated females, while in domesticated *star* bearers potential fertility was higher than in standard silver foxes. In 3-year-old and older females, there are differences in potential fertility between standard silver and *star* heterozygotes in favour of the normal both in domesticated and undomesticated groups. Possibly, these age-related changes in the values of potential fertility of Ss females are due to differences in hormonal status determining the preparation of egg cells to ovulation. However, the observed differences in potential fertility cannot be decisive in differences in actual fertility between standard silver and mutant foxes.

Embryonic mortality

Embryonic mortality is a major factor determining the value of actual fertility. Embryos can die at any step of pregnancy, but they mainly succumb before preimplantation. Implantation takes place on days 16-18 of pregnancy in foxes (Kler, 1949), and it unfolds gradually. Females at the same term of pregnancy can have embryos differing in development (Valtonen *et al.*, 1985). We expressed the value of preimplantation mortality as the difference between corpora lutea number in ovaries and implantation site number in uterine horns. Implantation site number in females hetero- and homozygous for the *star* gene is related to the type of cross in Table 3. The data for the *star* bearers are compared with the corresponding data for standard silver foxes.

As the data clearly show, implantation level in females not marked with the *star* is higher than

in mutant foxes. Low implantation level in matings between *star* marked females and white flanked males Ss x SS may be related to reduced fertilization capacity of these males. Cryptorchism is frequently observed among white flanked males and polygamy is very low compared to males without the *star*. Table 4 presents data on implantation site number and number of pups born to mutant and standard foxes which underwent laparotomy after delivery. Implantation level is low and the percentage of barren females is high in heterozygous females as shown in the table. There is an explanation for this: in all probability, females of this group were used in experiments with determination of hormonal status during pregnancy and their blood was collected with 5 day intervals. This exposed them to continuous stress. Stressing conditions were more obvious in mutant females. It is known, for example, that there are mouse strains more susceptible to stress than others (Borodin, 1987). A similar parallel can possibly be drawn in the given case. According to Osadchuk's data females marked with the *star* differ from those not carrying the gene and, for this reason, respond differently to stressing situations (unpublished data).

Postimplantation mortality was expressed as the difference between implantation site and living embryo number (at sacrifice) or the number of born pups (in females that delivered). The highest percentage of deaths for the postimplantation period of development usually fell at the time of placentation or early organogenesis. As the data of Tables 3 and 4 show, the number of embryos (Table 3) or that of pups (Table 4) in all the cases, with one exception, is lower than implantation level. This evidences for embryonic death after implantation, with the decrease being more substantial in females carrying the *star* gene in the heterozygous or homozygous condition. Sacrifice at days 18-30 of pregnancy demonstrated that postimplantation embryonic mortality in *star* bearers falls at the first stages of postimplantation development, i.e. during early organogenesis.

In contrast, embryonic deaths in silver foxes are distributed throughout the entire postimplantation period and there is a peak falling at early organogenesis, like the one observed for *star* bearers.

Table 3. Number of implantation sites and of living embryos in mutant and standard silver foxes depending on crossing type (data on control sacrifices on the 20-30th days of pregnancy)

Mating type	N matings	Behaviour type	N implantation sites	N live embryos	N pups born
Ss x Ss	9	Domesticated	5.22 ± 0.56	4.33 ± 0.74	
	5	Undomesticated	5.40 ± 0.25	4.80 ± 0.37	
Ss x ss*	11		5.70 ± 0.49	-	4.90 ± 0.52
SS x SS	26	Domesticated	6.77 ± 0.33	6.31 ± 0.37	
	19	Undomesticated	5.89 ± 0.53	5.63 ± 0.52	
Ss x SS	10		2.40 ± 1.03	1.80 ± 0.56	
	10		5.17 ± 0.78	4.25 ± 0.77	

* Females operated after delivery

Table 4. Number of implantation sites and pups born in different mating types to mutant and standard silver foxes (data for females subjected to laparotomy after delivery)

Mating type	N mating	Behaviour type	N implantation site	N pups born	% barren females
Ss x Ss	6	Domesticated	3.17 ± 0.98	1.83 ± 1.01	50
	5	Undomesticated	3.20 ± 1.46	2.60 ± 1.60	60
ss x ss	6	Domesticated	6.33 ± 0.80	6.17 ± 0.65	-
	5	Undomesticated	4.80 ± 1.03	4.80 ± 1.03	-
	5		5.00 ± 0.84	3.80 ± 1.56	40

"Fetal embryonic" is composite, including pre- and postimplantation losses for embryonic mortality in *star* bearers as compared with those for silver foxes not carrying the *star*. Fig. 2 is a histogram representing the values of embryonic mortality for females carrying the *star* gene compared with those for females not carrying the gene.

The data evidence that the level of embryonic mortality in *star* bearers, in all the mating types, ex-

ceeds the level of embryonic mortality in foxes both during the pre- and postimplantation periods.

The above data disagree with those of Belyaev et al. (1979), who have found no differences in the values of embryonic mortality between *star* marked and standard silver females. However, judging by the obtained data, embryonic mortality is not of a selective kind, determined by the genotype of the embryo.

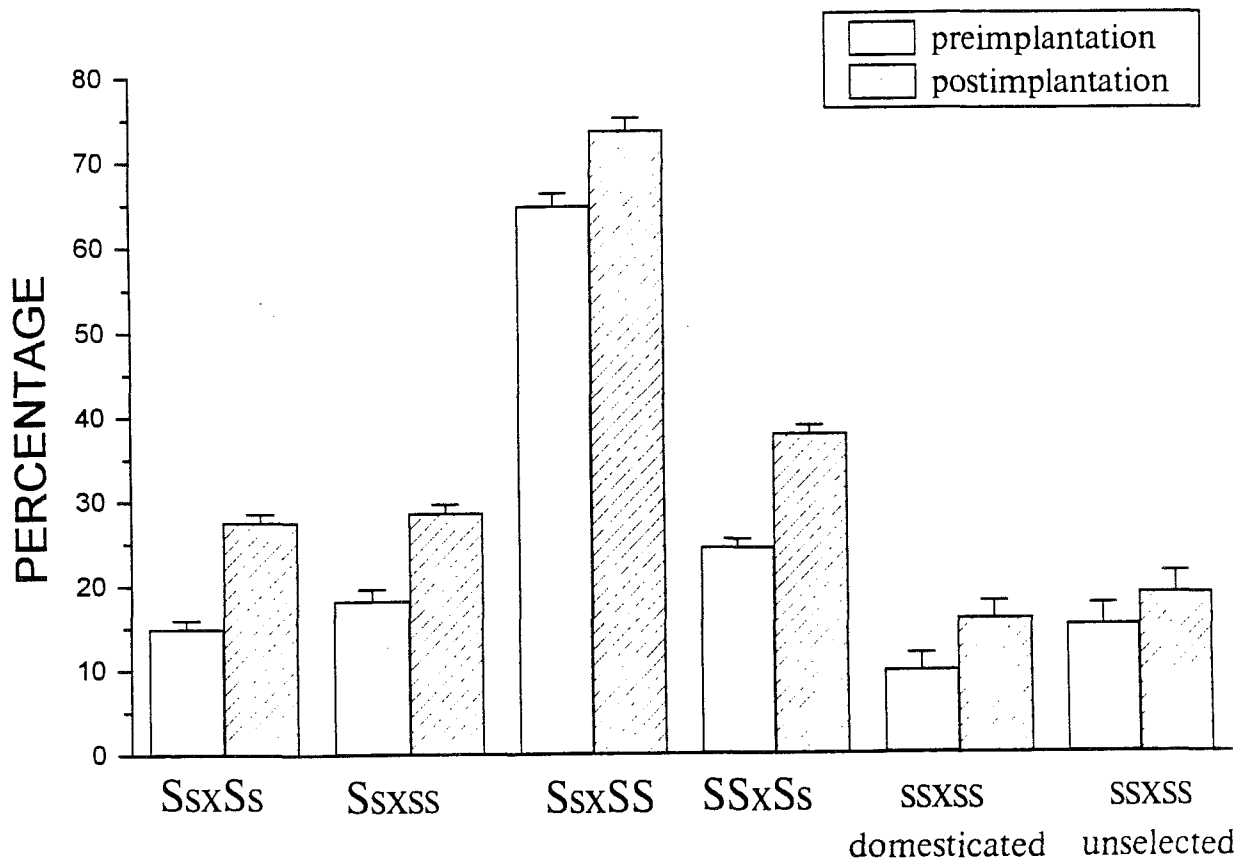


Fig. 2. Embryonic mortality in different crossings between silver foxes heterozygous and homozygous for the *star* gene

Embryonic mortality is much rather dependent on the hormonal status of the female. The data showing the difference in the values of embryonic mortality may be explained by differences in hormone levels between *star* bearers and standard foxes. According to Osadchuk's data, plasma progesterone levels during the implantation-placentation periods and early organogenesis are lower in *star* bearers than in standard silver foxes, and this surely affects the conditions of embryonic development and rate of embryonic losses (unpublished data).

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Studies on motor activity and body temperature of chinchillas (*Chinchilla laniger*)

Auke Antonius Boersma

The motor activity and body core temperature of 6 adult male chinchillas (*Chinchilla laniger* MOLINA 1782) were investigated during a period of several months under constant conditions. The animals were housed singly at an environmental temperature of 16°C, relative humidity 64%, with a light-dark cycle of 12 h:12 h (dark 6:00 p.m. - 6:00 a.m.), food (hay, chinchilla pellets) and water *ad lib*. A videometry system based on modern video and computer technique in combination with a special procedure of lighting was used for recording the motor activity of the chinchillas.

In addition to diurnal and nocturnal activity of the chinchillas, the feeding activity and the activity of the animals while in their rest box could be registered reliably. A radiotelemetry system specially designed for use in small laboratory animals allowed the precise recording of deep body temperature with an accuracy of 0.1°C during the function time (6 months) of the transmitter. A personal computer system collected all measured values via an interface and stored them on floppy disk in intervals of 6 minutes. Further processing of measured data with statistical and chronobiological procedures was carried out to a great extent by computer using BASIC programs and customary software, respectively.

Recording of motor activity by videometry confirmed the nocturnal activity rhythm of chinchillas and allowed it to be described in greater detail: The phase of activity was characterized by successive periods of high activity at irregular intervals, which started at the beginning of the dark phase at 6:00 p.m. and which lasted, with individual differences, 7-11 hrs. The remaining part of a 24-h day consisted of a "phase of relative rest" in which values of inactivity and few short-lasting periods of low or medium activity values were observed. The intensity of these activity periods in the phase of relative rest was in the early morning (after the activity phase) very low and in the afternoon (before the following phase of activity) rather high. A significant 24-h (=dian) rhythm could be shown with a χ^2 -periodo-

gram. The recording of the feeding activity demonstrated that every period of medium and high activity was associated with a meal. Consequentially the feeding activity had a similar significant dian rhythm. The recording of the "rest box activity" of the chinchillas showed that they stayed about the same time in the rest box during their phase of activity as during their phase of relative rest.

The body core temperature of the 6 investigated chinchillas recorded by radiotelemetry at an environmental temperature of 16°C moved mostly between the average daily minimum and maximum of 36.36°C and 38.31°C, respectively. The total mean values of body temperature varied in the relatively narrow range of 37.15-37.38°C. A significant dian 24-h rhythm of body temperature and ultradian 8-h and 12-h rhythms could be found by spectral analysis. The mean daily course of body temperature (24-h plexogram) could be described mathematically by cosinor rhythmometry with a composed cosine function.

Additionally, a positive correlation of the body temperature on the motor activity 6-12 min preceding could be demonstrated. This relation could be illustrated with a linear regression equation. The mathematical and graphical representation of the total daily variability of body temperature, both nycthemeral (24 hourly) and short-term, was possible.

The data for rectally measured body temperature of chinchillas available in literature are partly below the values found in this study. On the one hand, this could be explained by the daily course of body temperature following the circadian rhythm, which causes different measured values dependent on the time of day. On the other hand, the results of this study indicate that there is a temperature gradient in the rectum of the chinchilla which causes a considerable falsification of the rectal temperature by the measurement itself.

In another series of experiments 2 chinchillas were exposed to elevated environmental temperatures of 20°C, 24°C and 26°C over a period of several weeks. A significant reduction of the mean level of motor activity and significant elevation of mean body temperature were observed. In one chinchilla,

the circadian rhythm and the ultradian rhythms were seriously disturbed. These results could be due to a higher sensibility of chinchillas to moderately elevated environmental temperatures than were suggested by the data for the thermoneutral zone of chinchillas given in literature. They confirm the range of environmental temperature of 15-18°C for housing of chinchillas proposed by commercial chinchilla breeders and give reason to think critically about the environmental temperatures at which chinchillas are housed as pet animals.

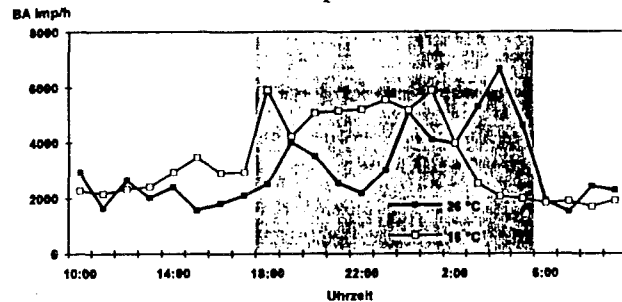


Abb. 26
Mittlere Bewegungsaktivität eines Chinchilla (Chin 1) bei einer Umgebungstemperatur von 16 °C (dünne Linie, weiße Quadrate) bzw. 26 °C (fette Linie, schwarze Quadrate); : durchschnittliche Stundensummenwerte von 42 Tagen (UT 16 °C) bzw. 13 Tagen (UT 26 °C); grauer Hintergrund: Dunkelphase

Tierärztliche Fakultät, Ludwig-Maximilians-Universität, München, Germany. Thesis, 141 pp. In GERM, Su. ENGL. 6 tables, 30 figs., 289 refs. Author's summary.

Hair growth and body weight gain in mink during the growing period

M. Valtonen, L. Jalkanen, L. Blomstedt

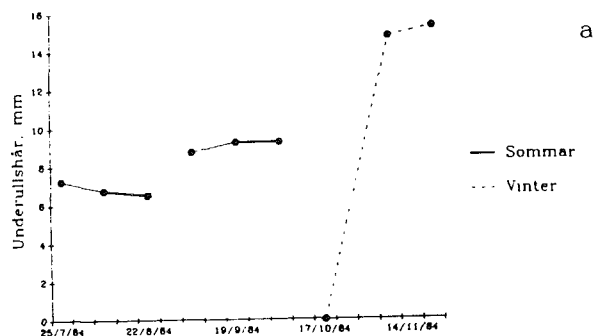


Fig. 1a. Average wool length in 4 male mink kits summer and winter pelts during the growing period.

Hair growth from Aug. to December (from around 3 to 7 months of age) was compared in 12 mink, 6 silver foxes and 9 blue foxes. Maximum hair growth took place in late Oct. in mink, in late Sep. - early Oct. in blue foxes and in Sep. - Oct. in silver foxes, and pelt maturity occurred in early Dec. in mink and in mid-Dec. in foxes. The maximum body weight was attained in late Nov. in mink and blue foxes and in Dec. in silver foxes. Final body weight of blue foxes born in June was similar to that of those born in May. Data are presented in 6 graphs.

Finsk Pälstidskrift 28, 10, pp. 216-217, 1994. In SWED, 6 figs. CAB-abstract.

Effects of melatonin implants in spring on testicular regression and moulting in adult male raccoon dogs (*Nyctereutes procyonoides*)

Y. Xiao, M. Forsberg, J.T. Laitinen, M. Valtonen

Six male raccoon dogs were treated with constant-release implants of melatonin on 29 March, when the animals still had mature spermatozoa and a winter coat. Six untreated animals served as controls.

High serum concentrations of melatonin were found in the treated animals throughout the study period (182.2 and 38.5 pg ml⁻¹ in April and August, respectively). The high serum concentrations of prolactin in April and May (18.9 and 15.7 ng ml⁻¹, respectively) in the controls were not seen in the treated animals. Testicular regression, judged by width of the testis and stage of spermatogenesis, was slowed after melatonin administration.

Testis width from April to June and stage of spermatogenesis in May and June were greater in the treated animals than in the controls; however, from July onwards the differences between the two groups were no longer significant. Serum concentrations of testosterone remained low (below the detection limit in most cases) in both treated and control animals throughout the study period. Melatonin treatment also affected moulting, which was assessed by changes in the number of growing and mature underfur hairs per bundle and the percentage of bundles with a growing guard hair.

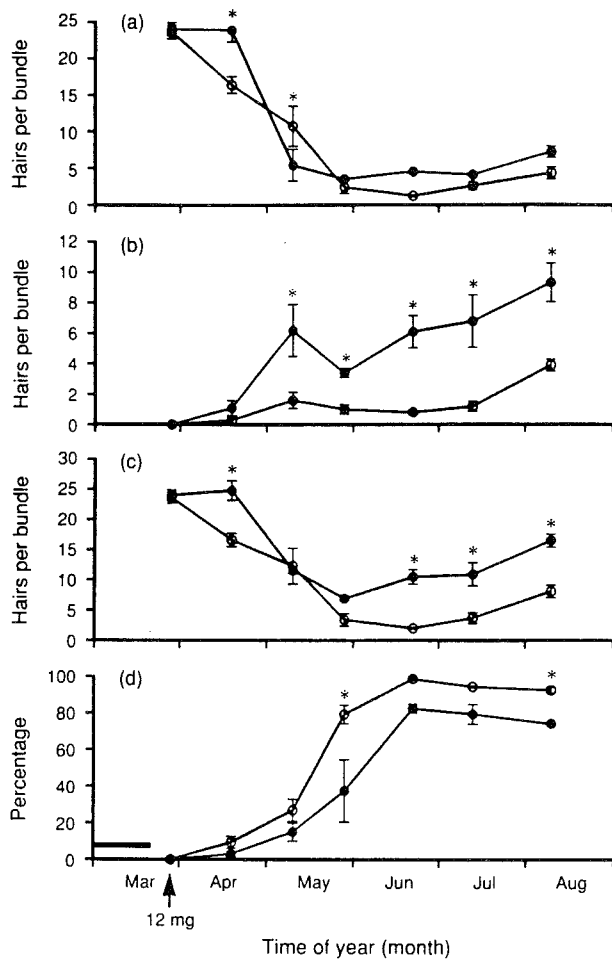


Fig. 4. Variations in numbers of (a) mature, (b) growing and (c) total underfur hairs per bundle, and (d) in percentages of bundles with a growing guard hair in raccoon dogs treated with melatonin implants (●) and untreated controls (○). Means for all variables are calculated from 3-5 animals in each group. The arrow and the number under the arrow indicate the date and dose of melatonin administration, respectively. The horizontal bar indicates the duration of the mating season. *Significant difference between two groups ($P < 0.05$).

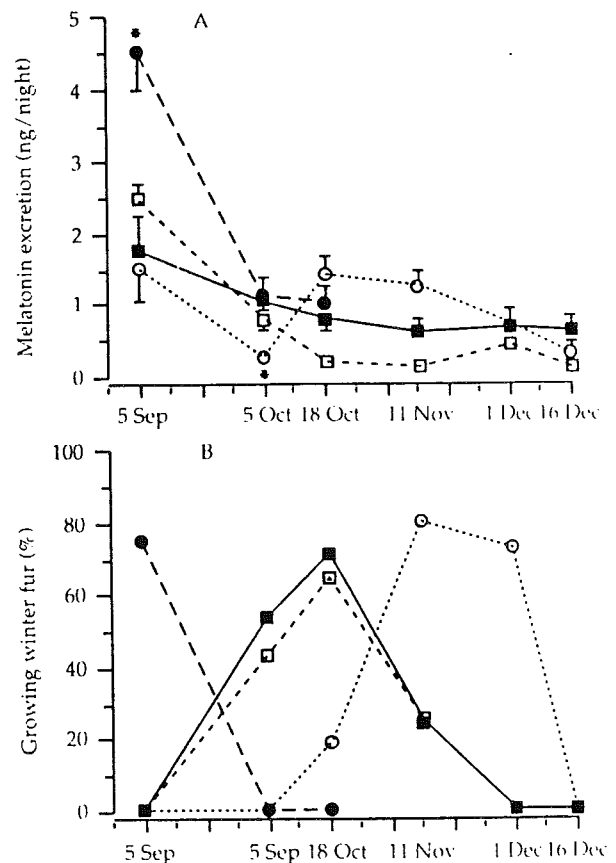
The treated animals showed a more rapid shedding of mature underfur hair and growth of new underfur hairs 6 weeks after melatonin implantation compared with the controls. During the study period, there were significantly more growing underfur hairs per bundle in May to August (4-9 per bundle)

and a lower percentage of bundles with a growing guard hair in May and August (38 and 74%, respectively) in the treated animals compared with controls (1-4 per bundle; 79 and 93%), indicating that melatonin treatment stimulated the initiation of growth of underfur hairs and inhibited that of guard hairs. Although melatonin administration in March slowed testicular regression and maintained an unchanged winter coat in the initial stage, earlier melatonin implantation may delay testicular regression and spring moult more effectively in raccoon dogs.

Journal of Reproduction and Fertility 105, 9-15, 1995. 4 figs., 33 refs. Authors' summary.

Autumnal timing of photoperiodic manipulation critical via melatonin to winter pelage development in mink

M. Valtonen, O. Vakkuri, L. Blomstedt



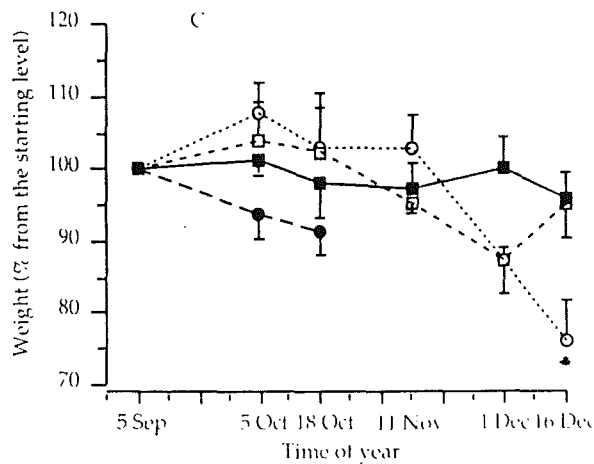


Fig. 2. (a) Urinary excretion of melatonin, (b) winter fur development monitored as percentage of growing underfur hairs during autumn (from September to December) and (c) weight development monitored as percentage of the starting weight in four groups of mink subjected to different photoperiods (mean \pm s.e., three mink per group). ■=Natural photoperiod (group 1); ○=18L:6D from 7 September to 14 October (group 2); □=18L:6D from 14 October (group 3); ●=melatonin implant 14 July, 18L:6D from 7 September (group 4) * $P<0.05$ v. control.

Quantitative collection of night-time urine every 2nd week was used to elucidate the temporal relationship between changes in melatonin production, weight gain, and priming of the winter pelage under natural light conditions and under a long photoperiod (18L:6D) imposed at different times in four groups of female mink during autumn. In mink maintained outdoors under the natural photoperiod (group 1), melatonin excretion was 1.80 (s.d. 0.80) ng per night (no.=3) at the beginning of September, thereafter it began to decrease slowly until November when it was only 0.62 (s.d. 0.32) ng per night. These mink had a normal autumn moult during the first half of October and the winter pelage was mature at the end of November. When mink maintained outdoors were transferred to 18L:6D on 7 September (group 2), excretion of melatonin decreased promptly, autumn moult was disrupted and winter fur priming delayed. A long photoperiod after mid-October (group 3), did not interfere with pelage maturation despite the decrease in melatonin production. Mink implanted with melatonin on 14 July (group 4) showed very high melatonin excretion in early September. In these animals the winter pelage growth was unaffected by the long-day conditions; the pelage matured in mid-October. Body

weight increased in mink of all groups during the autumn. This increase levelled off or a weight loss (group 2) was seen along with the final hair maturation. Activation of hair follicles occurred during a 4 to 6 week period. According to these results, melatonin is the photoperiodic signal to autumnal weight increase and autumn moult but seems not to be necessary for later pelage growth and maturation.

Animal Science 61, pp. 589-596, 1995. 2 tables, 2 figs., 35 refs. Authors' abstract.

Immunohistochemical study on the gastro-entero-pancreatic (GEP) endocrine cells of the blue fox, *Alopex lagopus*

J.H. Lee, H.S. Lee

The regional distribution and relative frequencies of endocrine cells were studied in nine portions of blue fox GI tract, and the distribution pattern and cell types of the pancreatic endocrine cells were also studied in the pancreas by the immunohistochemical method. Six kinds of immunoreactive cells were identified in the GI tract, and four kinds of immunoreactive cells were also identified in the pancreas. Although numerous 5-HT- and somatostatin-immunoreactive cells were seen throughout the GI tract, there were few in the intestine. Very numerous Gas/CCK-immunoreactive cells were restricted generally in the pyloric region and duodenum. Numerous glucagon-immunoreactive cells were found in the stomach except the pyloric region, and generally few in the intestine. A moderate number of BPP-immunoreactive cells were found in the stomach except the pyloric region, and a few in the large intestine. Numerous porcine CG-immunoreactive cells were restricted to the cardiac and fundic region. In the pancreas, four types of pancreatic endocrine cells-somatostatin-, glucagon-, BPP- and insulin-immunoreactive were identified in the pancreatic islet and exocrine portion. These results suggest that the regional distribution, the relative frequencies and cell types of the GEP endocrine cells in the GI tract and pancreas vary considerably among species.

Korean Journal of Veterinary Research, Vol. 33 (4), pp. 579-589, 1993. 2 tables, 7 figs., 45 refs. Authors' summary.

Bilateral adrenalectomy induces early onset of summer fur growth in mink (*Mustela vison*)

Jack Rose

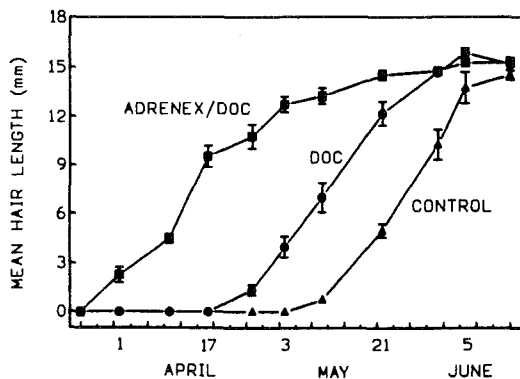


Fig. 1. Fur growth of adult female standard dark ranch mink subjected to bilateral adrenalectomy and treated with deoxycorticosterone (ADRENEX/DOC, N=4), treated with deoxycorticosterone (DOC, N=16) only, and control (N=4) from 25 March to 13 June 1991.

The purpose of this study was to determine the effects of bilateral adrenalectomy of adult female mink between 2 and 11 March 1991, supplemented with deoxycorticosterone (DOC) as a mineralocorticoid, which resulted in the onset of the summer fur growth approximately 5 weeks earlier than the controls ($P < 0.01$). Mink with their adrenal glands intact and treated with DOC, exhibited summer fur growth 2 weeks earlier than the controls ($P < 0.01$). The duration of time between the first observed hair growth and attainment of maximal guard hair length, was approximately 10 days longer in mink with their adrenal glands intact and supplemented with DOC than the controls ($P < 0.05$). Adrenalectomized mink treated with DOC exhibited guard hair growth for approximately 13 days longer than controls ($P < 0.05$). Although exogenous DOC initiated hair growth, the rate of growth appeared to be reduced.

These data suggest that adrenal hormones, of undetermined identity, exert a tonic inhibitory effect

on the initiation of summer fur growth in mink and may be part of the mechanism through which changes in photoperiod regulate the onset of hair growth cycles.

Comp. Biochem. Physiol. Vol. 111C, No. 2, pp. 243-247, 1995. 1 fig., 37 refs. Authors' summary.

Presence of mammosomatotropic (MS) cells in mink (*Mustela vison*) adenohipophysis

Sergio Vidal, Antonio Ruiz-Navarro, Francisco Gracia-Navarro, Lucas Moya

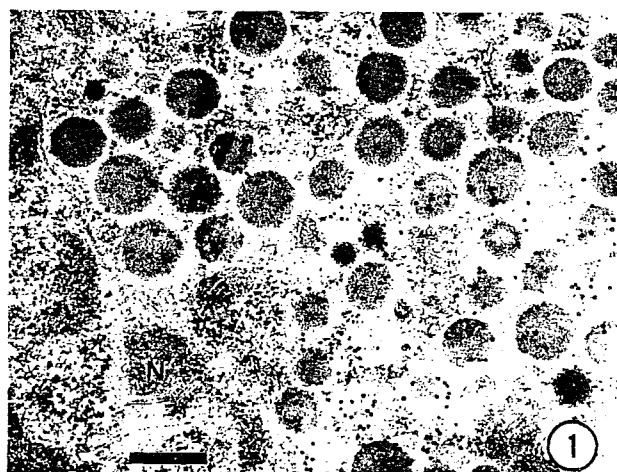


Fig. 1. Growth hormone cell of suckling mink. Nucleus (N). Secretory granules were immunolabeled with gold particles 20 nm. x 20,000; bar=0.5 μ m.

This study was undertaken to investigate the presence of mammosomatotroph (MS) cells in suckling mink. Using the double immunolabeling procedure, with colloidal gold as a label, we demonstrated the existence of MS cells in these animals. Only one type of MS cells has been observed. These cells showed a great morphological similarity to classic prolactin (PRL) cells. MS cells of suckling mink were pleomorphic in appearance with many processes, their nuclei were irregular and their Golgi apparatus and endoplasmic reticulum were poorly developed. Their secretory granules were small (about 144 nm in mean diameter) and round.

Two types of secretory granules have been found: monohormonal including PRL (the more frequent) and growth hormone (GH) (very scanty) granules, and bihormonal granules distributed between the former. We propose that MS cells of the mink, like other species, could represent an intermediate cell type in the transformation process of GH cells into PRL cells.

Tissue & Cell 27, 1, pp. 79-84, 1995. 3 tables, 5 figs., 26 refs. Authors' abstract.

The ventricles of the brain in the N. American mink (*Mustela vison* (Brisson, 1756))

Danuta Goscicka, Wojciech Stankiewicz, Michal Szpinda

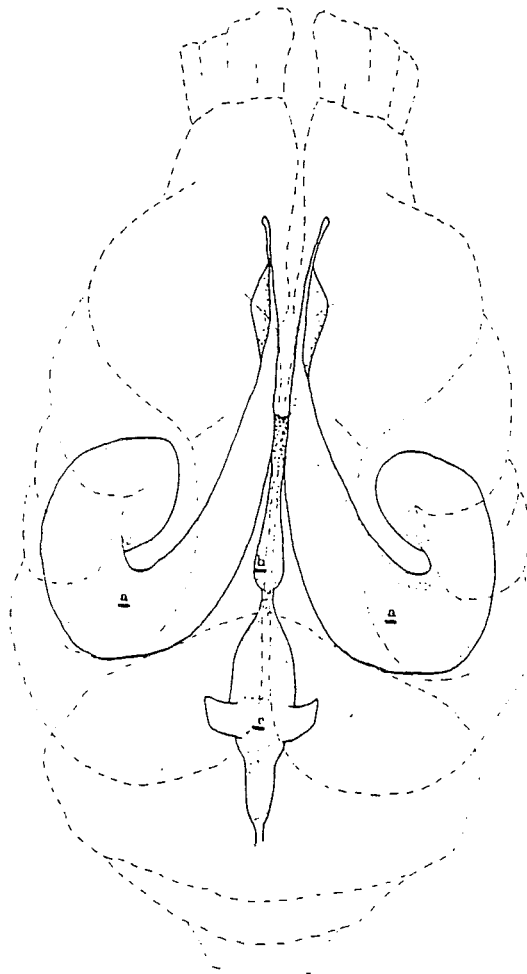


Fig. 1. Ventriculi encephali *Mustelae vison* (aspectus superior): a - ventriculus lateralis, b - ventriculus tertius, c - ventriculus quartus.

Using anatomical as well as radiographic and topographic methods, sixty brains of the N. American mink were examined. It was found that the brain consists of four ventricles. Also, it was noted that the posterior horn was missing and that there was an olfactory recess present in the lateral ventricle, a large-size interthalamic connection present in the third ventricle, and a flat, necklace-like bottom in the fourth ventricle. The ins and outs of the mink's anatomical structure have only recently begun to absorb anatomists. Apparently, it is related to the fact that fur animals, among them mink, are being domesticated as if "before our eyes". For this reason and because of the easy access to material, examination of the brain ventricles in the mink was taken up.

Archivum Veterinarium Polonicum, 33, 3-4, pp. 237-248, 1993. 13 figs., 14 refs. Authors' summary.

Heat production of adult blue chinchilla in dependence on ambient temperature, feed level and sex

Arthur Chudy, J. Wuensche

A feeding experiment (ad libitum) and five series of respiration experiments in one climatic chamber (24 hours measurements, indirect calorimetry) with different feeding levels (0, 40, 70 and 100% of the ad libitum feeding) and ambient temperatures (5 - 25°C) were carried out in adult **Blue Chinchillas** (LW 450 - 550 g).

Chinchillas have about 1/3 lower feed and energy requirements compared to other species. The feed intake even on ad libitum feeding is to meet the energy requirements (maintenance) only and not for fat storage. Males require about 15% more than females.

The energy metabolism depend mostly on ambient temperature: the maintenance requirement (heat production) amounts to 361 (=100%), 272 (76%) and 184 (51%) kJ ME/kg LW^{0.75} at 5°C, 15°C and 25°C respectively. That means about ± 9 kJ ME/kg LW^{0.75} / 1°C temperature change.

The thermoneutral zone is placed above 25°C. Below thermoneutrality there is no relationship

between intake of metabolizable energy and heat production. This means that in these "thermoisolated" species of animals up to the energy equilibrium feed- and body nutrients replaced energy equivalent (utilization = 100%!) to the coverage of the heat requirement below thermoneutrality.

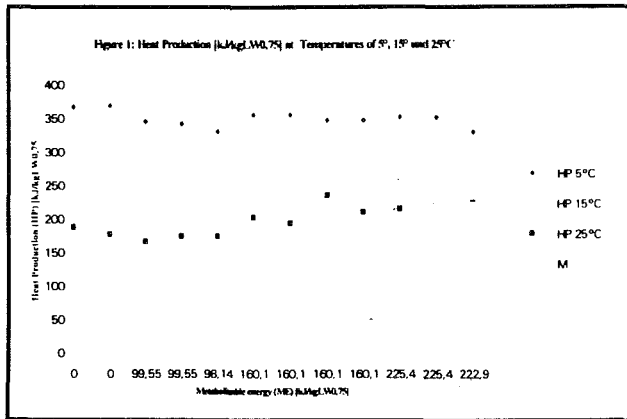


Fig. 1. Heat production (kJ/kg LW^{0.75}) at temperatures of 5°, 15° and 25°C.

Archiv für Tierzucht (Germany), Vol. 37 (Spec. no.) pp. 186, 1994, Poster. 3 tables, 2 figs., Authors' summary.

Increasing environmental stimulation for fur-bearers. 2. Use of cage area and activity

H. Korhonen, S. Alasuutari

In mid-Aug., 8 blue fox cubs, born in May, were placed in an enclosure with an earth floor, measuring 17 x 19 x 8 m, and their behaviour was monitored by video camera and visual observation for periods of 24 h.

It was not possible to establish any significant differences in behaviour, growth rate, pelt quality or animal welfare between the foxes in the enclosure and those in standard, shaded cages.

Finsk Pälstidskrift, 28, 10, pp. 226-229, 1994. In SWED, 3 tables, 2 figs., 4 photos. CAB-abstract.

A comparison of pelt development in blue foxes born early or late in the season

Leena Blomstedt

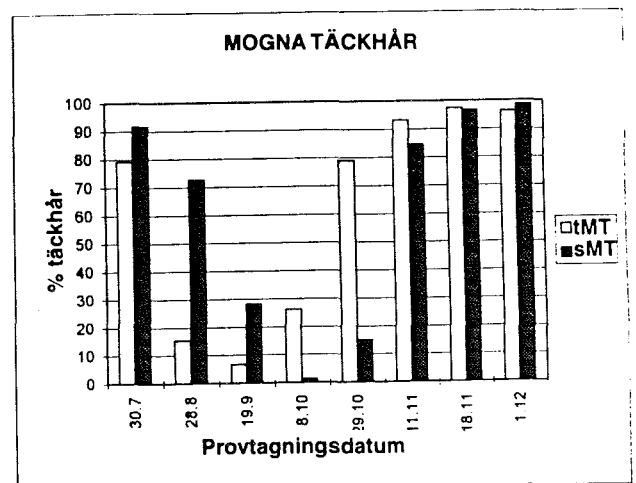
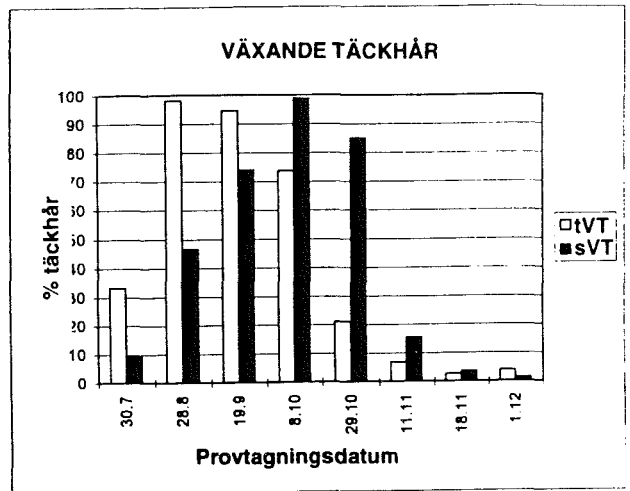


Fig. 1. Per cent (%) growing and mature guard hairs from August to December in blue foxes born in the first week of May (early group, 4♂) or June (late group, 4♂). tVT: the early group, growing guard hairs, sVT: the late group, growing guard hairs, tMT: the early group, mature guard hairs, sMT: the late group, mature guard hairs.

Hair samples were obtained on 8 occasions from 30 July to 1 Dec. from 8 blue fox males born during 4-7 May or 1-4 June (groups 1 and 2, respectively). Although 65% of foxes in group 1 had mature

underfur in mid-Nov. vs. 50% of males in group 2, the difference between the groups (81 vs. 77%) was not significant at the end of Nov., and there were no significant differences between groups in the percentage of mature guard hairs from 18 Nov. Body weight was significantly higher in group 1 than in group 2 in Aug. and Sep. only.

Finsk Pälstidskrift 29, 11, pp. 281-283, 1995. In *SWED*, 3 figs., 4 refs. *CAB-abstract*.

Increased environmental stimulation for foxes. Trials with group housing.

H. Korhonen, P. Niemelä

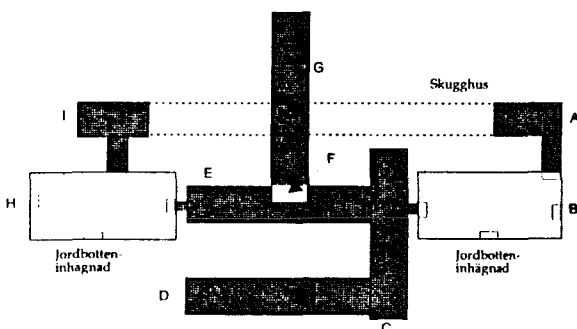


Fig. 1. Schematic illustration of group housing seen from above.

The performance of 15 male and 15 female blue foxes placed in group housing in 9 sections with access to social interaction and recreational areas from weaning to pelting was compared with that of 15 males and 15 females housed in traditional single cages.

On 25 Oct., body weights of group-housed males and females averaged 9.8 and 7.5, respectively, vs. 9.3 and 8.4 kg for individually housed foxes ($P < 0.01$). Daily feed intake was 50 g higher in group-housed than individually housed foxes, and pelt quality was poorer in the former than in the

latter. There was no significant difference between the 2 groups in behaviour towards humans.

Finsk Pälstidskrift 29, 3, p 60-63, 76-77, 1995. 4 tables, 2 figs., 3 pictures, 3 refs. In *SWED*. *CAB-abstract*.

Finnish investigations on the welfare of farmed foxes (review)

M. Harri

An account is given of recent research in Finland on the effects of housing on the behaviour, production, reproduction and welfare of silver and blue foxes.

Finsk Pälstidskrift 29, 5, p 120-123, 1995. *CAB-abstract*.

Wire netting or earth floors for foxes?

H. Korhonen, P. Niemelä, S. Alasuutari

An account is given of 3 trials in Finland, in which silver and blue foxes were housed in cages or large enclosures and provided with shelves or platforms made from wire netting or wood.

Wire netting surfaces were found acceptable by foxes in all trials, and foxes showed a greater preference for high than for low shelves.

Finsk Pälstidskrift, 29, 8-9, pp. 206-209, 1995. In *SWED*, 3 figs., 3 tables, 4 photos. *CAB-abstract*.

Raccoon dogs chose the cage

S. Alasuutari

The behaviour of 3 pairs of raccoon dogs, kept in a cage for 2 years before being released in January into a large, enclosed area at an experimental farm in Finland, was monitored by video cameras. Given the choice of a raised cage, reached by an enclosed ramp, wooden huts on the ground or underground

shelters, the animals chose to give birth and rear their litters (to 3 weeks of age) in the cage.

Finsk Pälstidskrift, 29, 10, pp. 238-239, 255, 1995. In SWED, 3 photos, 3 refs. CAB-abstract.

Blood lead levels of wild raccoons (*Procyon lotor*) from the Eastern United States

A.N. Hamir, D.T. Galligan, J.G. Ebel, Jr., K.L. Manzell, C.E. Rupprecht

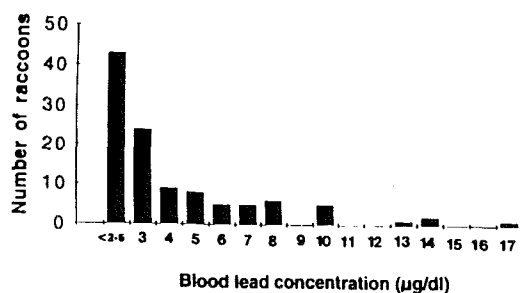


Fig. 1. Blood lead levels of 109 raccoons from New Jersey, USA, June to September, 1992.

We analyzed 161 raccoon (*Procyon lotor*) blood samples obtained from New Jersey (n=109), rural Pennsylvania (n=29) and laboratory confined animals (n=23) in the USA for lead content; we found significantly higher levels in the New Jersey raccoons (mean = 4.4 µg/dl, SE = 2.9). There was no difference between the lead levels of raccoons from the other two groups (mean = 2.6, SE = 0.5 and mean = 2.5, SE = 0, respectively).

Journal of Wildlife Diseases, 30 (1), pp. 115-118, 1994. 1 fig., 19 refs. Authors' abstract.

Home range of the raccoon dog (*Nyctereutes procyonoides*) in southern Finland

K. Kauhala, E. Helle, K. Taskinen

Home ranges, relationships between individuals and dispersal among raccoon dogs (*Nyctereutes procyonoides*) were studied in southern Finland in 1989-91. The average maximum home range, calculated by the harmonic mean method, was 9.5 km² and the

core area (85% utilization) 3.4 km². There were no statistically significant annual, seasonal or sexual differences in the size of the average core area of adults, but the home ranges of juveniles in autumn were larger than those of adults. However, the maximum home ranges of adults were larger in autumn than in summer, especially those of males, which were conspicuously small in summer and large in autumn. The core areas of adjacent pairs did not usually overlap in the pup-rearing season, but in autumn some home ranges shifted and there was much more overlap. The home ranges of the male and female of a pair overlapped almost totally, and a male and a female sharing the same home range also travelled together or close to each other, thus supporting the idea that the raccoon dog is monogamous in Finland. None of the adults left the study area, but 38% of the juveniles were recovered further than 10 km from the marking place during the first autumn.

J. Zool. Lond. 231, pp. 95-106, 1993. 1 table, 6 figs., 38 refs. Authors' summary.

Age determination of the raccoon dog in Finland

Kaarina Kauhala, Eero Helle

We compared the age determination using the relative width of the pulp cavity in the lower canines and the one using the ossification stage of the epiphyseal cartilage of the radius and ulna with the most reliable method, namely, that based on the incremental lines in the tooth cementum in order to find a quick and reliable method for identifying young raccoon dogs *Nyctereutes procyonoides* (Gray, 1834), in Finland. Most juveniles could be identified by means of the pulp cavity/tooth diameter ratio in early autumn, and a remarkable proportion of them could still be separated from adults in late autumn and early winter. When using a separation point of 50%, only 2% of adults were determined as young. In spring, by contrast, the method is of no use, because the pulp cavity/tooth diameter ratio rarely exceeds 50% even in the young. All individuals killed before December were correctly aged from the ossification stage of the long bones. In December-January the proportion of incorrect determinations was 2-3%, but in spring it rose rapidly, being 17% in April-May. Until the end

of February this method is very safe; no adults are determined as young. In conclusion, the best method for identifying juveniles in the present study is that using the ossification stage of the long bones until the end of February. The method using the relative width of the pulp cavity is less practicable especially in late autumn. Neither of these methods works well in spring, so, at that time all animals should be aged from the incremental lines.

Acta Theriologica 35 (3-4), pp. 321-329, 1990. 4 figs., 35 refs. Authors' summary.

Age structure, mortality, and sex ratio of the raccoon dog in Finland

Eero Helle, Kaarina Kauhala

We studied the age, sex structure, and mortality of a population of the raccoon dog (*Nyctereutes procyonoides*) in southern Finland from 1986 to 1990. The sex ratio was 1:1. There were no sexual differences in age structure. In the course of the study, the population declined slightly, which was taken into account when life tables were calculated.

The age structure of the captures in autumn were rather stable in successive years. Life tables were calculated by two methods; by treating the captures from the breeding season (March-April) as a random sample of the population, and by treating the year-round captures (from August to May) as a sample of the animals that die in the course of 1 year.

The two life tables did not differ statistically; the annual mortality rate of the population in southern Finland was 80.5% (54 and 51% for adults, and 88 and 89% for juveniles, respectively). According to the life table based on the random sample of the population, the mortality rate was lowest among 2-4-year-old raccoon dogs and increased after 5 years of age, maximum life span was 7-8 years. Because of heavy pressure from hunting, mortality among juveniles was high, which may have resulted in a high rate of reproduction.

J. Mann. 74 (9), pp. 936-942, 1993. 2 figs., 3 tables, 38 refs. Authors' summary.

Reproduction in the raccoon dog in Finland

Eero Helle, Kaarina Kauhala

Reproduction of the raccoon dog (*Nyctereutes procyonoides*) was studied on the basis of 632 female carcasses in Finland in 1986-1990. In Finland, raccoon dogs usually mate from February to April, with a peak in March. Differences occurred both regionally and with respect to age, with older females breeding earlier than younger ones. Fecundity (number of corpora lutea per breeding female) averaged 11.5, with variation in fecundity occurring both annually and regionally, but not in relation to age of females. Embryonic litter size averaged 9.6 and was highest among females 3-5 years old. Litter size at birth averaged 8.8 and also peaked at 3-5 years of age. Loss of ova and preimplantation mortality averaged 15% in southern Finland, but was as high as 30% in the northeastern part of the study area. Because fetal mortality averaged an additional 5-10%, total prenatal mortality may surpass 20%. The proportion of reproducing females averaged 78%, increasing with age, as did productivity (number of young per female), increasing from 5.5 at 1 year of age to 8.2 at ≥ 3 years. Reproductive value was highest among 2-year-old females. Reproduction in raccoon dogs is strongly affected by climate and weather, and the availability of food (voles and berries) in relation to population density. The abundance of food and population density influence growth (including sexual maturation) of young raccoon dogs and their condition (fat reserves). In adult females, condition mostly affects annual variation in litter size at birth, whereas, in young females, it affects the regional variation in the proportion of reproducing females.

Journal of Mammalogy 76 (4), pp. 1036-1046, 1995. 1 table, 6 figs., 38 refs. Authors' summary.

Local distribution of pelt production in 1993-94

J. Mäkelä, M.B. Johansson

In 1993-94, in Finland, the production of mink pelts totalled 1,566,700 (vs. 1,512,120 in 1992-93), that of fox pelts 1,149,934 (a reduction of 6.7%), that of raccoon dog pelts 70,775 (vs. 52,000) and that of

polecat pelts 92,820 (vs. 70,000). Data are tabulated by district, farm size and colour type, and details are given of pelt quality and prices.

Finsk Pälstidskrift 28, 12, p 297-301, 1994. 23 tables. In SWED. CAB-abstract.

Population of fur bearers in 1995

Per Clausen

In 1995, in Denmark, the numbers of breeding females were as follows: mink, 1,834,169; blue fox, 10,210; silver fox, 5184; shadow fox, 1057; polecat, 256; raccoon dog, 123; chinchilla, 6239. Of the mink females, 24, 64, 5, and 3% respectively were Scanblack, Scanbrown, Pastel and Pearl. Data are tabulated by district and farm size, and numbers are compared with those in previous years.

Dansk Pelsdyravt 58, 5, p 198-199, 1995. 6 tables. In DANH. CAB-abstract.

The 100,000 limit will be breached next year

K. Smeds

In 1995, in Finland, 31,000 mink, 57,000 fox and 3300 raccoon dog breeding females participated in the Sampo litter recording scheme vs. 24,000, 45,000 and 4000 respectively in 1994.

Finsk Pälstidskrift 29, 4, p 88, 1995. 1 table. In SWED. CAB-abstract.

Annual report 1994

Anonymous

An account is given of the reproductive performance in 1990-1994 of mink, polecat, blue, silver, and crossbred foxes and raccoon dog females in Finland, and of AI in foxes. Details are also given of pelt production, health and research, and economic aspects are considered.

Finsk Pälstidskrift 29, 5, p 124-150, 1995. In SWED. Many tables and figures. CAB-abstract.

Collagen characteristics of skin, fell, and epimysium from rams, wethers, and zeranol-implanted ram lambs

G. Maiorano, R.J. McCormick, R.A. Field, G.D. Snowden

Eighteen spring-born Columbia ram, wether, and zeranol-implanted ram lambs were examined to determine the influence of castration or zeranol implantation on collagen characteristics of skin, fell, and epimysium and possible relationships between collagen properties of each tissue and difficulty of pelt removal. Pelt removal force was lower in wethers than in rams ($P < .05$) and intermediate for zeranol-implanted rams. Collagen concentration in skin of rams was greater ($P < .05$) than that in wethers or implanted rams, but percentage of heat-soluble collagen in skin was higher in implanted rams. Percentage of type III collagen in skin was highest in rams and lowest in wethers ($P < .05$); that in the skin of implanted rams was intermediate. The fell of wethers contained a higher ($P < .05$) collagen concentration, higher insoluble collagen amount, and lower percentage of soluble collagen than that of rams or implanted rams. The fell had a lower percentage of type III collagen than that of rams ($P < .05$). Epimysium collagen concentration of rams and wethers was higher ($P < .05$) than that of implanted rams; however, percentage of soluble collagen was higher for the implanted rams than for the other classes. Type III collagen percentage in the epimysium did not differ by animal class ($P < .05$).

Zeranol-implanted ram lambs had a higher percentage of soluble collagen in all tissues examined than did non-implanted rams and force required for pelt removal was reduced in implanted rams. Overall, however, there seem to be few clear relationships between the characteristics of collagen evaluated and force required to remove the pelt when rams and wethers are compared. The composition of the fell is different from that of skin and epimysium and a more complete description of its characteristics as well as elucidation of putative interactions between the fell and skin or epimysium may serve to explain differences in difficulty of pelt removal.

J. Anim. Sci. 73, pp. 393-398, 1995. 4 tables, 35 refs. Authors' summary.



Breeding of orphaned young animals. 1. Indication and composition of mothers milk

E. Kienzle, E. Landes

In this investigation the indication for handrearing of sucklings is discussed. The composition of mother's milk of various species (dog, cat, guinea pig, chinchilla, rabbit, hare, hedgehog, roe and red deer, seal) is given.

In the milk of all these species the energy content is higher and water content is lower than in cow's milk. Water content amounts to less than 50% in seal's milk, hares and rabbits show about 70% water in the milk and the other species about 80%. As a rule of thumb the water content correlates with the lactose content in the milk. There is a tendency to shorter chain length and higher degrees of saturation in the milk fat of herbivorous than in omni- or carnivorous species.

Calcium content increases with increasing energy concentration, the ratio amounts to between 300 and 700 mg Ca/MJ, the ratio of calcium/phosphorus to between 1.2 and 1.6 (exception seals 50 mg Ca/MJ, Ca/P 1/1.4). As far as investigated, the milk of the species named here contains more iron and copper than cow's milk.

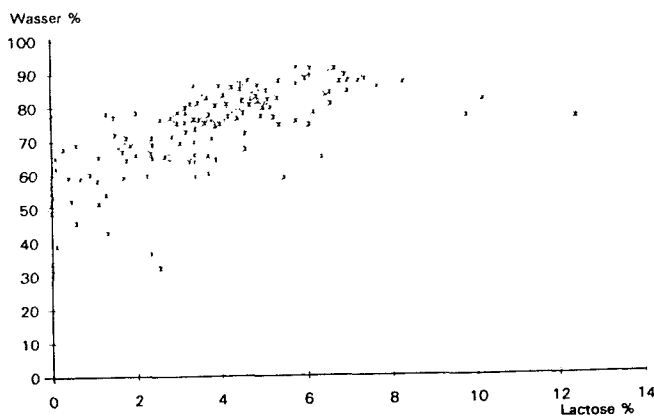


Fig. 1. Beziehungen zwischen dem Laktose- und Wassergehalt in der Milch verschiedener Spezies nach Literaturangaben.

Kleintierpraxis 40, Heft 9, pp. 633-728, 1995. In GERM, Su. ENGL, FREN. 1 table, 1 fig. Authors' summary.

Breeding of orphaned young animals. 2. Production of milk substitutes and practice of motherless breeding

E. Kienzle, E. Landes

In this review recipes for milk substitutes for various species (dog, cat, red- and roedeer, rabbit, hedgehog, guineapig, hamster, chinchilla, seal) are collected. Options for evaluation of commercial products are given. Data on energy requirements, the correct amounts of milk substitutes, number of meals per day, feeding technique and the husbandry of sucklings are given.

Kleintierpraxis 40, Heft 9, pp. 633-728, 1995. In GERM, Su. ENGL, FREN. 3 tables, 49 refs. Authors' summary.

Space use and activity in a mediterranean population of badgers *Meles meles*

Alejandro Rodriguez, Rosalia Martin, Miguel Delibes

Activity, spatial ecology, and pattern of sett use of a mediterranean population of badgers *Meles meles* Linnaeus, 1758, are described. Data come from Donana National Park (SW Spain) where a 1-year radio-tracking study and a 9-year capture-recapture study were carried out.

Badger home ranges were spatially structured, territories having an average size that is the largest reported in the literature. There was a correlation between territory size and ecological variables reflecting food patch dispersion.

It is suggested that badgers might set territory limits to include enough patches of rabbit burrows in the critical summer period of low rabbit abundance. Badgers were not strictly nocturnal, and showed decreased activity levels in winter. Activity levels were higher in badgers living in dry habitats, and in all badgers during the dry season. Both photoperiod and rabbit availability were suggested as factors influencing activity parameters like activity length or resting intervals during activity periods. Differ-

ences in the pattern of use of the main and secondary setts were found between reproductive females and other individuals.

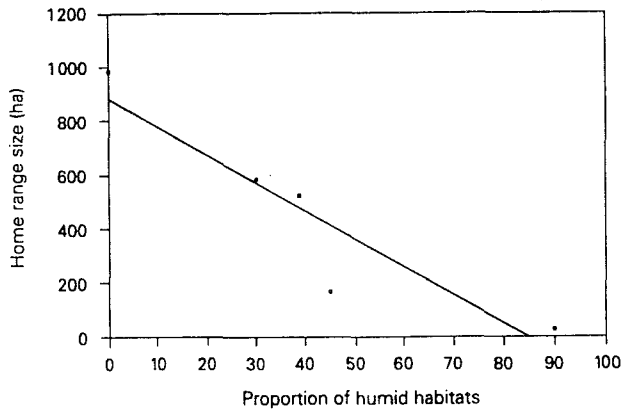


Fig. 2. The relationship between home range size of individual badgers and the arcsin transformed proportion of humid habitats contained in their ranges.

Acta Theriologica 41 (1), pp. 59-72, 1996. 4 tables, 2 figs., 43 refs. Authors' summary.

Determination of the normal values on physiology, biochemistry and haemorheology of mink

Liu Zhiqiang, Bei Nianxiang, Ye Lin, Huang Juncheng, Yao Gang, Wei Bin, Li Xinping, Wang Zhiqin, Xiao Yuedong, Zhang Jingyu

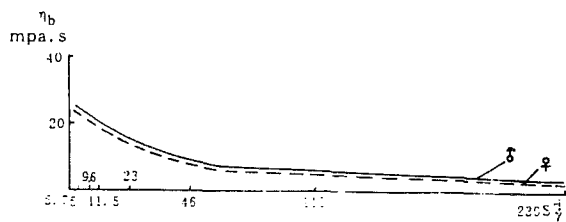


图 切变率对血液粘度的影响

Fig.1. The effect of shearing rate to blood viscosity.

The mink belonged to the Rettus of Mammalia, which were a kind of precious fur animals. The mink of the College Raising Farm were imported from Norway, Denmark, England, USA, and Canada in the sixties. The authors measured the normal values of physiology, biochemistry and

haemorheology of these mink. From 1991 to 1992, some values were dealt with biostatistics. We could not find any reports on the normal values of physiology, biochemistry and haemorheology of the mink through the international information system.

Acta Veterinaria et Zootechnica Sinica, 26, 3, pp. 255-260, 1995. In CHIN, Su. ENGL. 1 fig., 3 tables, 10 refs. Authors' summary.

Morphological convergence of the polecat (*Mustela putorius*) and the American mink (*Mustela vison*) toward the European mink (*Mustela lutreola*)

T. Lodé

We studied the external morphology of the face, colour of pelage and body weight in 52 American mink, *Mustela vison* (3 young and 49 adults) and 295 polecat, *M. putorius* (65 young and 230 adults, killed in collisions with vehicles or captured in the western and central part of France between 1986 and 1993. The same morphological characters were studied in 28 captive-bred polecat. We took morphometric measurements of the skulls of 43 adult polecat (34 males and 9 females) and 12 adult American mink (9 males and 3 females).

These data were compared among each other, and with data of European mink, *M. lutreola*, taken from the literature. Three percent of the adult road-killed or captured polecates showed a phenotypic divergent trait associating a dark pelage (face and body, melanistic form) and very low body weight, indicating a convergent evolution in morphology toward the European mink. Six percent of the adult road-killed or captured American mink had an asymmetric white spot on the upper lip, which also indicates a morphological trait evolving convergently in this species and the European mink. The concomitant obtention of several cranial measurements made identification of these three mustelid species much easier. Differentiation in living animals, however, is still a delicate matter. To distinguish polecat from European mink, the following diagnostic characters should be observed: length of dorsal guard hair and contrast between underfur and guard hair, and to distinguish American mink from European mink the absence or asymmetry of the white spot on

the upper lip, and body weight. To recognize European mink with certainty, it is important to apply several diagnostic criteria simultaneously. By taking only one criterion into account confusions may arise due to the above-mentioned convergence of morphological characters.

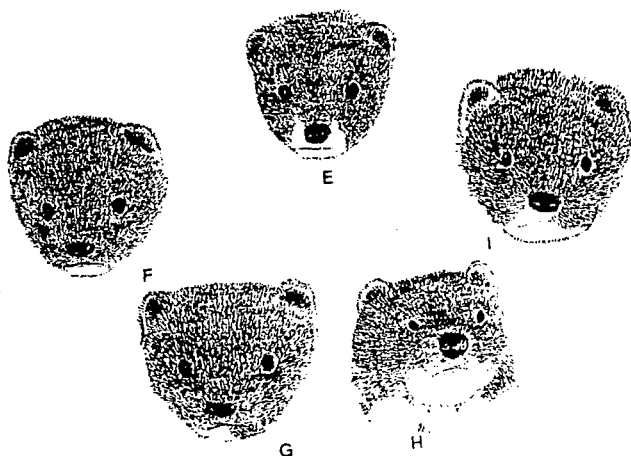


Fig. 2. Drawing representing the different facial patterns of the American mink, *Mustela vison* (F: typical individual, G: asymmetric spot, H: diffuse spot on upper lip, and I: asymmetric spot on upper lip), in comparison to the facial pattern of the European mink, *Mustela lutreola* (E).

Gibier Faune Sauvage, Game Wildl., Vol. 12, pp. 147-158, 1995. In FREN, Su. ENGL, GERM. 2 tables, 2 figs., 21 refs. Author's abstract.

Skeletotomy of the gall bladder in American mink (*Mustela vison* (Brisson, 1756))

Danuta Goscicka, Piotr Flisinksi

Using anatomical and radiological methods, the projection of the gall bladder was studied in relation to the vertebral column in fifty adult mink of both sexes. The gall bladder was found to be in three positions when in relation to: 1) the longitudinal axis of the vertebral column, 2) the numerical order of the vertebrae.

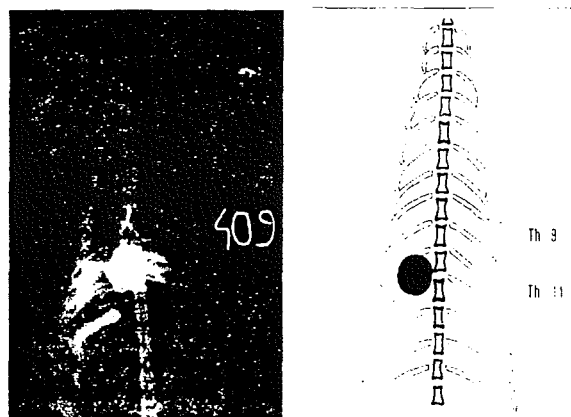


Fig. 2. Photoradiogram and schema: the gall bladder in mink in the intermedial position.

Archivum Veterinarium Polonicum 34, 1-2, pp. 127-131, 1994. 3 figs., 6 refs. Authors' summary.

The triangle of the urinary bladder in American mink (*Mustela vison* (Brisson, 1756))

Danuta Goscicka, Elzbieta Krakowiak, Malgorzata Kepczynska

60 bladders of American mink were dissected according to conventional method. Biometrical analysis with the use of digital image analysis system was applied to the triangles of the bladders. It was found that these triangles differ both in shape (narrow, broad) and symmetry (considerable asymmetry). The ureteral orifices also showed a variety in shape (five types) and number (double orifices).

Archivum Veterinarium Polonicum 34, 1-2, pp. 133-138, 1994. 3 tables, 5 figs., 13 refs. Authors' summary.

Basilar arteries of the brain in raccoon dog (*Nyctereutes procyonoides* (Gray, 1834))

Witold Brudnicki, Cezariusz Wiland, Ryszard Jablonski

Observations carried out on 43 brains of raccoon dogs show that the system of basilar arteries of the

brain is similar to that in other carnivores. The observed differences were manifested in different vessel connections and occurrence of some variations. In 53.4% cases the basilar artery in raccoon dogs develops from the combination of the even ventral spinal arteries and the vertebral arteries entering them. An unusual case of the reduction of spinal artery was also found.

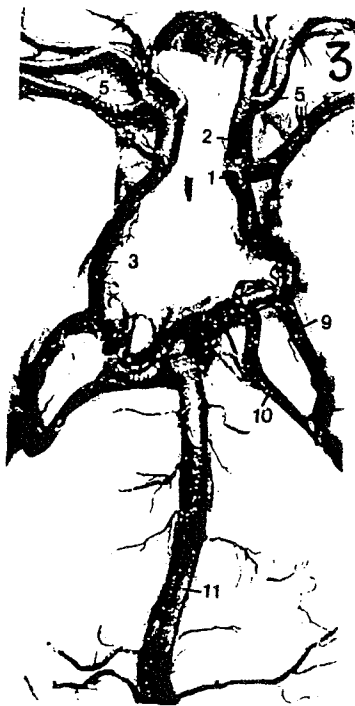


Fig. 3. Dual middle cerebral arteries.

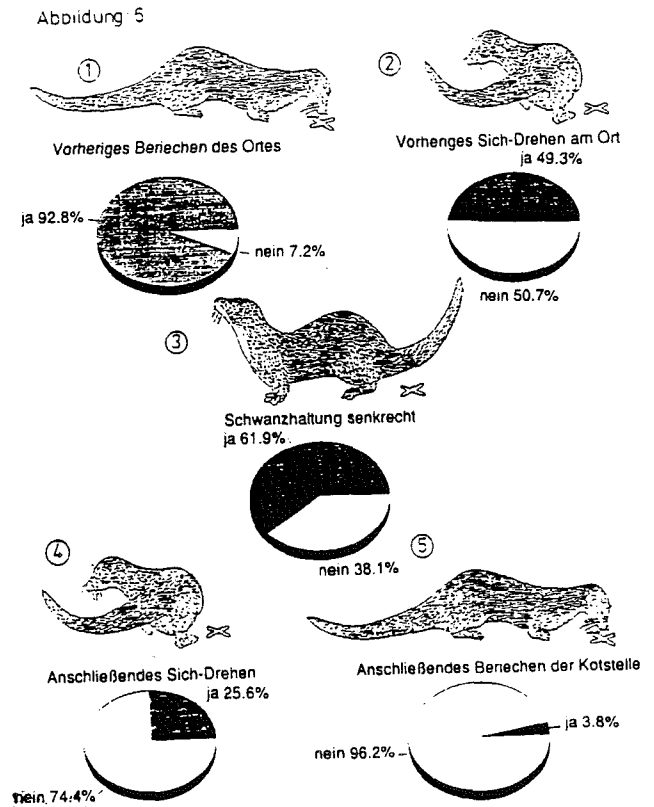
Archivum Veterinarium Polonicum 34, 1-2, pp. 141-146, 1994. 4 figs., 9 refs. Authors' summary.

Investigations about the scent marking behaviour of the European otter (*Lutra lutra*) in captivity

Barbara Heins

During the period from March to October 1991 the scent marking of 4 adult European otter (*Lutra lutra*) was observed in detail with regard to the behavioural patterns "sprainting" and "body-rubbing". The exploration was undertaken under the conditions existing in the enclosures on the research area of the "AKTION FISCHOTTERSCHUTZ e.V."

(Hankensbüttel). The inquiry was divided into 3 experiments, the standard one and the experiments A and B in which stimuli were consciously set. The behavioural patterns that were to be investigated were interpreted under the aspects of their temporal and spatial relation, the behavioural context and the reaction to the given stimuli.



The "sprainting", which is no rigid instinctive action is, according to these studies, definitely part of the scent marking. There is some evidence that it frequently takes place during conflict situations and that it includes an aggressive element. Preferred points of communication were marked. The sprainting sites were thereby selected carefully. Neither foreign nor own spraint did necessarily produce a reaction. The reaction to the scent of individuals of the same sex seemed indifferent but showed a tendency to intolerance and moreover tended to be dependent from the order of ranking. Foreign spraint could, however, be proven to be a factor of stress which, under certain circumstances, as for example the simulation of an increased population density, was capable of initiating a "sprainting" on stones or a scraping. These additional behavioural

elements only appeared amongst males which otherwise were more active and curious than the females too.

The "body-rubbing" showed characteristics of comfort behaviour as well as those of scent marking. Frequently only both behavioural complexes together enabled a satisfactory interpretation of the phenotypes of these manners of behaviour to be done. Thus for example the males used some parts of the body more often than the females which in their turn showed a higher readiness for escaping. It seems obvious to interpret these behavioral patterns as part of the comfort behaviour, the social component of which gains more and more in significance as far as the otter is concerned.

Tierärztliche Hochschule, Inst. für Zoologie, Hannover, Germany. Thesis, 109 pp. In GERM, Su. ENGL. 32 figs., 8 tables, 97 refs. Author's summary.

Seasonal changes in coat structure traits in Greenland nutria

Ryszard Cholewa

In order to check these observations the investigations were carried out on the reproductive farm of Greenland nutria in Steszew near Poznan. The experimental material included 198 males and 205 females. The hair samples were taken from the hind part of the right side of 7 month old animals.

The following traits were measured: a) diameter of hair and medulla in 50 segments taken from 3 parts of the hair (top, middle and base) in under- and overcoat layers, b) the share of overcoat in the coat (as the weight percentage of all hairs in the sample), c) heights of underhair and overcoat were measured on the skin of live animals.

The obtained results permit the conclusion that the investigated coat traits in nutria kept in pavilions differed in individual seasons. As concerns the thickness of hair and medulla it was found that the medulla diameter was most differentiated depending on the season. In the percentage of overcoat in coat structure no differences were found in individual seasons. Among the investigated coat traits the

heights of overcoat and of underhair were most influenced by the season.

Roczniki Akademii Rolniczej w Poznaniu - CCLXI, pp. 29-33, 1994. In POLH, Su. ENGL. 1 table, 3 refs. Author's summary.

Conformation and coat traits in blue polar foxes of different body weights

Ryszard Cholewa, Sławomir Nowicki

The authors attempted to find the indices of animal size (body length, circumferences of head and chest) and coat traits, namely height of hairs of different anatomic types, the hair and medulla diameters, weight percentage of overcoat in the coat and colour in blue polar foxes with mature coat but of different live weights. The experimental material included 125 blue polar foxes on the farm at Splawie near Poznan.

The foxes of the same sex but of different body weights had similar head circumferences and body lengths but differed in chest circumference. Among the coat traits the height of awned, awned down and guard hairs increased with growing live weight, while the percentage of overcoat layer decreased.

Roczniki Akademii Rolniczej w Poznaniu - CCLXI, pp. 73-78, 1994. In POLH, Su. ENGL. 2 tables, 7 refs. Authors' summary.

Elasticity and resistance properties of single hairs in foxes (*Vulpes vulpes* L.)

Ryszard Cholewa

The aim was to learn about the physical traits such as extensibility, maximum elongation and resistance to tearing of hairs of foxes of different colour varieties.

The investigations were carried out in the programme of Alexander von Humboldt grant in the German Institute of Wool Investigations in Aachen. The undercoat and overcoat hair samples were taken from the back and side of 62 foxes of both sexes of the varieties: gold, pastel, silver, platin, platin-pastel,

and golden cross. The author measured the diameter of the hair, its resistance to tension and tearing.

Among the investigated colour varieties the pastel foxes were distinguished by the physical traits of both coat layers. Their underhairs were the thickest and most resistant to tension and tearing, while their overcoat hairs were the thinnest, less resistant to tension but stronger against tearing than those in the remaining fox varieties.

Rozniki Akademii Rolniczej w Poznaniu - CCLXI, pp. 41-49, 1994. IN POLH, Su. ENGL, 4 tables, 3 refs. Author's summary.

Resistance to tension and tearing of overcoat hair in nutrias kept in conditions with different access to water for bathing

Ryszard Cholewa

The author analysed some properties of individual overcoat hairs in animals maintained in different environmental conditions as concerns bathing possibilities. The investigations were carried out in the German institute of Wool Investigations in Aachen in the programme of Alexander von Humboldt grant. The hair samples were taken on the hind part of the belly and on the back from 61 Greenland nutrias, which after weaning at the age of 6 weeks were maintained in different conditions, namely on dry ground, or with shower-bath or with water basin for bath. In 60 overcoat hairs chosen from each sample their diameters were measured in the middle. The resistance to tension and to tearing was measured on 60 hairs chosen of random from each sample.

The results of measurements of hair diameter and resistance to tension and tearing showed that keeping Greenland nutrias without bath possibilities had a positive effect on their hair quality.

Rozniki Akademii Rolniczej w Poznaniu - CCLXI, pp. 67-71, 1994. IN POLH, Su. ENGL, 1 table, 4 refs. Author's summary.

The physical-mechanical hair properties in polar foxes

Ryszard Cholewa

In order to differentiate some coat properties, the author evaluated thickness, resistance to tension and to tearing of single hairs in polar foxes, Polish and Norwegian, of different varieties sexes and ages.

The investigations were carried out on 211 hair samples in the German Institute of Wool Investigations in Aachen in the programme of Alexander von Humboldt grant.

It was found that the age and sex of animals had very little influence on the tested physical properties of hairs from both coat layers. The comparison of these traits in Norwegian and Polish foxes showed a differentiation in resistance to tension of underhair and to tearing in overcoat hair. Both these values were higher in Norwegian than in Polish polar foxes.

Rozniki Akademii Rolniczej w Poznaniu - CCLXI, pp. 21-27, 1994. IN POLH, Su. ENGL, 2 tables, 4 refs. Author's summary.

Quality of polar foxes and their skins when kept in cages in pavilions or standing in the open air

Ryszard Cholewa

The investigations were carried out on the farm of fur animals at Splawie near Poznan on 150 animals (74 females and 76 males) born on 2nd and 3rd June, chosen from quantitatively similar litters. The puppies, after 47 days with their dams, were weaned and placed in cages situated in pavilions or standing separately in the open air. After marking they were weighed individually at the ages of 2 and 3 months; in autumn their exterior was estimated and after slaughter the quality of their raw skins was evaluated.

The results of these investigations showed that the young polar foxes in the period from weaning to 3

months grew better in pavilions than in free-standing cages. The quality of the live animals reared in pavilions was slightly better and the quality of their raw skins was also better than of those which were housed in free-standing cages.

Rozniki Akademii Rolniczej w Poznaniu - CCLXI, pp. 51-57, 1994. IN POLH, Su. ENGL, 2 tables, 7 refs. Author's summary.

Diurnal variations of the plasma corticoid and sexual steroid hormone levels in the silver vixens

L.V. Osadchuk

Domesticated and wild silver fox vixens were shown to differ in their diurnal contents of cortisol and progesterone in the blood plasma. The data obtained reveal that domestication of silver fox vixens modifies their diurnal rhythms of the adrenocortical steroid activity.

Sechenov Physiological Journal 81, No. 10, pp. 70-77, 1995. In RUSS, Su. ENGL. 2 tables, 4 figs., 18 refs. Author's summary.

Adrenal cortisol biosynthesis and its stimulation by ACTH in male and female silver foxes during prenatal life

L.V. Osadchuk

At present silver fox is a popular object for fur farming and is raised in captivity in large numbers. Despite a number of works on the cortisol secretion in adult silver foxes, to date no investigations on

cortisol production in silver foxes during embryogenesis have been reported. The present study was designed to examine the cortisol production by silver fox fetal adrenals and their response to ACTH at different periods of prenatal life. Blood levels of cortisol and ACTH were determined on days 35, 40, 45 and 50 of gestation (term=52 days) in embryos of both sexes. Contents in adrenal tissue homogenates and *in vitro* adrenal production of cortisol were also investigated at the same times. Hormones were measured by RIA. The levels of ACTH and cortisol were little altered during embryonic life.

The adrenal content and the *in vitro* production of cortisol increased sharply and progressively (by 4-10 times from day 35 to day 50). The rises in cortisol content and *in vitro* production were associated with a rapid growth of the fetal adrenals.

There were no sexual differences either in level of cortisol and ACTH or in adrenal content and *in vitro* production of cortisol. ACTH (50 mIU per incubate) increased the *in vitro* cortisol production by adrenals above basal levels in both sexes on all studied days (by 3-4 times at day 35 and 1.4-1.7 times at day 50).

To our knowledge, this is the first demonstration of: 1) silver fox fetal adrenals being able to synthesise cortisol; 2) ACTH being a potent activator of fetal cortisol production *in vitro* at the earliest stages of adrenal development in this species; 3) Immunoreactive ACTH level being measurable already in 35-day-old silver fox fetuses.

Only abstract received. 15th Joint Meeting of the British Endocrine Societies, 25-28 March 1996, Dublin. Journal of Endocrinology Ltd, 1996.



Assessment of genetic variability in mink by DNA fingerprinting

A. Farid, M.P. Sabour, M.A. Johnson

Genomic DNA was extracted from 87 dark mink from two farms in Nova Scotia. Genetic variability was assessed by DNA fingerprints generated using Hae III restriction endonuclease and Jeffreys' 33.15 probe. The results showed a high degree of DNA polymorphism in both farms. All but one of the 22 bands scored in the range of 4 to 7.2 kb were polymorphic.

The two farms were comparable for the mean number of bands per individual (6.2 and 6.8), average band frequency (0.33 in both farms), locus heterozygosity (0.51 and 0.53) and index of band sharing among individuals within each farm (0.53 and 0.54). The results suggest a higher genetic variability than expected based on the population number and the historic prevalence of inbreeding of mink in the region. Similarity between the two farms could be due to gene flow from common sources.

Proceedings, 5th World Congress on Genetics Applied to Livestock Production, University of Guelph, Guelph, Ontario, Canada, 7-12 August 1994, Volume 21, pp. 137-139. 6 refs. Authors' abstract.

Rapid karyotyping of mammalian cells

N.B. Rubtsov, A.I. Protopopov, V.G. Matveeva, N.V. Rubtsova, T.B. Nesterova, S.M. Zakiyan

The use of the "pipette" method ensures rapid preparation of standardized whole metaphase spreads. Experiments with human, murine, Chinese hamster, American mink, green African monkey, dog, and vole cells demonstrated that G-banded whole metaphase spreads can be obtained in less than two hours after the beginning of work with cell or tissue culture. Due to that, it became possible to start karyotyping of animal tissue explants, as well as fetal cells present in human amniotic fluid, on day 3 to 4 after their receiving.

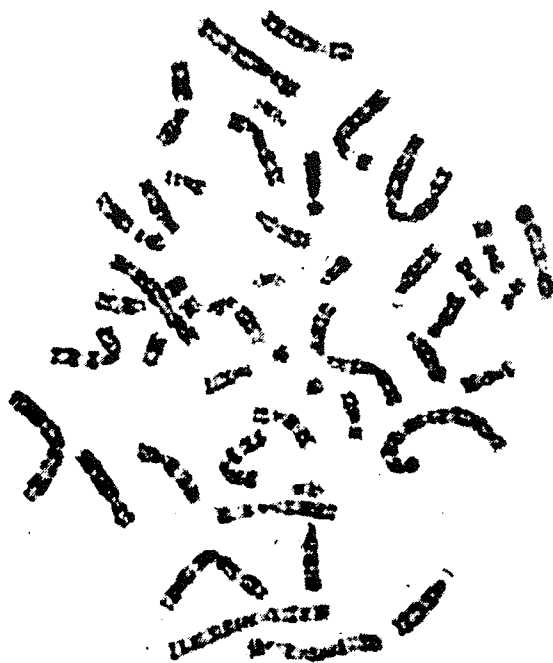


Fig. 2. G-banded whole metaphase spread of the amniotic fluid fetal cell harvested by the "pipette" method. Karyotype 46, XY, normal.

Genetika, 30, 1, pp. 66-17, 1994. In RUSS, Su. ENGL. 6 figs., 6 refs. Authors' summary.

Preliminary assignment of genes *TK1* and *UMPH2* to pig chromosome 12

N.M. Astakhova, N.S. Xhdanova, E.M. Kaftanovskaya, S.B. Kuznetsov, O.L. Serov

A new type of pig-mink cell hybrids was produced. It was demonstrated that segregation of pig chromosomes occurs in these hybrids and that no rearrangements between the chromosomes of different species occurs; fragmentation of pig chromosomes is also absent. Using these hybrids, genes *TK1* and *UMPH2* were preliminarily located on pig chromosome 12. The obtained data demonstrate that these hybrids can be used for chromosome mapping of pig genes.

Genetika, Vol. 30, No. 6, pp. 832-838, 1994. In RUSS, Su. ENGL. 5 figs., 16 refs. Authors' abstract.

Expression of immunoglobulin kappa and lambda chains in mink

L.A. Bovkun, V.V. Peremislov, A.M. Nayakshin, E.S. Belousov, L.V. Mechetina, B. Aasted, A.V. Taranin

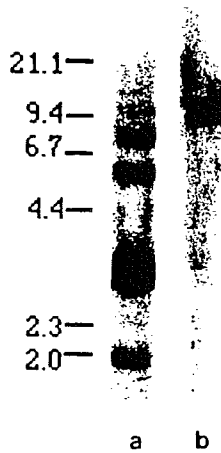


Figure 5. Blot hybridization of mink fibroblast DNA with V κ (a) and C κ (b) probes. DNA was digested with PstI and PvuII restriction endonucleases, respectively. Sizes of marker fragments (digests of λ phage DNA by HindIII) are given in kbp.

The ratio of κ and λ chains of immunoglobulins varies significantly from one species to another. It has previously been thought that λ was the only type expressed in mink. We tested mink immunoglobulin light chains using two monoclonal antibodies G80 and G88. It has been shown that G80 and G88 specifically recognize two antigenically different subpopulations of the light chains. Immunochemical analysis of these subpopulations separated by affinity chromatography suggested that they represent λ and κ types of light chains, respectively. Screening of a mink cDNA library with monoclonal antibody G88 resulted in the isolation of clone pIGK-1 containing κ chain-encoding sequence. The cDNA insert of pIGK-1 included most of the V segment, as well as the J, C and 3' untranslated sequences. Mink v κ sequence shown the highest homology with the human V κ II subgroup genes (76-79%). Mink C κ sequence was 53-63% homologous to C κ of other species. The striking feature of mink C κ chain is the presence of glutamine in the C-terminal position. Southern blot analysis suggested that mink haploid genome has one C κ gene and multiple V κ genes. The κ λ chain ratio in the 12 mink studied was on average, 46:54. The same ratio was observed for the κ - and λ -producing cells in the mesenteric lymph nodes. The five previously identified mink light chain allotypes were assigned to

the λ chains, thereby confirming that λ chains in this species are additionally subdivided into several subtypes.

Eur. J. Immunol. 23, pp. 1929-1934, 1993. 1 table, 6 figs., 38 refs. Authors' summary.

High-resolution GTG-banding patterns of dog and silver fox chromosomes: description and comparative analysis

A.S. Graphodatsky, V.R. Beklemisheva, G. Dolf

The GTG-banding patterns and ideograms of two canid species, the domestic dog and the silver fox, are presented and compared. For both species the number of bands visualized has increased to well over 400. A standard dog karyotype is proposed.

Cytogenet Cell Genet 69, pp. 226-231, 1995. 5 figs., 19 refs. Authors' abstract.

RNA fingerprinting using arbitrarily primed PCR identifies differentially regulated RNAs in mink lung (My1Lu) cells growth arrested by transforming growth factor β 1

D. Ralph, M. McClelland, J. Welsh

RNA fingerprinting using arbitrarily primed PCR (RAP) samples an RNA population and allows the detection of differentially expressed genes between two or more populations. This method was applied to mink lung epithelial cells, which respond to treatment with transforming growth factor β (TGF- β) by undergoing cell cycle arrest at or near the G1/S-phase boundary. The steady-state abundances of approximately 200 RNAs were surveyed, a few of which displayed differential regulation in response to TGF- β 1. Three products were isolated, cloned, and sequenced. One differentially regulated RNA corresponded to cyclin A, a gene known to be required for the progression of mammalian fibroblasts through S phase. Northern blot analysis confirmed that the cyclin A mRNA steady-state abundance decreased dramatically in response to a 24-hr TGF- β 1 treatment and also in response to cell cycle arrest caused by contact inhibition. A second RAP product corresponded to a previously

unknown 7.5-kb mRNA, the level of which decreased dramatically in response to TGF- β 1 treatment. Unlike the cyclin A mRNA, the abundance of this transcript did not decrease in response to growth arrest induced by contact inhibition. A third RAP product corresponded to the mRNA for osteonectin, an extracellular matrix protein. The abundance of this mRNA increased at least 2-fold during TGF- β 1 treatment. This observation is consistent with other reports of increases in extracellular matrix proteins during TGF- β 1 treatment. RAP should be able to identify many of the genes that change in steady-state expression during the cell cycle.

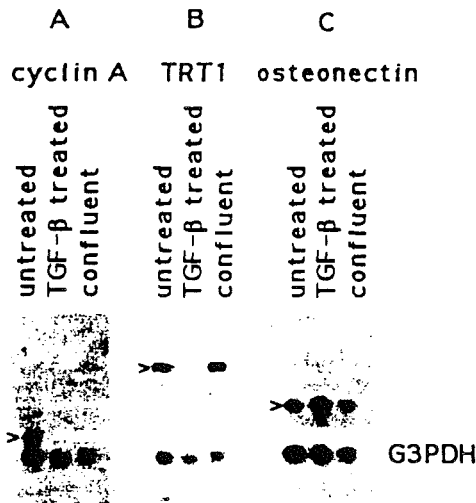


Fig. 3. Regulation of cyclin A, osteonectin, and TRT1 mRNA after TGF- β 1 treatment of cells. Each lane contained 2 μ g of poly(A)-selected RNA from Mv1Lu cells. (A) Cyclin A probe. (B) TRT1 probe. (C) Osteonectin probe. Each blot was probed with G3PDH, shown below. Arrowheads indicate the differentially expressed RNAs.

Proc. Natl. Acad. Sci, Vol. 90 (22), pp. 10710-10714, 1993. 3 figs., 43 refs. Authors' abstract.

mtDNA polymorphism and differentiation of subspecies of Chinese raccoon dog (*Nyctereutes procyonides*)

Zhao Wei, Zhuang Wei, Shi Linqing

The mtDNA from 14 raccoon dogs of 7 geographical populations was analyzed with 8 restriction endonucleases, and the restriction map was constructed. Furthermore UPG molecular phylogenetic trees of the mtDNA were constructed based on the genetic distances. Our results indicated that the differentiation was obvious within geographical populations of the subspecies *N. p. procyonoides*, and that the event of divergence in Chinese raccoon dog first occurred between the southern and northern populations, and then, between the western and the eastern populations. We proposed that both of the Huabei and Shanxi populations which had not been identified could be classified into two independent subspecies respectively.

Acta Genetica Sinica, Vol. 21 (1), pp. 7-16, 1994. In *CHIN*, Su. *ENGL.* 5 tables, 5 figs., 17 refs. Authors' abstract.



"But why do you want to transmute asparagus into cotton?"

Gonadal function in mink under artificial photoperiods

R.G. Gulevich, D.V. Klotchkov, L.N. Ivanova, L.V. Osadchuk

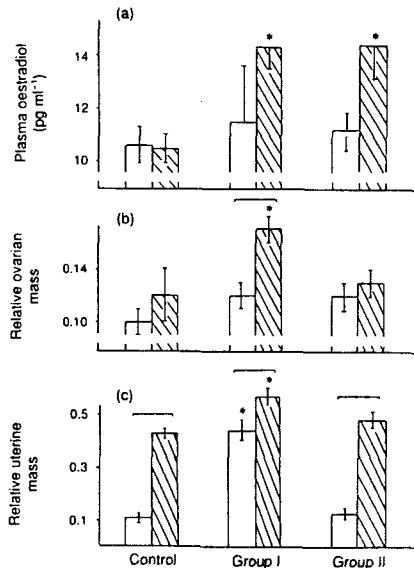


Fig. 5. Effect of hCG on oestradiol concentration in plasma and relative uterine and ovarian masses in female mink in different photoperiods. *Significant difference ($P < 0.05$) between animals of Groups I or II and controls (intact (□) or after hCG treatment (▨)); — Significant difference ($P < 0.05$) between intact and hCG-treated animals.

Exposure of juvenile mink to artificial light conditions imitating early autumn (additional illumination from 20 June to 20 July followed by 8 h daylight from 21 July to 10 October - photoperiod I; 8 h daylight from 21 July to 10 October - photoperiod II) induced the prolonged modification of sex steroid concentrations. The increase in plasma testosterone concentrations during the prepubertal period was followed by a decrease before and during the mating period in experimental males. The concentration of oestradiol in plasma increased just before the start of the mating period (January and February) in females under photoperiod I, and these hormonal changes were accompanied by an increase in fertility. The conditions of photoperiod II (involving fewer hours of daylight) had less effect on the sex steroid concentration in the blood

of females, and fertility was not changed. The response of gonads to hCG injection at the beginning of puberty (November) was higher in males exposed to photoperiod I conditions and in females exposed to both photoperiods than in control animals.

Prebreeding season signs of estrus and prediction of fertility in mink

D.V. Klotchkov, Yu. D. Koveshnikov

The homeostatic system controlling fertility in female mink was studied on a large number of animals. The heritability coefficient in estrus patterns between sibs was defined. Control of maturity time by means of vaginal smears can be used for predicting female mink fertility and as an additional index in selection for fertility.

Sel'skokhozyaistvennaya Biologiya, No. 4, pp. 53-56, 1993. In *RUSS*, Su. *ENGL.* 1 table, 10 refs. Authors' summary.

The role of steroid hormones in sexual and agonistic behaviour in silver fox males

L.V. Osadchuk

Silver fox males were tested for sexual and agonistic behaviour after introduction of a female at different stages of the reproductive cycle. The high level of aggressive interactions between male and female and no mountings were observed during the reproductive season. During the reproductive season, the introduction of an anoestrous female did not affect the aggressive behaviour but increased the number of mountings while introduction of a receptive female reduced aggressive contacts and augmented sexual behaviour in pairs independently of mating. Considerable variations in testosterone and oestradiol but not cortisol plasma levels were observed between different stages of sexual activity. At the beginning of the reproductive season, silver fox males responded to anoestrous females with a significant increase in their blood testosterone and oestradiol levels. Contents of these two hormones did not change in males during the reproductive season when they encountered a recep-

tive female. A female did not elicit any cortisol response in a male during different periods of the reproductive cycle. The data obtained suggest that the sexual behaviour in silver fox males can be facilitated by testosterone and oestradiol while aggressive interactions between male and female occur independently of these hormones.

ЖУРНАЛ ВЫСШЕЙ НЕРВНОЙ ДЕЯТЕЛЬНОСТИ *Tom 46, pp. 18-83, 1996. In Russ, Su. ENGL. 2 tables, 19 refs. Author's summary.*

Reproductive strategies of the raccoon dog and the red fox in Finland

Kaarina Kauhala

Reproductive strategies of the raccoon dog *Nyctereutes procyonoides* (Gray, 1834) and the red fox *Vulpes vulpes* (Linnaeus, 1758) were studied in southern Finland in 1986-1995. Litter size and relative litter weight, body size, population status and ecology were compared. Although the body sizes are almost equal, diets rather similar and both raccoon dog and fox populations have been rather stable during the study period, the litter sizes and relative litter weights differ greatly. The mean litter size of the raccoon dog was 9.0 and that of the red fox 5.1. The mean relative litter weight was 18.3-24.0% for the raccoon dog and 10.4-12.5% for the red fox. Thus, raccoon dog females are able to invest relatively more in reproduction than the red fox. There are several features in the ecology and behaviour of these species which can explain the different strategies. First, vole cycles have a strong effect on red fox reproduction, but have only a weak effect on the litter size of the raccoon dog. Second, the raccoon dog sleeps during harsh winters and females are in good condition in the breeding season regardless of the weather and food supply during the winter. The red fox is always active in winter when food availability may be low and moving in snow is energetically costly. Omnivory, the ability to accumulate large fat reserves and winter dormancy guarantee the good condition of raccoon dog females even in fluctuating environments by reducing the relative costs of reproduction. Third, raccoon dog pups are easy prey to other predators, and mortality during their first year is very high. If mortality rate before the reproduc-

tive age is high and independent of litter size, natural selection will favour large litters. Juvenile mortality among red foxes is lower, and it probably would increase in larger litters due to egg starvation.

Acta Theriologica 41 (1), pp. 51-58, 1996. 4 tables, 35 refs. Author's summary.

Effect of body condition and dietary energy supply on reproductive processes in the female mink (*Mustela vison*)

A.-H. Tauson

This paper reviews a series of experiments regarding the influence of body condition and dietary energy supply on reproductive processes in the female mink. The reporting is based on 1905 sets of reproductive performance data and on data regarding number of corpora lutea, implantation rate, plasma progesterone and oestradiol, luteinizing hormone (LH) release and ovulation ratio, and the early development of the fertilized ova.

Generally, treatment effects were more pronounced in yearling females than in adults; furthermore, adults responded less to varied energy supply by changes in body weight. A weight reduction of >300 g during the winter resulted in poor reproductive performance in yearling females. A long-term study indicated better reproductive longevity for females on a low-intensity feeding regimen, whereas females on a high-intensity feeding regimen tended to have larger litters until 3 years of age.

Nutritional flushing was carried out by a 2-week period of moderate energy restriction followed by feeding *ad libitum* from 3-5 days before initiation of matings until matings were completed for the individual females. Mainly in yearlings, but also in adults, litter sizes were improved for females with a first mating early in the breeding season, which was confirmed by an increased number of corpora lutea. The interval between the first recorded increase in plasma progesterone and the day of the peak progesterone concentration was decreased. Plasma oestradiol concentrations were higher in flush-fed females; age-dependent differences in the appearance of the profiles were also found. LH

release tended to be more synchronized and distinct in flush-fed females. The early development of fertilized eggs was advanced, documented as a higher percentage of eggs reaching the four-cell stage or more within 3 days after mating. It was thus concluded that flushing induces changes in the concentrations of the reproductive hormones which in turn lead to a more synchronized and advanced embryonic development, resulting in increased litter sizes.

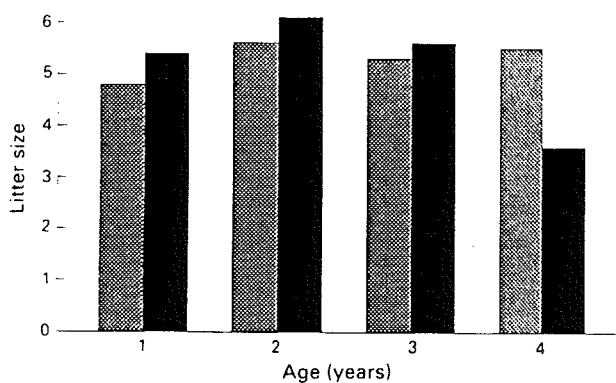


Fig. 1. Mean litter size in mink fed a low-intensity (▨) versus a high-intensity (■) diet for 4 years.

J. Reprod. Fert., Suppl. 47, pp. 37-45, 1993. 5 tables, 2 figs., 16 refs. Author's summary.

Rapid detection of the preovulatory luteinizing hormone peak in the blue fox (*Alopex lagopus*) by an enzyme-linked immunosorbent assay

M.C. Maurel, M. Mondain-Monval, W. Farstad, A.J. Smith

An enzyme-linked immunosorbent assay (ELISA) developed for the rapid measurement of luteinizing hormone (LH) in blood of many mammalian species has been validated in the fox. For this purpose, daily plasma samples collected from six vixens during the periovulatory period were assayed for LH using ELISA. The results were compared with those obtained by radioimmunoassay (RIA), and related to parameters used to determine the time of ovulation (onset of estrus, vaginal electrical resistance peak) and to ovarian findings. This ELISA provided a high sensitive measure of LH (125 pg ml^{-1}) from a $10 \mu\text{l}$ plasma sample within 3 h. Plasma concentrations of LH measured by ELISA and

RIA were significantly correlated ($r = 0.911$). In the blue fox, ovulation occurs once a year and coincides with the start of estrus. The LH peak preceded the start of estrus by 1.5 days (1-3) and preceded the vaginal electrical resistance peak by 2.2 days (1-4). The rapid and precise detection of the preovulatory LH peak by this assay provides a convenient method to determine the time of ovulation and therefore the optimum time for artificial insemination or oocyte collection for fertilization *in vitro*.

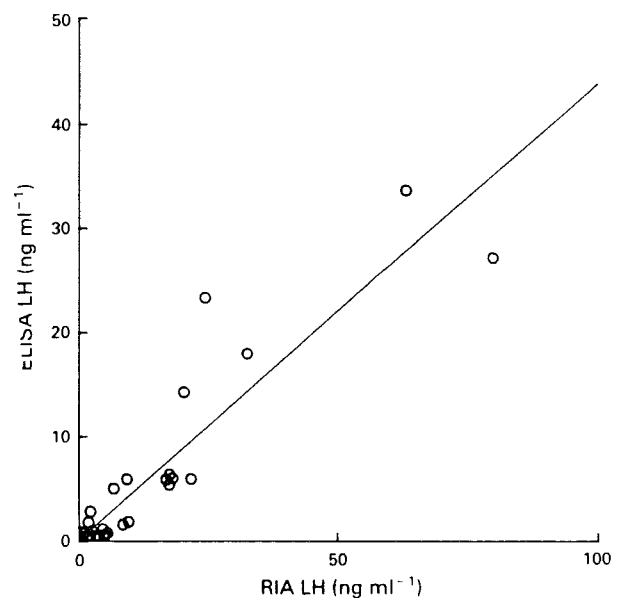


Fig. 1. Linear regression curve between concentrations of luteinizing hormone (LH) measured by enzyme-linked immunosorbent assay (ELISA) and radioimmunoassay (RIA).

J. Reprod. Fert., Suppl. 47, pp. 121-125, 1993. 1 table, 2 figs., 9 refs. Authors' summary.

Control of luteal function in the mink (*Mustela vison*)

B.D. Murphy, K. Rajkumar, A. González Reyna, D.W. Silversides

The ranch mink was studied to determine the role of pituitary luteotrophins on corpus luteum (CL) function before and after implantation. Twelve mink were treated with monoclonal antiserum against gonadotrophin-releasing hormone (GnRH), and 12 with an irrelevant monoclonal antibody

during embryonic diapause. Activation of the CL, plasma progesterone concentration and embryo implantation were unaffected by this treatment. In a second trial, groups of ten mink were treated with GnRH antibodies, bromocriptine, bromocriptine plus 0.5 mg prolactin per day per animal, or ethanol vehicle. Comparison of the consequent profiles of progesterone indicated that both bromocriptine and anti-GnRH compromised postimplantation CL function by inducing regression of the corpus luteum. Incubation of dissociated luteal cells from ovaries of mink at 21-24 days after implantation with either LH or prolactin increased the accumulation of progesterone over 2 h. Addition of 25-hydroxy-cholesterol (250HC) as substrate increased basal levels and the progesterone accumulation stimulated by LH and prolactin; the increases induced by luteotrophins were additive. There was an apparent synergistic interaction between prolactin and canine low-density lipoproteins (LDL) in the stimulation of progesterone secretion *in vitro*. The results are interpreted to indicate that LH/FSH are not required for luteal support during embryonic diapause, or for luteal activation. Prolactin is necessary for luteal activation, and LH and/or FSH and prolactin are obligate luteotrophins during the postimplantation period in the mink.

J. Reprod. Fert., Suppl. 47, pp. 181-188, 1993. 1 table, 6 figs., 23 refs. Authors' summary.

Species-specific features of estrous development and blastogenesis in domestic canine species

M. Valtonen, L. Jalkanen

The reproductive physiology of taxonomically closely related species is usually very similar. The main difference in the reproduction of the dog and fox is the length of the different phases of the estrous cycle. Pro-estrus and estrus are longest in the dog; estrus lasts 3-5 days in the blue fox and 1-3 days in the silver fox, compared with about 1 week in the dog. The profiles of sex steroid concentrations in plasma during estrus and pregnancy are similar and the luteal phase in non-pregnant animals is prolonged, progesterone concentrations reaching a maximum by 15-30 days after the luteinizing hormone (LH) peak in the dog, by 10-

20 days in the blue fox and by 5-15 days in the silver fox. The duration from LH surge to ovulation is about the same in the dog and fox, but thereafter the oocytes and early embryos develop faster in foxes than in the dog. The tubal transport time is 4-6 days in the silver fox, embryos entering the uterus at the 4-16-cell stage. In the blue fox the oocytes remain in the oviducts for 8-10 days, developing into the morula stage, whereas in the dog a still longer oviductal phase results in embryos that are at the compact morula or blastocyst stage when entering the uterus. The preimplantation period is about 1 week in the dog and the blue fox, but 9-10 days in the silver fox. The gestation length relative to the LH peak can be calculated to be 56 days in the blue fox and about 54 days in the silver fox.

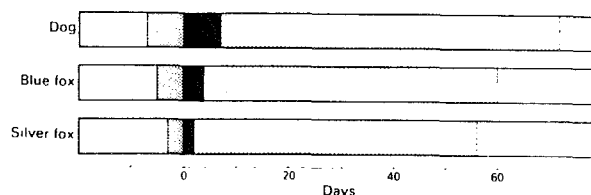


Fig.1. Schematic presentation of the duration of different phases of the estrus cycle in the dog, the blue fox and the silver fox: ▨, pro-estrus; ■, estrus; ▩, metestrus. Day 0 denotes start of estrus.

J. Reprod. Fert., Suppl. 47, pp. 133-137, 1993. 1 table, 2 figs., 21 refs. Authors' summary.

Sperm abnormalities in silver fox (*Vulpes vulpes*) semen selected for artificial insemination

L. Jalkanen

Sperm morphology was examined in fresh ejaculates accepted for insemination. The material included 161 ejaculates of 36 male silver foxes. Samples were fixed, stained with eosin/nigrosin and evaluated microscopically. The abnormal spermatozoa were categorized by the location of the defect. The mean (\pm SD) percentage of morphologically normal spermatozoa was 87.55 ± 10.45 . The incidence of sperm defects was low and variation high in all defect classes. Defects of tails of spermatozoa accounted for >50% of the abnormalities found. Morphological quality did not correlate with

the volume of the sperm-rich fraction, mass activity, progressive motility, or total sperm count in ejaculates of acceptable sperm quality. The incidence and effects of morphological defects in low-quality semen remain to be studied.

J. Reprod. Fert., Suppl. 47, pp. 287-290, 1993. 3 tables, 6 refs. Author's summary.

Induction of follicular development in silver foxes (*Vulpes vulpes*) with equine chorionic gonadotrophin (eCG) and antibodies against eCG

D.A. Douglas, M. Harri, A. González Reyna, D.K. Onderka, B.D. Murphy

Experiments were conducted that demonstrated that 1000 iu equine chorionic gonadotrophin (eCG) was effective in induction of follicular development and ovulation in silver foxes during anestrus. This treatment resulted in large, unovulated follicles; thus, trials in which the effects of eCG were reduced or abrogated by antibodies against eCG were carried out. Passive immunization against eCG on days 3 and 4 after eCG treatment interfered with subsequent follicular development and prevented ovulation. Treatment with eCG antibodies on days 5 or 7 after eCG treatment did not prevent ovulation and neutralization beginning on day 5 appeared to provide for the best ovulatory yield. The results suggest that combinations of eCG and anti-eCG antibody may provide a useful means of inducing ovarian activity in anestrus foxes.

J. Reprod. Fert., Suppl. 47, pp. 379-385, 1993. 4 figs., 19 refs. Authors' summary.

Photoperiodic control of reproduction of the mink: the role of melatonin

L. Martinet, F. N'Toumi, C. Bonnefond

The American mink, *Mustela vison*, which is reared for fur production, is a seasonal photosensitive breeder. In the male, gonadal activity is triggered by decreasing days, so that testis growth in juveniles or recrudescence in adults begins in November. Mating occurs in March followed by a long period of sexual rest. Testis regrowth can be induced by transferring males under artificial short days from mid-July; in May-June, the hypothalamo-pituitary system is refractory to the stimulating action of short days. The cycle of reproduction of the female is also related to the annual change in daylength; furthermore, the secretion of progesterone during pregnancy is inhibited by days with <12 h light, leading to a period of delayed implantation in the females mated early in March.

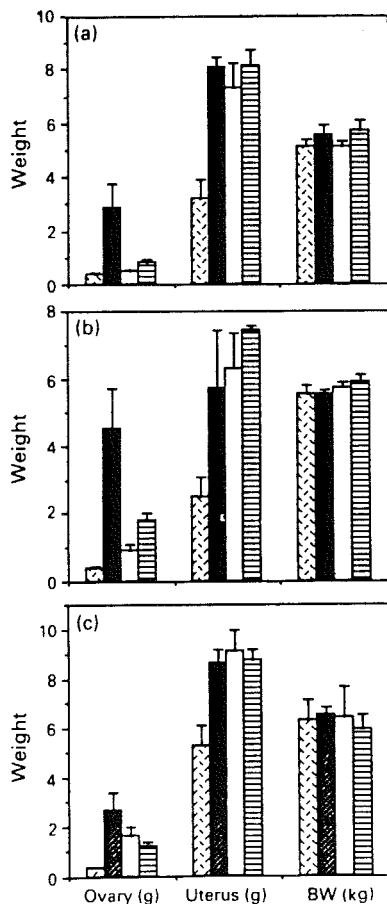


Fig. 1. Mean \pm SEM body weight (BW; kg), uterine weight (g) and ovarian weights (g) of silver foxes treated with saline (controls, □), 1000 iu equine chorionic gonadotrophin (eCG, ▣), or 1000 iu eCG followed by monoclonal antibodies against eCG on the third (◻) or fourth (◼) day (a), or in replicate experiments on the fifth (◻) or seventh (◼) day (b, c) after eCG treatment.

In the mink as in other photoperiodic mammals, the pineal gland is a key element in the control by light of reproduction. The rhythmic secretion of melatonin transduces the photoperiodic signals received by the retina and conveyed through the suprachiasmatic nucleus of the hypothalamus to the pineal gland. Results of data indicate that (a) the

duration of melatonin secretion is proportional to the length of the night, (b) timed infusions of exogenous melatonin, mimicking the pattern of exogenous secretion during short days, replicate the effect of short days and (c) refractoriness of the pituitary gonadal system of males to the effect of short days during spring is caused by the insensitivity of the target tissue to melatonin.

The author's recent results suggest that the role of melatonin in mink reproduction is related to its effect on gonadotrophin-releasing hormone synthesis and/or release.

J. Reprod. Fert., Suppl. 47, pp. 557, 1993. Authors' summary.

Folliculogenesis, ovulation and gestation in the mink (*Mustela vison*).

B.D. Murphy, D.A. Douglas

The mink (*Mustela vison*) has been domesticated for commercial production of fur for approximately 100 years. Although the reproductive process is not well understood, it has interesting reproductive characteristics, including ovulation induced by copulation, superfetation, superfecundation and a relatively brief period of obligate delayed implantation. Further, the capacity to breed on almost any day during the breeding season and the occurrence of offspring from more than one episode of ovulation appear to be unique to this species. The authors have investigated the mechanisms of folliculogenesis and ovulation and of the activation and maintenance of the corpus luteum in the mink. It has been known for some time that a period of 6-7 days is required between two fertile matings. The authors have shown that there is a wave of follicles which develop after mating, and there is selection of the preovulatory follicles on day 4 *post coitum*. The selected follicles attain a diameter of 0.8-1.0 mm by day 7. Non-atretic follicles with diameters >0.6 mm are capable of responding to a copulatory stimulus by ovulation. Cervical stimulation of mink induces a surge of luteinizing hormone (LH) of 5-8 ng serum ml⁻¹ within 20 min after initiation, and is blocked by barbiturate or halothane anaesthesia.

Ovulation ensues 36-50 h after mating in the mink, with an average of ten or more ova released per animal. In the absence of an ovulatory stimulus, follicles with diameters ≥ 0.9 mm undergo luteinization, followed by degeneration rather than by the usual process of atresia.

The corpus luteum that forms from ovulated follicles is dormant during the period of delayed implantation. The authors have previously shown that its activation depends on hypophyseal secretion of prolactin. Dopamine agonists will prevent and dopamine antagonists will hasten luteal reactivation. Passive immunization of mink with monoclonal antibodies against gonadotrophin-releasing hormone (GnRH) had no effect on luteal function, indicating that LH is not necessary for activation of the corpus luteum. Both antibodies against GnRH and dopamine agonists interfere with the luteal output of progesterone in the activated corpus luteum. These results indicate that there is a requirement for both LH and prolactin for the support of postimplantation gestation. Administration of excess prolactin by injection or minipump induces degeneration of the mink corpus luteum by an unknown down-regulatory mechanism.

In summary, further apparently unique characteristics of mink reproduction - a pattern of follicular development, the capability for ovulation of follicles over a wide range of sizes, the luteinization and degeneration of large follicles - have been shown. Further, there is a luteotrophic complex that varies during the luteal lifespan. It comprises prolactin only before implantation and prolactin and LH after implantation.

J. Reprod. Fert., Suppl. 47, pp. 560, 1993. Authors' summary.

Spermatogenesis and testosterone level in young silver fox males during the reproductive season

L.V. Osadchuk, V.V. Gultiaeva, A.A. Philimonenko, L. Jalkanen

15.7% of the spermatozoa were found to be abnormal in silver fox males during their first reproduc-

tive season. The total number of spermatozoa and the abnormal spermatogenesis remained unchanged during the mating season. Sexual stimulation increased the testosterone level only at the beginning of the mating season.

Sechenov Physiological Journal 82, No. 5-6, pp. 103-108, 1996. In *RUSS, Su. ENGL. 1 table, 2 figs., 19 refs. Authors' summary.*

Influence of run on appearance of estrus in fox vixens (*Vulpes vulpes* L.)

Ryszard Cholewa, Boleslaw Kordas

The influence of a run on the time of estrus appearance was observed in 186 one-year-old vixens. The females in the experimental group were kept in a run from January 2 to the appearance of heat. In this run there were placed 2 cages with the males used as testing animals. They were let in the run for a few hours (9.00 a.m. to 1.00 p.m.) and in this time the animals were continually observed. When the heat symptoms were noticed, the females were caught and mated with the proper males. In the control group the females were checked initially twice a week (from 15 to 31 January), then every day. All females were served on the first and second day of estrus. It was found that the run environment accelerated the appearance of oestrus in the vixens observed.

Roczniki Akademii Rolniczej w Poznaniu - CCLXXII, pp. 9-13, 1995. IN POLH, Su. ENGL. 1 table, 2 refs. Authors' summary.

Effects of stimulating ovary functions in mink with gonadotropic preparations

Ludmila Szulga, Ryszard Cholewa, Michail Prokofiew

On the State fur animal farm "Puszkin" in the Moscow district an experiment was carried out on the application of gonadotropic preparations to 109 mink females of standard variety which did not show estrus by 12 March. They were divided into seven groups. In six experimental groups the females were given a supplement of the preparation

containing the hormone stimulating ovary vesicles: gonadotropine of retrohypophysis in serum of a pregnant mare or profazin and surfagon.

Some females were anatomically examined in order to estimate the state of their reproductive organs.

The results showed that the gonadotropic preparations used in this experiment had stimulated ovarian functions. Thus, there is a possibility of estrus synchronization and of effective fertilization of the females which did not come into heat, and in this way to obtain progeny from them.

Roczniki Akademii Rolniczej w Poznaniu - CCLXXII, pp. 143-148, 1995. In POLH, Su. ENGL. 2 tables, 4 refs. Authors' summary.

Whelping results in 1994

K. Lindh

In 1994, in Finland, the number of births of mink, polecats, blue foxes, silver x blue foxes, silver foxes and raccoon dogs was 1,779,667, 69,787, 1,562,276, 95,755, 157,151 and 85,020 respectively. Litter size averaged 4.10, 4.55 and 3.78 respectively for Scanblack, Scanbrown/Scanglow and Sapphire/silverblue mink females, and 5.96, 5.90, 5.09, 2.78 and 5.55 for polecats, blue, silver and silver x blue foxes and raccoon dogs. Results are compared with those in 1993.

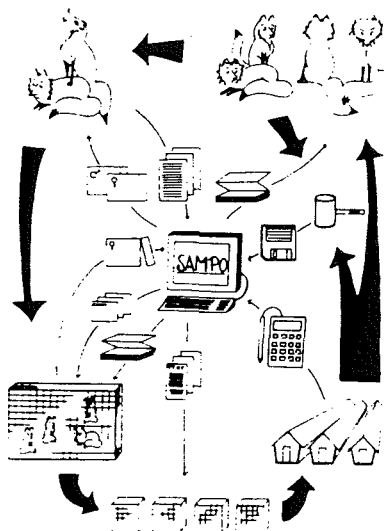
Finsk Pälstidskrift 28, 10, pp. 214-215, 1994. In *SWED, 3 tables. CAB-abstract.*

Whelping results of females in the Sampo recording scheme in 1994

K. Smeds

In 1994, in Finland, 22,836 mink, 23,424 blue fox, 1889 silver x blue fox and 5865 silver fox females participated in the Sampo performance recording scheme, representing 6 and 10% respectively of the total mink and fox population. Litter size per mated female averaged 4.11, 4.68 and 3.97 respectively for Scanblack, Scanbrown/Scanglow and other mink, and 6.4, 5.42 and 1.79 for blue, hybrid

and silver foxes. All recorded females except silver foxes had better than average performance, but only blue foxes performed better than in 1993.



Finsk Pälstidskrift 28, 10, pp. 215, 1994. In SWED, 1 table. CAB-abstract.

Whelping results in 1995

K. Lindh

In 1995, in Finland, litter size per mated female averaged 4.49, 5.91, 5.83, 4.9, 2.8 and 5.59 respectively for 1,866,723 mink, 39,479 polecats, 1,817,976 blue foxes mated with males of the same species, 41,050 blue foxes mated with silver fox males, 130,671 silver foxes, and 70,053 raccoon dogs. Results are compared with those in 1994, and data on mink are tabulated by colour type.

Finsk Pälstidskrift 29, 10, pp. 252-253, 1995. In SWED, 2 tables. CAB-abstract.

Whelping performance of females in the Sampo litter recording scheme in 1995

K. Smeds

For 27,859 mink, 41,534 blue fox and 6200 silver fox females participating in the Sampo performance recording scheme in Finland in 1995, litter size averaged 4.7, 6.23 and 2.84 respectively vs. 4.42, 6.4 and 2.79 in 1994, and for 1453 blue fox females mated with silver fox males it averaged 5.13 vs. 5.42.

Finsk Pälstidskrift 29, 10, pp. 253, 1995. In SWED, 1 table. CAB-abstract.

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Digestion in monogastric fur animals

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Summary

Among the more popular carnivorous, monogastric farm-raised fur animals are: fox (*Vulpes vulpes* and *Alopex lagopus*), raccoon dog (*Nyctereutes procyonides*), mink (*Mustela vison*), ferret-fitch (*Mustela putorius*) and, belonging to the herbivores, nutria (*Myocastor coypus*), rabbit (*Oryctolagus cuniculus*) and chinchilla (*Chinchilla laniger*).

1. Morphology of the digestive tract

1.1. Mouth

In the mouth of ferrets (fitches) and other fur animals are found five major paired salivary glands, paratid. The sublingual and molar glands in carnivora secrete mainly mucous while paratid and other glands secrete serous and mucous. The carbohydrate-splitting enzyme alpha-amylase is more concentrated in the saliva of herbivores and only slightly in the saliva of carnivores. The control of salivation is mediated by the autonomic nervous system (Low and Zebrowska, 1989).

1.2. The teeth

The teeth of *carnivores* are typical of predators: in adult foxes the upper/lower dental formula is: incisors 3/3, canines 1/1, premolars 4/4, molars 2/3, total 42 teeth (Voight, D.R., 1987); in mink

and ferret: incisors 3/3, canines 1/1, premolars 3/3, molars 1/2, total 34 teeth (Eagle, T.C., 1987). In *herbivores* the upper/lower dental formula is: in nutria and chinchilla, incisors 1/1, canines 0/0, premolars 1/1, molars 3/3, total 20 teeth (Kopanski, 1988; Jarosz et al., 1991), in rabbit incisors 2/1, canines 0/0, premolars 3/2, molars 3/3, total 28 teeth. Compared to omnivores and herbivores, which have the ability to chew food, carnivora have well-rooted strong teeth with sharp edges which serve for catching and tearing food rather than chewing it.

1.3. Oesophagus

The oesophagus in fur animals, as in other farm animals, constitutes the first part of the tubular digestive system. The lumen is covered by a stratified epithelium, beneath which there are numerous mucous glands providing a lubricant for bolus passages. The length of the oesophagus in fox and raccoon dog is approx. 30 cm and in ferret approx. 20 cm (Baran, 1993). The food passes through the oesophagus due to peristaltic movement and hypotension in this organ created by hypotension in the pleuric cavity.

1.4. The stomach

The stomach in carnivora is straight having thin elastic walls with weakly developed muscles. It

belongs to the intestinal type. In foxes and raccoon dogs the stomach is quite large when compared to the mink and ferret. The length of the minor curve of the stomach in foxes and raccoon dogs is approx. 10 cm and in ferrets and mink approx. 7 cm (Baran, 1993). The volume of the stomach in adult mink is approx. 70-75 cm³ (Jørgensen, 1985; Jarosz, 1993) and in nutria 400-500 cm³ (Tocka, 1984). In Canidae cardial glands cover a narrow stripe of the mucous membrane; the zone of the fundus glands occupies the left half of the stomach while that of the pyloric glands the right one (Aka-jewski, 1973). In herbivorous monogastric fur animals the abdominal cavity is relatively large with a simple stomach (Harkness, 1987).

1.5. The small intestine

The intestine (small and large) of the carnivorous compared to herbivorous animal is rather short.

The average lengths of the intestine in male and female are as follows: foxes 223-256 cm (small intestine 178-209 cm, caecum 8 cm), raccoon dogs

289 cm (small intestine 246 cm, caecum 8 cm), ferret male 255 cm and female 230 cm (small intestine 221 and 204 cm, respectively) (Baran, 1993), mink male 214 cm and mink female 175 cm (Slawinski *et al.*, 1962). While in nutria 620 cm (small intestine 500 cm, large intestine 120 cm, with capacious caecum - 40 cm) (Tocka, 1983), rabbit approx. 360 cm (small intestine 240 cm, large intestine 120 cm including capacious caecum) (Harknes, 1987) and chinchilla approx. 120 cm (small intestine 98 cm, caecum approx. 37 cm, volume approx. 69 cm³ (Langenfeld and Kohan, 1990). The ratios of the length of the intestine to the length of the body are: foxes 4-5 times, raccoon dogs and ferret 6 times (Baran, 1993), mink 4.1 times (Elnif and Enggaard-Hansen, 1988) but in nutria 12-16 times (Tocka, 1983) and in rabbit 13 times.

On the inside wall of the small intestine there are many tiny folds and therefore it is an incredibly large surface through which the nutrients are absorbed.

Table 1. The time of food passage through the particular parts of the intestine (Baran, 1993)

Animal	Duodenum	Jejunum	Ileum	Colon	Caecum	Rectum
Ferret	0.5	0.5	0.5	1.0	-	2.0
Blue fox	1.0	1.5	2.0	2.0	2.5	3.5
Silver fox	1.0	2.0	2.5	3.0	4.0	5.0
Raccoon dogs	1.0	2.0	2.5	3.0	4.0	4.5

Into the upper part of the duodenum enter two ducts one from the pancreas and the other (the bile duct) from the gallbladder. In carnivorous animals the large intestine is not adapted to bacterial digestion to break down carbohydrates (fiber) and it acts as a collecting tank for excrement until this is defecated. Before defecation, water and salts are absorbed through the wall of the intestine, so that the faeces get normal consistency (Jørgensen, 1985). In the herbivores - rabbit and probably nutria - the caecum and haustrated colon produce caecotrophs, (night faces), that are eaten directly from the anus. Other gastrointestinal characteristics include lack of vomiting and copious bile production (Harkness, 1987).

2. Passage of food through the intestinal tract

The time of food passage through the particular parts of the intestine is presented in Table 1. In all these animals the remnant of the ingested food is completed in 15-20 hrs. after ingestion (Bleavins and Aulerich, 1981).

3. Enzymatic digestion

The growth rate of farmed fur animals depends on the digestibility and utilization of nutrients in the feed which includes hydrolysates of proteins, polysaccharides and lipids. A condition for this requires, among other factors, a sufficient production and activity of digestive enzymes in the gastrointestinal tract of animals (Henriksen et al., 1987; Eggum et al., 1989).

Ingested food mixed with saliva and, in herbivorous animals, partially chewed and saturated by the carbohydrate/splitting enzyme alpha amylase, passes through the oesophagus to the stomach.

3.1. Secretion and digestion in the stomach

In the stomach of monogastric fur animals the food is impregnated with the gastric juice secreted from the epithelial, cardiac, peptic, pyloric and parietal cells but primarily derived from peptic glands. The mixture of this gastric juice contains pepsin, mucin and electrolytes. Pepsins are the main proteolytic enzymes synthesized in the peptic cells as inactive precursors - pepsinogens I, II, III, which are released and activated in the acidic gastric juice at pH over 2.5 (Levis and Hill, 1983). The initial

secretion is regulated by the impulses of the vagal nerve centre to the stomach by the action at the level of the parietal cells (Gharib Naseri et al., 1991). But the major secretory response occurs when food reaches the stomach and consists essentially of acid secretion.

Olejnik (1984), who carried out an experiment on fur animals such as mink, foxes, rabbits and rats (the last one as a control) showed the following pH of gastric humus in fasting animals; mink 3.8, fox 4.2, rabbit 1.9 and rat fed the same feed as the carnivores 4.1 (control 2.6). These results revealed significantly lower acidity of gastric humus in the herbivorous monogastric fur animals, also confirmed by Cheeke (1984), than it was in the carnivores. According to Olejnik (1984), there is some relation between the stomach humus activity and activity of pepsin. At pH approx. 6 in mink the pepsin activity was lower than in the digesta at the mucous layer, where the lower pH creates a more optimal environment for the proteolytic activity of the pepsin.

In the gastric mucus of rabbits, representative of herbivora and of rats, representative of omnivora, a much lower content of pepsinogens and pepsin activity as well as other proteases were found than in the carnivorous fur animals (Olejnik, 1984). According to this author in the suckling mink the pepsin activity in the stomach mucus was only 10 - 25% of the activity of this enzyme in the adult mink. Then the pepsin activity was increasing until the period of the transfer from milk nutrition to the mixed diet (Gawlikowska and Barabasz, 1990).

In the stomach proteins are only partially digested, mostly split to dipeptides. Carbohydrates and lipids are only slightly digested in the stomach of monogastric herbivorous fur animals, mostly due to salivary alpha amylase and lipase.

3.2. Secretion and digestion in the small intestine

Slightly digested feed in the stomach moves to the duodenum where it is subjected to pancreatic juice activity and the intestinal enzymes secreted by the cells of brush border interface, and the bile.

The pancreatic juice contains dicarbonates which cause the passing gastric content to become more alkaline, providing a favourable medium for pan-

creatic and intestinal enzymes. To them belong: proteolytic enzymes (trypsinogen-trypsin, chymotrypsinogen-chymotrypsin, procarboxylase-carboxylase, proelastase-elastase, dipeptidases and aminopeptidases), amylolytic enzymes (pancreatic amylase, maltase and others), enzymes splitting the nucleic acids (nucleases) and the enzymes decomposing the lipids emulsified by the bile. Inactive trypsinogen is converted to the active trypsin by enterokinase secreted from duodenal mucous cells, and then free trypsin converts chymotrypsinogen to chymotrypsin, proelastase to elastase and procarboxylase to carboxylase.

According to Levis and Hill (1983), secretion of the bile produced by the liver contains an electrolyte mixture, the salts of the bile acids and phospholipids (mainly lecithin). There is a distinct relation between dietary habits and type of bile salts. Carnivores such as foxes, raccoon dogs, mink and ferrets, have bile salt with 3 or 4-hydroxyl groups of taurine conjugates, while herbivores, like rabbit and nutria have dihydroxy-acids conjugated almost entirely with glycine. The bile is discharged into the duodenum due to gall-bladder contraction during digestion as well as following liberation of cholecystokinin-pancrease from duodenum mucosa.

Greenwood and Read (1985), on the basis of an experiment on ferrets, suggest that the vagal nerve stimulation induces intestinal secretion accompanied by a rise in transmural potential difference. But, according to Levis and Hill (1983), the main factor inducing pancreas secretion hormone secretion from the mucus of the duodenum such as secretin and cholecystokinin-pancreozymin.

3.3. Age effect on pancreatic secretion

Interesting studies on the activity of the proteolytic and amylolytic enzymes in mink aged from 0 to 12 wks. were carried out by Elnif and Enggaard-Hansen (1988). They found that mink kits are born with the ability to digest proteins by means of trypsin, whose activity is relatively high in the first week of life, falling to about two thirds of this level in the next two weeks. After this period enzyme activity increases reaching at week eleven about two thirds of the level for adult mink. Similar experiments on ferrets showed an increase in the activity of proteolytic enzyme at week twelve of

about 4 fold in comparison to the level at age 25 days old (*Gawlikowska and Barabasz, 1990*).

Chymotrypsinogen-trypsin activity, according to Elnif and Enggaard-Hansen (1988) was not detectable in the pancreas of newborn kits. In the next few weeks this pancreatic endopeptidase activity was still low. A slow rise in its activity occurred up to week ten. From week ten an appreciable activity was found and for adult mink it was approx. $2 U_{ch}/mg$ pancreas. Also in the newborn mink kits (4-6 hrs. old) no detectable pancreatic amylase was found. In the following four week period hydrolase activity rose, reaching a relatively high level and, over the next six weeks, an appreciable decline in pancreatic alpha amylase activity was found reaching the level of adult mink. Olejnik (1991) confirmed the proteolytic and also lipolytic activities of pancreatic enzymes in newborn mink kits, whereas a marked increase in lipolytic activity was noted with a change to mixed diet. In 15-day-old mink kits fed solely on milk the activity of proteolytic pancreatic enzymes was 25-45% and amylolytic 10-15%; in the small intestine the values were 26-30% and 36-71%, respectively, of these hormones levels in adult animals. In 25-30-day-old mink and foxes, proteolytic activity of the pancreas after the change to mixed diet was 34% in mink and 57% in foxes, whereas in the small intestine mucosa the values were 40 and 80%, respectively, in relation to the levels of enzyme activity in adult animals. A considerable increase in amylase (invertase) and monoglycerido-lipase levels was observed in the small intestine of these animals. Those levels decreased in the later period.

The activity of digestive enzymes varies between particular animal varieties (*Kroghdal and Holm, 1982*). Thus in order to compare the specific characteristics of digestive enzyme activities in various fur animal species, Olejnik (1991) advises the use of reciprocal relation between these enzyme activities and not the absolute values of enzymatic activities as these may be influenced by the experimental conditions. According to Olejnik (1991), who characterized reciprocal activity relations in four species of fur animals (mink, polar foxes, silver foxes and raccoon dogs), and for comparison also in rats, the value of amylase/protease coeffi-

cient was highest in rats, both in the pancreas and the small intestine. The value was about twice as low in raccoon dogs and the lowest in polar and silver foxes. In comparison with the proportions of other enzymes, it may be noticed that proteolytic digestive enzymes are prevalent in mink, while in raccoon dog, which are placed between omnivora and carnivora, the enzymatic spectrum of the digestive tract is more balanced in relation to protein, fat and carbohydrate hydrolysis.

3.4. Adaptation of the digestive enzyme to the diet composition

A strong proteolytic activity and weak carbohydrolytic activity are general properties of the enzymatic spectrum of the digestive tract in carnivorous fur animals. The fact is compatible with their diet type, for these animals are evolutionally adapted to digest animal protein. In carnivorous fur animals an increase in proteolytic activity occurs much earlier than amylolytic. In two-month-old mink and foxes the proteolytic enzyme activity was approx. 90%, whereas amylolytic was respectively 60% of adult activity in mink and 40% in foxes (Cwietskova *et al.*, 1984; Olejnik, 1991). It was determined that amylase in mink and foxes, as compared with rat amylase, hydrolyses glycogen to a higher extent than starch. The results of experiments on mink fed diets containing higher amounts of carbohydrates (up to 33%) and fat (up to 27%) as given by Simoes-Nunes *et al.* (1984) point to an adaptation ability of pancreatic lipase to an increased content of fat in the diet. In a similar experiment on mink, Olejnik (1991) did not confirm the adaptation ability of pancreatic lipase or amylolytic or proteolytic enzymes dependent on the diet composition. According to the same author, an individual adaptation to food composition occurs in mink on the level of the functional organisation in the mucosa of the small intestine.

With a standard diet a high enzymatic activity takes place in the distal segments of the small intestine. The results received by Szymeczko and Skrede (1990), seem to confirm this data. They found that the highest digestibility of amino acids in mink takes place in the second and third parts of the small intestine. The specificity of enzymatic digestion in herbivores, like rabbit or nutria, as opposed to carnivores, lies in an increased amount

and activity in the gastro-intestinal tract of amylolytic enzymes and cellulytic enzymes produced by microorganisms in the large intestine with a caecum which decomposes fiber (Lebas, 1988; Cheeke, 1984). The large intestine in these animals is the main region where, apart from water and electrolytes, volatile fatty acids produced as a result of intestinal fermentation are absorbed.

3.5. Absorption of nutrients

Products of enzymatic digestion are absorbed mainly in the small intestine but in carnivorous fur animals mostly in distal parts of the small intestine: through diffusion or passive absorption, through active absorption with the use of high energy compounds - ATP (absorbed glucose, amino acids, Na, Ca, and others) and by the way of pinocytosis - an absorption of big particles (proteins, monoglycerides) which, in its initial phase, is similar to phagocytosis (Barej, 1983).

3.5.1. Absorption of protein and amino acids

Absorption of proteins occurs in the first period after birth when the animal is fed by colostrum whose protein contains approx. 10% globulins - mostly ready - made immunological bodies produced by the mother. At that time achlorhydria occurs in the stomach of a newly-born animal and colostrum contains trypsin-inhibitor which blocks protein digestion (Barej, 1983).

Amino acids are absorbed actively. Depending on chemical composition, there may be several systems of absorption; neutral amino acids are characterized by competitive absorption, with a precedence to more polarised ones; there is a common way by which alkaline amino-acids and cystine are absorbed. Proline and hydroxyproline are assimilated in the same way as glutamine and asparginian acids which become desaminated in the process. Some amino acids penetrate into the blood as peptides which become split in the enterocytes of the intestinal mucosa or in the liver.

3.5.2. Absorption of sugars

Sugars become absorbed only as monosaccharides. Glucose and galactose are assimilated through an active transport where Na⁺ ions are the stimulants of glucose absorption. Fructose, pentose and some hexoses are absorbed through diffusion. According

to Buddington et al. (1991) mink are able to regulate sugar transport activity in response to changes in the amount of dietary carbohydrate.

3.5.3. Absorption of fats

Fats undergo a hydrolysis in the small intestine and together with bile acids free fatty acids and steriods form still smaller micelles. Short-chained fatty acids (C₂ to C₈) diffuse into the blood most easily. Higher fatty acids and monoglycerides are absorbed in the farther region of the intestine by way of pinocytosis and penetrate into enterocytes where monoglycerides are further hydrolized to fatty acids and glycerol. These elements, together with monoglycerides which have not been split, are re-synthesized to triglycerides and phospholipids. Salts of bile acids are absorbed into the blood in the end of the ileum where as a whole they become intercepted by the liver and secreted in bile into the duodenum (Barej, 1983).

4. Digestibility of nutrients

4.1. Carnivorous fur animals

The amount of animal foods in a mink diet is 60-85% and 50-70% for foxes, raccoon dogs and fitches. The quantity of these foods in a diet depends on protein and energy requirements throughout a particular breeding season, as well as on the biological value of proteins and nutrient digestibility. Digestibility of protein in animal foods depends mainly on the content of collagen and ash (bones). For example, digestibility of poultry legs (high ash content) is 52% for mink, whereas the value for soft parts (bowels) is about 80% (Leoschke, 1986). Digestibility of muscle meat is higher, 85-95%, and that of cottage cheese approx. 90% (Jarosz, 1993). According to Skrede (1980), if the protein of food has a high biological value, there is no big difference in digestibility among particular amino acids, whereas if the biological value of the protein is low, the differences in amino acid digestibility increases.

Generally, it may be stated that in cooked or autoclaved meat byproducts, the protein digestibility for carnivorous fur animals declined by approx. 10%. Considering the species differences, digestibility of meat byproducts for foxes, raccoon dogs and fitches is about 5% higher than for mink.

Digestibility of fat depends mostly on the content of stearic and palmitic fatty acids (Jørgensen & Glem-Hansen, 1983). According to these authors digestibility of beef tallow is 72%, of lard 84% and fish oil 93%. Ahman (1976) quotes the digestibility values of stearic acid in beef tallow: 65-73% and of palmitic acid 68-75% and the values for palmitic acid in Capelin oil 95-97%. According to Rouvinen (1990), digestibility of fat depends on its amount in the diet. On the 15 and 25% levels of fat in the diet, the digestibilities of tallow, capelin oil and rapeseed oil were respectively: 74.94%, 94%, 95% and 71.96%, 96% and 96%. For tallow, soya oil and a mixture (50:50) of both fats the values assumed respectively 71.93%, 93% and 81%.

Digestibility of carbohydrates for carnivorous fur animals depends on the kind of feedstuff, grinding and heat treatment. Cooking or autoclaving of cereal feedstuffs generally increases their digestibilities about 10-20% and more in case of potato starch. According to Leoschke (1986) digestibility of raw ground wheat is 68% and of cooked 80%, for raw ground corn it is 54% and 80% when cooked, the value is 2% for raw potato starch and 77% when cooked (Jørgensen & Glem-Hansen, 1973). Digestibility of wheat milled with a 3 mm sieve is 69% and barley 58% while milled with 1 mm sieve digestibilities are 71% and 62%, respectively (Jørgensen, 1985). A fiber content over 2% (dry matter) of the diet reduced digestibility, at 3.5% of fiber by 5%, at 10% of fiber by 20%. Digestibility of carbohydrate feedstuffs is somewhat higher for foxes, raccoon dogs and fitches than for mink.

4.2. Herbivorous fur animals

The following digestibility coefficients are most frequently assumed for rabbit diets: 75% for protein, 65% for fat and 40% for crude fiber (Gut, 1981). However, crude fiber digestibility may differ depending on the degree of cell walls lignified in the plants. Digestibility of alfalfa fiber may vary from 10-30%, and in young plants only slightly lignified it may even reach 60% (Lebas, 1988). Maynard et al. (1979) give the digestibility of alfalfa fiber - 14% and Slade and Hinz (1969) - 16.2%. The low digestibility of crude fiber in rabbits is explained by a physiological mechanism of segregation in the large intestine of big fiber par-

ticles, which are rapidly excreted from the digestive tract, and in small soluble ones which are the base of fermentative processes in the caecum (Cheecke, 1984).

Digestibility of nutrients for nutria and chinchilla are similar, approx. 66-73% of protein, approx. 68-73% for fat, 37-57% of fiber and of digestible energy 61-75% (Dabrowska, 1977; Børsting et al., 1992).

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**Fat as an energy source in fur animal diets.
Effects of dietary fat:carbohydrate ratio and fat source
on physiological parameters and production performance**

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"New" doctor in the family. We congratulate, a bit delayed, Øystein Ahlstrøm with the new title and the fine reports which are abstracted in the following if they have not occurred in SCIENTIFUR before.

**Fat as an energy source in fur animal diets.
Effects of dietary fat:carbohydrate ratio and fat
source on physiological parameters and produc-
tion performance**

Øystein Ahlstrøm

Effects of three different dietary fat:carbohydrate (F:C) ratios (55:1, 43:13, 25:31) on blue foxes in the reproduction period were studied (Paper I). The monitoring of plasma lipids and other blood parameters throughout the period from 25 days *prepartum* to 42 days *postpartum* revealed characteristic changes associated with pregnancy and parturition. Only plasma acetoacetate and cholesterol were affected by diet. Milk fat content tended to increase with the dietary F:C ratio. Kit mortality was highest among females receiving the highest F:C ratio (55:1), while kit growth was reduced by the lowest F:C ratio (25:31). A relatively low F:C ratio during pregnancy and an increasing F:C ratio during the early lactation period seem to be optimal for blue foxes.

Studies on the suitability of frozen-stored herring scraps as a feed ingredient in diets for mink (Paper II) and silver foxes (Paper II, III) in the growing-furring period, showed that 25-30% herring scraps supported normal growth. Plasma and liver vitamin E in silver foxes and glutathione peroxidase ac-

tivity in silver foxes and mink were not affected by the dietary level of herring scraps. Silver foxes fed a diet high in polyunsaturated fatty acids originating from herring by-products did not show any signs of impaired fat metabolism. Fur quality characteristics were not negatively influenced by feeding herring scraps to any of the species. The results of the studies show that large amounts of herring by-products can be used in feed for silver foxes and mink in the growing-furring period.

Nutrient digestibilities and production performance were evaluated in comparative experiments with blue foxes and mink by using six diets differing in F:C ratio. The F:C ratios tested were 65:5, 60:10, 55:15, 50:20, 45:35, 40:30 (Papers IV, VI) and 60:10, 55:15, 50:20, 45:25, 40:30, 35:35 (Paper VI). Lard and soybean oil (Papers IV, V), and capelin oil (Paper VI) were the main fat sources.

The digestibility experiments showed that blue foxes digested nitrogen (N), most amino acids, fat and high carbohydrate levels more completely than mink did (Paper IV). In mink, but not in blue foxes, the apparent digestibilities of N and fat declined significantly with decreasing F:C ratio. In the study dealt with in Paper VI, we observed species differences in digestive capacity similar to those described above, but the digestibilities of N, fat and carbohydrates were generally higher.

The production experiment showed that in blue foxes, the very high F:C ratios resulted in increased energy intake (ME), and high final body weights (Papers V, VI). By contrast, in mink the very high F:C ratio diets (65:5 and 60:10 in Paper V; 60:10 in Paper VI) seemed to increase ME consumption per body weight gain somewhat, but the final body weights were similar to those obtained with the lower F:C ratio diets.

In blue foxes, blood and liver levels of compounds involved in the antioxidative system were not closely related to dietary level of fish oil (Paper VI). In mink, however, liver vitamin E and plasma vitamin E increased with decreasing levels of fish oil or F:C ratio. Vitamin E deficiency symptoms were not observed in any of the species, and mortality was low.

Species differences were found in hematocrit, hemoglobin, liver vitamin E, and the plasma compounds triacylglycerol, ASAT, superoxide dismutase, Cu, and vitamin E.

Fur quality in blue foxes was not affected by the F:C ratio, but the extremely high F:C ratios (65:5 and 60:10 in Paper V; 60:10 in Paper VI) tended to reduce fur quality in mink, possibly owing to impaired guard hair growth. It can be concluded that both blue foxes and mink can be fed various fat sources in diets with diverging F:C ratios without affecting production performance in the growing-furring period. However, the very high F:C ratios diets should be used with caution in mink when *ad libitum* feeding is applied owing to risks for negative effects on fur quality.

The studies in Paper VII aimed at revealing differences between blue foxes and mink in their ability to oxidize long-chain, unsaturated n3 fatty acids from fish oil by comparing the liver lipid content of these fatty acids and liver peroxisomal β -oxidation activity. The total fat content, including phospholipids, in blue fox and mink liver averaged 5 and 10%, respectively, whereas the phospholipid content was 0.5-1% for both species.

The proportion of the total liver fat accounted for by n3 fatty acids was higher in foxes than in mink, owing largely to differences in liver lipid:phospholipid ratio. On the basis of the fatty acid composi-

tion of liver lipids, there is no reason to believe that the species studied differ in the efficiency with which they oxidize long-chain unsaturated n3 fatty acids.

Hepatic peroxisomal β -oxidation activity was higher in blue foxes than in mink (Paper VII). For both species the total activity rose as the level of dietary fish oil increased.

Thesis 1994:25. 31 refs. ISSN 0802-3220, ISBN 82-575-0234-0. Author's summary. Øystein Ahlstrøm, Agricultural University of Norway, Department of Animal Science, P.O. Box 5025, N-1432 Ås, Norway.

The thesis is based on the following reports except Paper I (Vol. 16, No. 4, pp. 314, 1992), No. IV (Vol. 20, No. 1, pp. 102, 1996) and No. V (Vol. 20, No. 1, pp. 102, 1996).

PAPER II

Herring scrap as feed for silver foxes and mink in the growing-furring period

Øystein Ahlstrøm, Anders Skrede

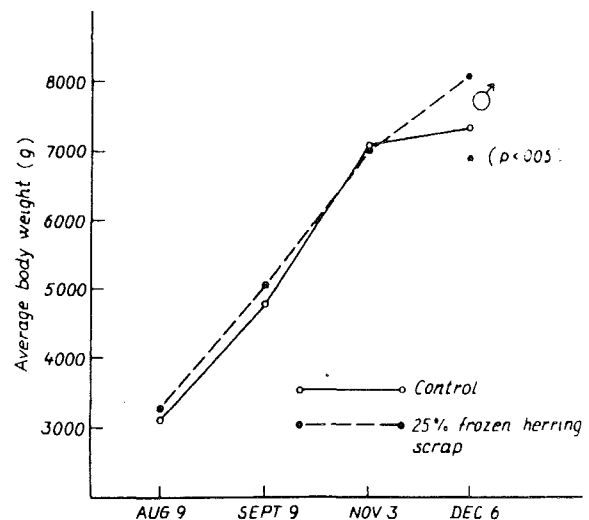


Fig. 1. Body weight gain in silver foxes.

Up to 25% frozen-stored herring scrap was fed to silver foxes and mink in conventional wet diets during the period from 13 July (mink) or 8 August (silver foxes) to pelting time in November/December. Blood analyses revealed no effects of diet on vitamin E status or glutathione peroxidase activity. Body growth in silver foxes was improved by the herring scrap diet. Mink fed 25% herring scrap showed an initial growth impairment, but the differences in body weights vanished towards the final weighing. In silver foxes, the experiment revealed improvement in hair quality and general fur impression in animals fed herring scrap. The occurrence of brownish hairs in silver foxes was not affected. Fur quality or colour in mink was not influenced by the feeding of herring-scrap.

Norwegian Journal of Agricultural Sciences 7, pp. 175-187. ISSN 0801-5341. 7 tables, 2 figs., 29 refs. Authors' summary. Øystein Ahlstrøm, Agricultural University of Norway, Department of Animal Science, P.O. Box 5025, N-1432 Ås, Norway.

PAPER III

Effects of herring scraps feeding on body fat composition, growth and fur quality in silver foxes

Øystein Ahlstrøm, Anders Skrede, Magny Skintlo Thomassen

A study was carried out to evaluate herring scraps as a feed ingredient for silver foxes, focusing in particular on alterations in fatty acid composition of body fat which could be due to impaired fat metabolism. Frozen-stored and acidpreserved herring scraps accounted for 0, 20 and 30% of the diets in the growing-furring period. It was found that acidpreserved herring scraps as feed resulted in better fat quality than the frozen-stored scraps, possibly because of a more thorough blending of the antioxidant into the material. The dietary fatty acid composition was reflected in the subcutaneous fat of the animals. Liver fat was less affected by dietary fat, and independent of dietary fat source, high percentages of 20:4 n₆ (arachidonic acid) and of 22:6 n₃ (docosahexaneonic acid) were detected in the liver fat. Liver vitamin E content was not affected by the diets. General health status,

measured as mortality rate and growth performance, was satisfactory in all dietary groups. Fur characteristics were not significantly influenced by the herring scraps diets.

Norwegian Journal of Agricultural Sciences 8, pp. 55-67. ISSN 0801-5341. 5 tables, 1 fig., 26 refs. Authors' summary. Øystein Ahlstrøm, Agricultural University of Norway, Department of Animal Science, P.O. Box 5025, N-1432 Ås, Norway.

PAPER VI

Fish oil as an energy source in feed with diverging fat:carbohydrate ratios for blue foxes (*Alopex lagopus*) and mink (*Mustela vison*) in the growing-furring period

Øystein Ahlstrøm, Anders Skrede

The present investigation addressed the effects of the dietary fat:carbohydrate (F:C) ratio and level of fish oil on blue foxes and mink. Blue foxes digested the main nutrients more efficiently than did mink. Increasing the F:C ratio resulted in faster growth and heavier final body weights in blue foxes, but had no such effect on growth performance in mink. Analysis of blood lipids and plasma compounds related to the antioxidative system and liver vitamin E revealed few significant differences between diets. In mink there was a significant relationship between dietary level of fish oil and vitamin E status. Significant differences between species were found for hematocrit, hemoglobin, plasma vitamin E, liver vitamin E, plasma triacylglycerols, plasma superoxide dismutase and plasma ASAT. Because there were no clinical symptoms of malfunctions in the antioxidative system we concluded that both species tolerate high levels of good quality fish oil. In blue foxes, fur quality characteristics were little influenced by the F:C ratio. In mink, fur quality characteristics were highest in the intermediate F:C ratios, whereas the highest F:C ratio (60:10) tended to reduce skin length and length of guard fur.

Thesis 1994:25. 7 tables, 28 refs. 21 pp. Authors' summary. Øystein Ahlstrøm, Agricultural University of Norway, Department of Animal Science, P.O. Box 5025, N-1432 Ås, Norway.

PAPER VII

Liver fatty acid composition and peroxisomal fatty acid oxidase activity in blue foxes (*Alopex lagopus*) and mink (*Mustela vison*) fed diets containing different levels of fish oil

Øystein Ahlstrøm, Anders Skrede

Dietary fat content had little influence on total liver fat content but affected the liver fatty acid composition. Blue foxes had a lower liver lipid content (4-5%) than mink (7-10%), whereas the phospholipid (PL) content was 0.5-1% in both species. Levels of n3 fatty acids were higher in the PL fraction than in the remaining fraction of liver lipids in both species. Because PL accounted for a larger part of the total liver lipids in blue foxes than in mink, the proportion of the total liver lipids accounted for by n3 fatty acids was highest in blue foxes. On the other hand, the mink and foxes had about the same quantity of n3 per gram liver owing to higher fat content of mink liver. Analyses of liver lipid fatty acid composition did not reveal any differences between the species in their ability to metabolize n3 fatty acids originating from fish oil.

Peroxisomal β -oxidation activity in the liver was significantly higher in blue foxes than in mink. For both species the total activity rose as the level of dietary fish oil increased.

Thesis 1994:25. 4 tables, 17 refs. 14 pp. Authors' summary. Øystein Ahlstrøm, Agricultural University of Norway, Department of Animal Science, P.O. Box 5025, N-1432 Ås, Norway.

Diet of the raccoon dog, *Nyctereutes procyonoides*, in Finland

Kaarina Kauhala, Marja Kaunisto, E. Helle

We studied the diet of the raccoon dog (*Nyctereutes procyonoides*) in Finland by examining the contents of 172 stomachs mainly from August-April and 206 scats from May and June. Findings suggest that the raccoon dog is a true omnivore, with the seasonal composition and diversity of the diet varying with the availability of different food items. Small mammals, plants, and carcasses and

other waste were frequently eaten during all seasons, and some birds were eaten throughout the year. Insects were a common food in summer and autumn, and frogs and lizards in late spring and early summer. The diet also included fish, particularly in early spring and autumn. The annual variation in food composition seemed to be affected by the availability of small rodents. The raccoon dog seems to be rather harmless to full-grown tetraonids and waterfowl, but the role of the raccoon dog in the predation of eggs and downy young of gallinaceous birds and waterfowl remains obscure.

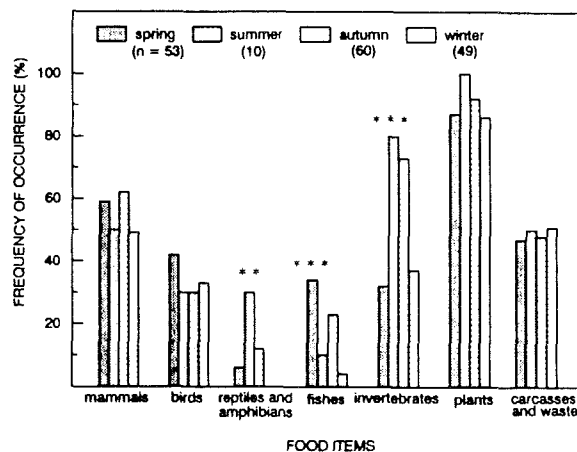


Fig. 1. The frequency of occurrence of seven main food categories in raccoon dog stomachs in different seasons in Finland. The differences between seasons were tested with the G test; the statistical differences are indicated by asterisks (** means $P < 0.01$, *** $P < 0.001$).

Z. Säugetierkunde 58, pp. 129-136, 1993. 2 tables, 1 fig., 27 refs. Authors summary.

Application of bifidumbakterin in fur animal husbandry

N.A. Balakirev, E.I. Drozdova, N.N. Loenko, N.I. Bezv, O.G. Efimova, A.N. Kuzikov, N.A. Abramov, V.M. Bondarenko

Bifidumbakterin, a probiotic preparation which is a mass of *Bifidobacterium bifidum* (strain B-1), given to mink and arctic vixens from 3 days before

and until 2 months after whelping, at 1.5- to 10x10⁷ live cells/head daily, had no positive effect on reproduction, considerably increased liveweight of the young at 40 days old and improved pelt quality. Bifidumbakterin, used as a dietary supplement for feeding female silver vixens before whelping and during lactation, increased the growth of offspring during the suckling period, helping to increase their weight at 40 days old and reduced culling percentage. When given to foxes just before slaughter, Bifidumbakterin improved pelt quality.

Zootekhnika, No. 7, pp. 17-19, 1994. In RUSS. CAB-abstract.

Natural adsorbents in diets for fur-bearing animals

N.A. Balakirev, V.S. Snytko

Mink and foxes in 4 groups were fed from July to September on a basal diet with 0, 0.5, 1.0 or 1.5% zeolite by weight. Optimum dose of zeolite was 0.3%. At that level zeolite increased fecundity by 0.3 young/dam. Zeolite added to the diet at 0.7% increased the size of the offspring. For foxes 0.3% zeolite increased fertility by 0.7 to 0.8 young/dam. The added zeolite increased vitamin A retention in the liver by 20-40%.

Zootekhnika, No. 2, pp. 22-23, 1995. In RUSS. CAB-abstract.

Chemical and carbon isotopic composition of fatty acids in adipose tissue as indicators of dietary history in wild arctic foxes (*Alopex lagopus*) on Svalbard

Caroline M. Pond, Christine A. Mattacks, I. Gilmour, M.A. Johnston, C.T. Pillinger, P. Prestud

The chemical and carbon isotope compositions of triacylglycerol fatty acids were analysed in samples from two or more adipose depots dissected from adult and subadult arctic foxes collected between November 1991 and March 1992 in four different areas of Spitsbergen in the Svalbard archipelago (latitude 78°5' to 79°50' N). Site-specific differences were minor but there were large and consi-

stant differences in the fatty acid composition of the storage lipids of foxes caught in the same area, suggesting that residents of contiguous territories may have had quite different diets. The adipose tissue of adult foxes caught in Austfjordneset, an area where reindeer are rare, contained a much greater proportion of unsaturated fatty acids, suggesting that these animals were feeding mainly in the marine ecosystem, probably on seabirds and/or fish in summer and the remains of polar bear kills in winter. Measurements of the relative abundance of the carbon isotopes ¹²C and ¹³C in individual fatty acids show that palmitoleic acid (C16:1) in storage triacylglycerols originate from the marine food chain, probably together with most other unsaturated lipids, but that the foxes obtain oleic acid (C18:1), and probably most saturated fatty acids, from either terrestrial or marine sources.

J. Zool. Lon. 236, pp. 611-623, 1995. 2 tables, 1 fig., 51 refs. Authors' summary.

The carbon isotopic composition of individual fatty acids as indicators of dietary history in arctic foxes on Svalbard

I. Gilmour, M.A. Johnston, C.T. Pillinger, C.M. Pond, C.A. Mattacks, P. Prestud

We have measured the carbon isotopic compositions of individual fatty acids isolated from the adipose tissue of arctic foxes (*Alopex lagopus*) from the island of Svalbard on the Spitsbergen archipelago to examine whether dietary sources can be distinguished in the fatty acid isotopic signature. The diets of Svalbard arctic foxes are unusual in that some members of the population are believed to feed largely in the terrestrial food chain while others feed mainly from the marine food chain. Isotopic data were obtained for the five major fatty acids present (16:0, 16:1, 18:0, 18:1, and 20:1). A wide range in $\delta^{13}\text{C}$ values for specific fatty acids in Arctic foxes is observed and the mixing lines produced by the correlation in $\delta^{13}\text{C}$ of the 16- and 18-carbon fatty acids indicate that both marine and terrestrial dietary sources determine fatty acid isotope composition. The differences in $\delta^{13}\text{C}$ values between marine and terrestrial organisms appear to be passed on to individual fatty acids. The abundance and isotopic composition of 16:1 indicates

Table 1. Intake and excretion of nitrogen (N) from mink fed at the present dietary protein level and after implementing the suggested reductions (kg N / 1000 breeding female¹⁾).

Period	Present protein level (% of ME)	Suggested protein level (% of ME)	Present level (kg N/1000 breeding females)	Suggested level (kg N/1000 breeding females)
N-intake				
1/12 - 30/4	55	35	786	498
1/5 - 31/5	52	40	242	186
1/6 - 30/6	42	40	394	376
1/7 - 30/11	34	30	3086	2782
Total N-intake			4508	3782
N-losses				
Faeces			676	567
Urine ²⁾			2930	2458
Total N-excretion			3606	3025

¹⁾ One breeding female includes 0.17 breeding male and 5.3 kits.

²⁾ N-losses in urine is based on the average value 65% of dietary N-intake.

The figures in Table 1 for the protein levels and amounts fed are approximate values for commercial Danish mink herds in 1995. The urinary excretion is set at the average value 65% found by Chwalibog et al. (1982). It is well known that this value varies a lot according to dietary N-intake, performance of the animals etc. However, the amount of urinary N which is collected in the manure system varies a lot more depending on how the system for urine collection is made in the mink sheds. In general, mink sheds are equipped in a way leading to rather substantial N leakage to the soil and/or evaporation to the air. Therefore, in most cases less than 65 % of N-intake can be found in the urine in the manure system.

The suggested changes in protein level and consequently dietary N intake are within the recommendations from both previous and recent research on the protein and amino acid requirements in different periods of the life cycle of the mink. Therefore, such changes should be possible to obtain within a few years. If these reductions in protein levels are followed total N losses can be reduced

by 16%. Over the last few years N losses have already been reduced more than 10 %.

Three areas where further reductions may be achieved were pointed out. Firstly, further studies on the optimal amino acid composition may show new possibilities to reduce the total protein level. Secondly, selection for animals with a higher feed utilization also seems to be a possible way to reduce nitrogen losses. Finally, the use of finer grids in the thread at the top of the cages where the feed is placed may lead to less spillage of the feed, and therefore less feed will have to be used.

Internal report no. 62, 1995 from Danish Institute of Animal Science, chapter 2, p. 13-22. In DANH. 1 table, 16 refs. Author's summary.

Feeding different diets to a nutria breeding herd

Ryszard Cholewa

The study concerned the influence of two diets with different protein contents on nutria. The investigations were carried out in the Institute of Small Animals in Celle (Germany) in the programme of Alexander von Humboldt grant. The experiment included Greenland nutria breeding females after the first litter and lasted from 1 October to 19 February. The animals were marked and weighed individually at 4 week intervals and in each period the feed intake was measured, meal and pellets separately. The coefficients of correlation between live weight at the start and in the successive 4 week periods were calculated. In the group obtaining the ration with 12% crude protein the live weight and weight gains in females were lower though the feed intake was higher compared with the group fed the diet containing 17% crude protein. The pellets were more willingly consumed than meal.

Roczniki Akademii Rolniczej w Poznaniu - CCLXI, pp. 35-39, 1994. In POLH, SU. ENGL. 1 table, 3 refs. Authors' summary.

Original Report

Death occurrence in mink farms (*Mustela vison*) in Argentina

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Abstract

An inventory of time and principal causes of death was carried out to assess the health situation of mink farms in the south east of Buenos Aires province (Argentina). Throughout 1990 and 1991, samples from the farms grouped in the Argentine Association of Mink and Fox Breeders (AACVZ) were taken. Causes of death were established from macroscopic examinations and in some cases complementary studies carried out on autopsies.

The highest mortality rate was recorded in March, May and December and plasmacytosis and metabolic disturbances were the most important causes of death.

Introduction

Mink fur farming started in Argentina in the 1930's and reached a production of about 100,000 skins by 1990. Most of the farms are grouped in the Argentine Association of Mink and Fox Breeders (AACVZ). By the year 1991, there were 20 mink farms with 22,000 breeding females, most of them of the standard brown variety.

One of the determining factors in the profitability of a farm is the number of skins produced by each of the females. Some of the factors affecting this ratio are: selection of breeding animals, reproductive management, nutrition and health. Mortality rate in minks, as well as that of other fur animals, is high. Determining the agents causing these losses and the risk periods will permit the establishment of prevention programmes.

Materials and methods

A population of 50,000 young minks from 9 farms in the southeast of Buenos Aires province (Argentina) was surveyed. The records of dead animals, sex, age and size of litter in each farm were taken.

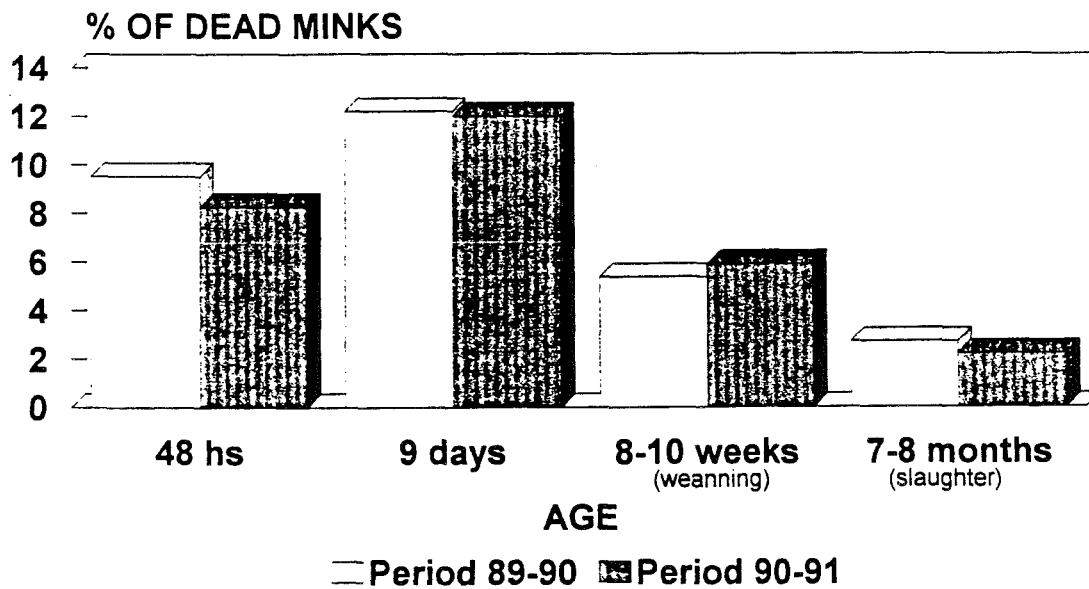
Autopsies were performed at the Diagnostic Service of the National Institute of Agricultural Technology (INTA) in Balcarce, or the carcasses were kept refrigerated until the weekly visit of the vet. During 1990 and 1991, 506 autopsies were performed. All the carcasses were anatomo-pathologically studied and the organs with gross lesions were recorded. Bacteriological cultures were performed on 60 samples at the Bacteriological Laboratory at INTA-Balcarce.

Results

Data showed a 6% mortality from the first week after birth to weaning (8 to 10 weeks of age). From weaning to pelting time, mortality was less than 3%. In one of the farms where litters were checked 48 hs postpartum, 9.52 and 8.26% of stillborns were recorded in 1990 and 1991, respectively. When checked one week after birth 12.2%

and 12% were registered per each year. (Fig. 1) Losses per sex and size of litter are shown in Fig. 2. Post-mortem findings on 506 autopsies were analyzed: 251 correspond to year 1990 and 255 to year 1991. The annual number of macroscopic alterations are shown on Table I. No gross lesions were found on 81 autopsies, 45 corresponding to year 1990 and 36 to 1991. Another 26 samples were not processed due to an advanced state of autolysis.

FIG. 1. DEATH IN YOUNG MINKS ACCORDING TO AGE



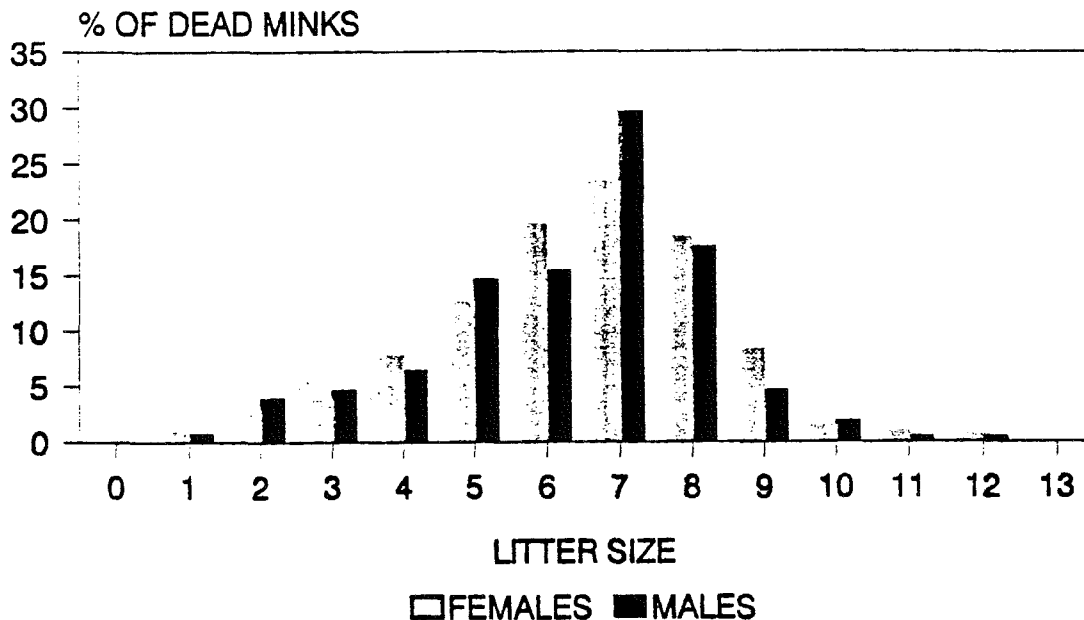
Over a mean population of 5,000 minks

Table I. Macroscopic findings from mink autopsies, years 1990-1991

MACROSCOPIC FINDINGS	YEAR 1990	YEAR 1991
Pneumonia	42	42
Congestive lungs	15	39
Fat infiltration of liver	112	87
Enlargement of spleen	126	84
Kidney lesions	126	52
Urolythiasis	16	8
Others	13	15



**FIG. 2. DEATH OCURRENCE OF YOUNG MINKS
ACCORDING TO SEX AND LITTER SIZE**



Hemorrhagic pneumonia was found in 78 autopsies, and *Pseudomonas aeruginosa*, β -hemolytic *Escherichia coli* and *Aeromonas hydrophila* were isolated. Six animals had fibrinous non-suppurative pleurisy, associated to pericarditis and enlargement of spleen.

Pneumonia was found in carcasses with large fat depots (37%) or with signs of plasmacytosis (63%).

In 16.60% of post-mortem examinations a fatty degeneration of the liver was observed, and 22.7% had low fat depots generally associated with plasmacytosis.

In 41.9% of the autopsies an enlarged mottled spleen was observed. 30.7% were associated to kidney lesions and small fat depots, in 5% severe fat infiltration, and in 4.8% with alterations in the urinary tract. In 1.4% the enlarged spleen was the only macroscopic finding.

On post-mortem examinations on 178 carcasses, 13.5% had enlarged suppurative kidney with calculi, and lesions in urethers and gall bladder. On 86.5% the kidneys were pale and the surface pitted, some of them with petechias and a higher resistance to cutting.

From the lesions observed in post-mortem examinations the following diseases were found:

Plasmacytosis	29.64%
Metabolic disorders	16.60%
Haemorrhagic pneumonia	15.41%
Urolythiasis	13.50%
Septicemia and traumatic lesions	4.15%
Suppurative pleurisy	1.18%

Fig. 3 shows the monthly distribution of deaths in 1989-1990.

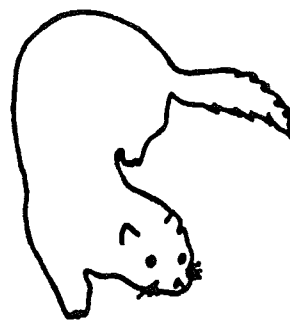
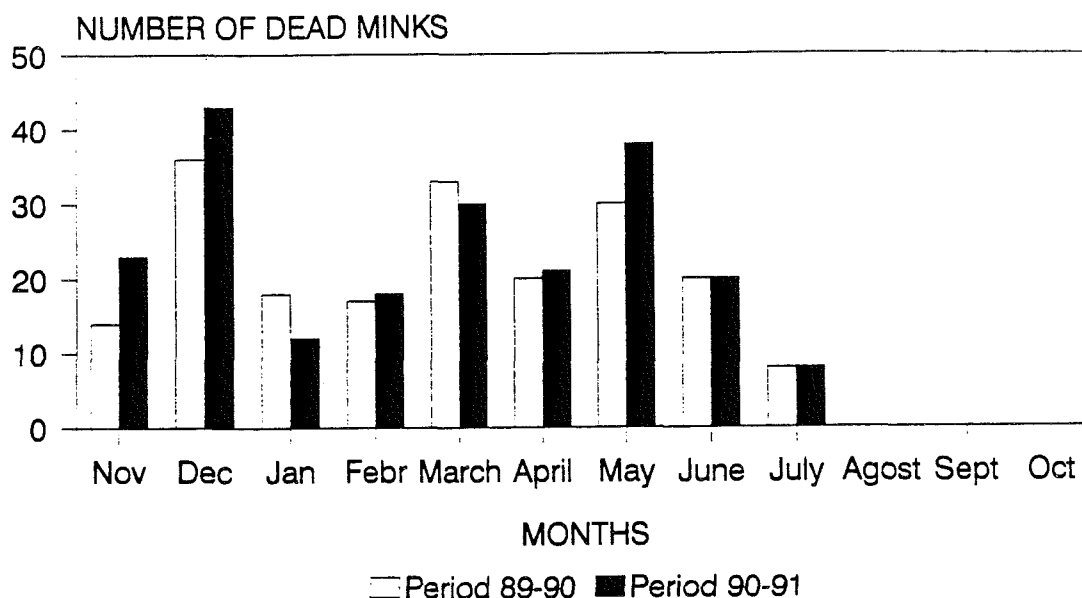


FIG. 3. MONTHLY OCCURENCE OF DEATH
YEARS 1989 - 1990



Discussion

The high number of stillborns and kits that die before the first week is not usually taken into account since the first counting is made between the fifth and the ninth day post-partum. The percentages recorded in this study are similar to those found by Grakova and Grakova (1977) and Einarsson (1980). Konrad and Mouka (1979) found that stillborns made up 21.9% of the losses in the first days after birth and only 48.3 % of them had a normal weight (8 to 12 g.). Henriksen (1983) said that dystocia and strangling with umbilical cord may be causes of death at birth.

The percentage of dead animals recorded from 10 days after birth to pelting time is around 10%, and can be considered normal for this species (Dousek, 1988).

Plasmacytosis signs were those found most frequently in post-mortem examinations (29.64%) throughout the entire productive cycle. Iodine agglutination is the routine test used in fur farms in Argentina to control this disease. Although this

technique is non-specific it is cheap and easy to use.

In 1991, of the 26,367 mink serums processed at INTA - Balcarce-55.88% were CIEP positive (Calvo *et al.*, 1992). This may indicate that although only in 150 autopsies plasmacytosis signs were observed, it may be a predisposing factor in others.

Isolation of *Pseudomonas aeruginosa*, β -hemolytic *Escherichia coli* and *Aeromonas hydrophila* in dead animals with signs of hemorrhagic pneumonia, agrees with the findings of other authors (Finley, 1980; Westlake, 1991). Because *Pseudomonas aeruginosa* spreads fast in mink farms, it is the most important bacterium from the epidemiological point of view. Martino *et al.* (1985) identified serotype 6 from samples taken in farm outbreaks on the southeast of BA province.

Pneumonia outbreaks due to β -hemolytic *Escherichia coli* or *Aeromonas hydrophila* affected a small number of animals, were not invasive and appeared as food poisoning.

Losses from suppurative pleurisy were registered late January probably due to an incorrect vaccination. The needle may be the entrance to the thoracic cavity.

Months of high mortality were December, March and May. Fat infiltration of liver and traumatic lesions were the most frequent pathologies in the months of November, and December, while pneumonias were more frequent during winter pelting time (March through May). These data agree with those reported by van Beek *et al.* (1990), Schneider and Hunter (1993), Seimiya *et al.* (1988), Martino *et al.* (1985), and Martino and Villar (1987).

Conclusions

The most frequent causes of death in mink farms in the production systems characteristic of the south east of Buenos Aires province were plasmacytosis and metabolic disturbances, and their highest incidence was in December, March and May. A thorough study of the causes of death of mink kits on their first days of life should be made.

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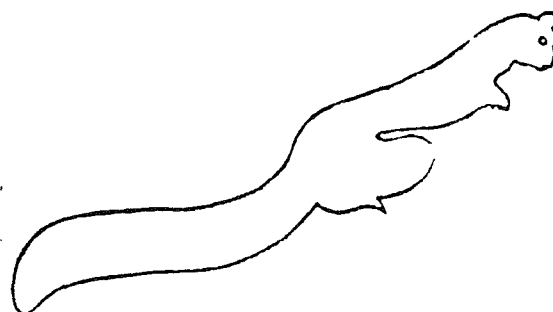
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Comparative ribotyping of *Staphylococcus intermedius* from dogs, pigeons, horses and mink

J. Hesselbarth, S. Schwarz

Strains of *Staphylococcus (S.) intermedius* from dogs, pigeons, horses and mink were typed by comparison of rRNA gene restriction fragment length polymorphism (ribotyping) and the resulting ribotypes examined by cluster-analysis. Digestion of whole-cell DNA with *Hind*III resulted in 9 ribotypes with 3 to 4 bands. Separation of isolates from different host animal species was not possible. *Eco*RI yielded 11 different patterns with 4 to 9 fragments. The *Eco*RI-ribotypes of all canine strains grouped in one cluster encompassing four closely related ribotypes. Isolates were indistinguishable with respect to their origin from cases of canine pyoderma or from healthy carriers. In contrast, pigeon and equine strains expressed a greater variety of ribotypes including some strains with patterns similar to canine isolates. However, for canine versus pigeon and equine strains the difference in distribution among ribotypes was significant ($P < 0.001$). The data might suggest that pigeons and horses carry *S. intermedius* transiently and might be able to spread these bacteria to other animal species.

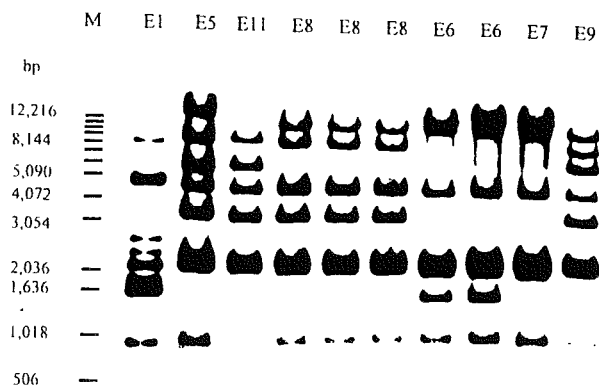


Fig. 1. Radiograph of some of the ribotypes of *S. intermedius* obtained after digestion of chromosomal DNA with *Eco*RI and probing with the 2.3 kb *Hind*III fragment of pBA2. Lane M: position of marker DNA fragments (1 kb ladder, Gibco-BRL) as derived from ethidium bromide stained agarose gels prior to blotting.

Veterinary Microbiology 45, pp. 11-17, 1995. 3 figs., 21 refs. Authors' abstract.

Myelomonocytic leucosis in the polecat

D. Turcu, Gh. Paunescu, N. Manolescu, R. Begnescu

Clinical and morphopathological investigations were conducted in 2000 polecats exhibiting advanced anaemia and cachexia, and where morbidity was 20% and mortality 50%. Cytomorphological examinations were carried out on blood, bone marrow and lymph nodes, and histological ones were performed on the spleen, lymph nodes, kidneys, heart, lungs, intestines, pancreas and central nervous system. In most samples, the same type of proliferated, large size (24-26 microns), malign cells of uniform monochromatic nucleus, with smooth filamented chromatin, and "cigarette smoke"-like cytoplasm was identified. The cells had a high degree of anaplasia. Besides these cells frequent myeloblasts (co-proliferated with monocytoïd cells) were identified in the parenchymatous organs (spleen, liver). The morphopathological aspects described support the diagnosis of myelomonocytic leucosis, representing the first report in Romania on this pathological condition in the polecat.

Revista Romana de Medicina Veterinara, 4, 2, pp. 159-164, 1994. 7 figs., 5 refs. Authors' abstract.

Results of serological investigations of *Leptospira* antibodies in foxes

H. Müller, P. Winkler

1253 serum samples of foxes were checked for the presence of *Leptospira* antibodies; 24 serum samples (1.92%) were positive. *Leptospira grippotyphosa* (10 samples) was the most common serotype, which is also widespread in other wild and domestic animals. The possibility of distribution of *Leptospira* in fox populations is discussed. *Leptospira* antibodies were found in only 0.20% of the examined serum samples of domestic animals of the same territory (South-Thuringia).

Berliner und Münchener Tierärztliche Wochenschrift, 107, 3, pp. 90-93, 1994. In *GERM*, Su. ENGL. 6 tables, 25 refs. Authors' summary.

Yeast infection in ferrets

J.R. Dinsdale, J.R. Rest

Eight of 50 domestic ferrets on the same premises were examined for painful, rapidly progressing crusting and necrosis of the pinnae. Concurrent otitis media and ear mite infestations were found in some ferrets. No bacteria or yeasts were detected at this stage. Despite treatment 6 more in-contact animals were affected. Histopathological examination of 2 excised pinnae identified *Malassezia* in the crusted epidermis and in intra- or sub-corneal pustules. Large areas of haemorrhagic necrosis were associated with thromboses. Yeasts were found on impression smears and in deep skin scrapings. Treatment with oral ketoconazole (Nizoral; 50 mg/day) and topical miconazole, polymyxin B and prednisolone ear drops (Surolan) produced a marked improvement within 5 days. Further cases have been seen in unrelated ferrets belonging to the same owner.

Veterinary Record, 137, 25, pp. 647-648, 1995. 3 refs. CAB-abstract.

***Phagicola angrense* (digenea: Heterophyidae) as a cause of enteritis in a raccoon (*Procyon lotor*)**

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

Numerous *Phagicola angrense* were associated with enteritis in a single male juvenile raccoon (*Procyon lotor*) live-trapped on Parramore Island, Virginia (USA). The raccoon was weak, ataxic and had melanic soft feces. The carcass was emaciated, pale and had ascites. Mesenteric vessels appeared prominent and the stomach and the intestines contained fetid bloody material.

The small intestinal mucosa contained three locally extensive sites of necrosis. Histopathologically, there were numerous small digeneans both attached to the mucosa and free within the lumen. Digeneans were usually found deep within the crypts where the epithelium was markedly attenuated and devoid of epithelial cells at the point of parasite attachment. In the lamina propria there were areas of acute haemorrhage and infiltration with plasma

cells and eosinophils. This appears to be the first record of severe enteritis in the raccoon caused by this digenean.

Journal of Wildlife Diseases, 25 (2), pp. 273-275, 1989. 6 figs., 14 refs.

***Sarcocystis* in muscles of raccoons (*Procyon lotor* L.)**

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

Sarcocysts of *Sarcocystis* sp. were found in 26 (50%) of 52 raccoons (*Procyon lotor*) from Ohio, Pennsylvania, Florida, and Maryland. Although only 4 (7.7%) of 52 cardiac muscle specimens were found to contain sarcocysts, 25% to 36.5% of tongue, diaphragm, masseter muscle, and esophagus specimens were found infected. By light microscopy, sarcocyst walls were <3 µm thick and had no conspicuous projections; interior septa were indistinct. By transmission electron microscopy, sarcocyst walls had short (mean=2.7 µm), villus-like protrusions; thin septa were seen within the sarcocysts. The raccoon may be an intermediate host for a *Sarcocystis* sp. that completes its life cycle in an unidentified, wild carnivore.

J. Protozool. 34 (4), pp. 445-447, 1987. 1 table, 1 fig., 17 refs. Authors' abstract.

Development of a *Sarcocystis*-like apicomplexan protozoan in the brain of a raccoon (*Procyon lotor*)

J.P. Dubey, C.A. Speer, A.N. Hamir, M.J. Topper, C. Brown, C.E. Rupprecht

Schizonts of a *Sarcocystis*-like protozoan were found in the brain of a raccoon (*Procyon lotor*). The parasites, located directly in the cytoplasm of macrophages, neurons, and multinucleated giant cells, were not surrounded by a parasitophorous vacuole. The parasite divided by endopolygeny, leaving a residual body. Schizonts were 5-35 x 5-20 µm and contained up to 35 merozoites. The merozoites had no rhoptries. The parasite was antigenically and structurally similar to *Sarcocystis*

neurona, the organism of equine protozoal myeloencephalitis.

J. Helminthol. Soc. Wash. 58 (2), pp. 250-255, 1991. 16 figs., 5 refs. Authors' abstract.

Morphologic and immunoperoxidase study of neurologic lesions in naturally acquired rabies of raccoons

A.N. Hamir, G. Moser, C.E. Rupprecht

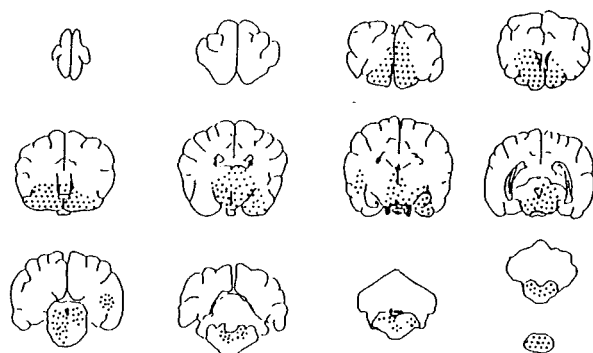


Fig. 1. Location of lesions (perivascular cuffing and gliosis) in brain and anterior cervical spinal cord of raccoon no. 1.

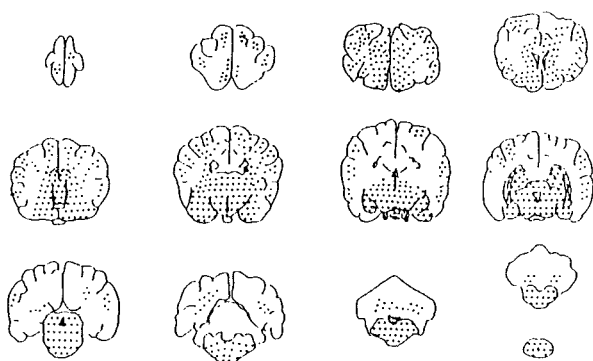


Fig. 2. Location of lesions (perivascular cuffing and gliosis) in brain and anterior cervical spinal cord of raccoon no. 2.

Histopathologic (hematoxylin and eosin [HE]) and immunoperoxidase (streptavidin-biotin complex)

methods were used for examination of formalin-fixes tissues of rabid raccoons from an enzootic area of Pennsylvania. Extensive morphologic lesions of rabies encephalitis were present in the cerebrum and the brain stem regions. Negri bodies were detected by both methods and were present in the brain (cerebral cortex, hippocampus, brain stem, cerebellum, and cervical spinal cord) and in the ganglia of the trigeminal nerves. The viral inclusions were also seen in ganglion cells in the tongue, parotid salivary glands, pancreas, intestines, and adrenal glands. These sites were not associated with any inflammatory cellular infiltrate. The immunoperoxidase method was superior to HE for the detection of Negri bodies. Because lesions of rabies encephalitis were consistently observed in the cerebrum, brain stem, and cervical spinal cord regions, these areas of the brain should be included when raccoons are examined by the fluorescent antibody test for rabies.

J Vet Diagn Invest 4, pp. 369-373, 1992. 8 figs., 13 refs. Authors' abstract.

Diseases of furbearing animals (in Finland) in 1994

V. Puurula

During 1994, distemper was reported on 3 mink and 4 fox farms. The disease was also found among wild animals (martens) that may have transmitted the disease to the farms; 500 cases were recorded in dogs. There were no cases of mink enteritis virus infection; nearly all of the mink kits had been vaccinated. Parvovirus was present in raccoon dogs on several farms. Mange was found on 6 farms. Vaccination against infectious meningitis was recommended as the disease had been found in wild animals. Trichinosis was diagnosed on one fox farm which prepared its own food; infection from rats or via food was suspected.

Pseudomonas aeruginosa was the cause of uterine infection and reduction in the number of young in some blue fox farms, but no outbreaks of respiratory disease caused by this organism were reported. *Clostridium botulinum* was thought to be the cause

of food poisoning of mink on a small farm. *Nosema* infection (encephalitozoonosis) was diagnosed in blue fox cubs on one farm. Heart disease, with up to 25% mortality among cubs, was found on 4 silver fox farms.

Finsk Pälstidskrift 29, 1/2, pp. 12, 1995. In SWED. CAB-abstract.

Freeze-resistant *Trichinella* (*Trichinella nativa*) established on the Scandinavian peninsula

K. Handeland, T. Slettbakk, O. Helle

The freeze-resistance of isolated *Trichinella nativa* muscle larvae was determined by examining the infectivity of the muscle larvae through experimental feeding of Arctic blue foxes (*Alopex lagopus*) with infected fox muscles that had been kept frozen at -20°C for varying periods of time. Some of these carcasses originated from foxes that had escaped from the farm and lived among the wild fauna for a time before being recaptured and pelleted. Each experimental fox received 50-150 grams of *Trichinella* infected fox muscle mixed with the ordinary food ration. The frozen muscles were allowed to thaw before feeding. The foxes were subsequently killed at >50 days pi and the carcasses examined for the presence of *Trichinella* muscle larvae. The *Trichinella* strain remained infective for experimental foxes after at least 4 months of storage at -20°C. The *Trichinella* species was confirmed as *T. nativa* by isoenzyme studies.

The results indicated that freeze-resistant *T. nativa* is established on the Scandinavian peninsula.

Acta Veterinaria Scand. 36, 1, pp. 149-151, 1995. 1 table, 5 refs. CAB-abstract.

The comparative diagnostic value of some precipitation tests in mink Aleutian disease

M. Spinu, F. Brudasca, O. Spinu

Several precipitation tests (iodine, glutaraldehyde, zinc precipitation, polyethyleneglycol) and immunoprecipitation tests (countercurrent immunoelectro-

phoresis, antigen binding in liquid medium) were performed to detect animals (n=59) infected with Aleutian disease virus.

Countercurrent immunoelectrophoresis proved to be the most sensitive (63.7% positive plasma samples) while the other methods rendered as follows: 4.2% PEG precipitation (34% positive samples), 3.75% PEG precipitation (28% positive samples), zinc sulphate precipitation (26.68% positive animals), glutaraldehyde coagulation test (22.8% positive plasmas) and iodine test (12.70% positive samples).

The differences between the positive and negative groups both in zinc and PEG precipitation tests were statistically highly significant ($t=7.85$, $p<0.001$ and $t=11.906$, $p<0.001$, $t=8.502$, $p<0.001$ respectively). There was a strong correlation between the plasma antigen levels and circulating immune complex levels ($r=0.788$, $p<0.001$).

Buletinul Universitatii de Stiinte Agricole Cluj-Napoca Seria Zootehnie si Medicina Veterinara, 47, pp. 201-207, 1993. In ROMN, SU. ENGL. 3 tables, 28 refs. Authors' summary.

Evaluation of urinary cortisol:creatinine ratios for the diagnosis of hyperadrenocorticism associated with adrenal gland tumors in ferrets

W.J. Gould, T.J. Reimers, J.A. Bell, H.J. Lawrence, J.F. Randolph, P.H. Rowland, J.M. Scarlett

Assays were validated for the measurement of urinary concentrations of cortisol and creatinine in domestic ferrets (*Mustela putorius furo*). Urinary concentrations of cortisol and creatinine and the calculated urinary cortisol creatinine ratio (UCCR) values were determined for 29 clinically normal female ferrets, 22 clinically normal male ferrets, and 12 ferrets with adrenal gland tumors. The UCCR values for the 51 clinically normal ferrets ranged from 0.04×10^{-6} to 1.66×10^{-6} , with a median value of 0.22×10^{-6} . The UCCR values were significantly ($P \leq 0.01$) higher in the 12 ferrets with adrenal tumors, with a range of 0.5×10^{-6} to 60.13×10^{-6} and a median of 5.98×10^{-6} . We concluded that determination of UCCR values was

useful in the diagnosis of hyperadrenocorticism associated with adrenal neoplasia in domestic ferrets.

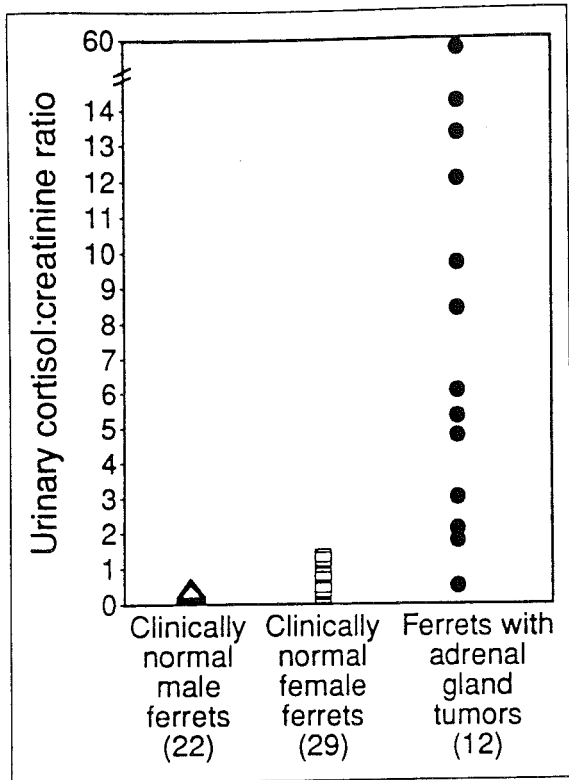


Fig. 2. Urinary cortisol:creatinine ratio values for clinically normal male and female ferrets and ferrets with adrenal gland tumors. Numbers in parentheses indicate the number of ferrets in each group.

Journal of the American Veterinary Medical Association, Vol. 206 (1), pp. 42-46, 1995. 2 figs., 21 refs. Authors' summary.

Survey for selected diseases in nutria (*Myocastor coypus*) from Louisiana

E.W. Howerth, A.J. Reeves, M.R. McElveen, F.W. Austin

Thirty-two trapper-caught nutria (*Myocastor coypus*) from East Baton Rouge, Iberville, Tangipahoa, and St. Helena Parishes in Louisiana (USA) were sampled for several disease agents. Antibodies against *Toxoplasma gondii*, *chlamydia psittaci*, *Francisella tularensis*, *leptospira* spp., and encephalomyocarditis virus were detected in 7%, 14%, 0%, 7%, and 0% of nutria, respectively. Both animals seropositive for leptospirae were positive for *L. interrogans* serovar *canicola*. No *Salmonella* spp. were isolated from feces, and no *Giardia* spp. were seen in trichrome-stained fecal preparations.

Journal of Wildlife Diseases, 30 (3), pp. 450-453, 1994. 1 table, 13 refs. Authors' abstract.

Urolithiasis in a chinchilla

S. Spence, K. Skae

Cystitis was suspected in a mature male chinchilla with a history of haematuria of several weeks duration. Clinical signs resolved following antibiotic treatment but recurred following withdrawal of antibiotics. An abdominal ultrasound scan revealed a hyperechoic smooth interface in the bladder which cast an acoustic shadow and bladder calculi were diagnosed. A cystotomy revealed a single calculus which was removed and cystitis. The chinchilla which had been fed on a proprietary pellet, recovered uneventfully. The calculus was found to be calcium carbonate.

Veterinary Record, 136, pp. 524, 1995. CAB-abstract.



28th International Congress of the ISAE

Research Centre Foulum
Denmark
3-6 August 1994



Abstracts regarding fur animals

Ontogenesis of endocrine function in silver foxes under domestication

I.N. Oskina

For decades, a model experiment with silver foxes (*Vulpes vulpes*) selected for defensive behaviour has been carried out at this Institute. Certain hormonal systems and their underlying mechanisms were altered in these foxes. The changes concerned pituitary-adrenal and reproduction functions. In the present study we took account of the fact that the status of steroid hormones in the developing organism has an influence on many reproductive characteristics persisting through puberty and manifest in adulthood. We compared the function of the adrenals and gonads during development in females selected for a domestic pattern of behaviour (16 tame animals) and enhanced defense responses to man (13 aggressive animals). Plasma cortisol was significantly lower in tame than aggressive counterparts aged 2-8 months ($p < .01$). The differences in the course of changes in plasma progesterone between tame and aggressive foxes were similar as in the case of cortisol, although smaller, during the first 2-8 months of life. The pattern of changes for plasma estradiol were reverse. In tame females, its content was significantly higher as early as at 3 months ($p < .05$), and its rise was more sharp during puberty. As a result, the level of plasma estradiol was 2-fold higher in tame than aggressive foxes at the ages of 6, 7 and 8 months ($p < .01$). Thus, selection of foxes for domestic behaviour has affected the time course of establishment of the function of the gonads and adrenals during development.

Proc. 28th International Congress of the ISAE, Research Centre Foulum, Denmark 3-6 August 1994, pp. L1.7. Only abstract received.

The effects of an improved man-animal relationship on the reproductive performance, sex-ratio in litters and on cub behaviour ontogeny of farmed silver fox vixens (*Vulpes vulpes*)

Morten Bakken

Many studies have shown that environmental effects can affect mammalian reproduction, both in relation to number of offspring raised and in rela-

tion to sex ratio in the litters. Perhaps, almost as important in relation to farmed animals, it is also demonstrated that the environmental effects during pregnancy and delivery need not be restricted to the effects on the mother but also affects cub behaviour ontogeny and later reproduction. This paper presents results on sex ratio in litters, and growth and behaviour differences between cubs from two groups of multiparae farmed silver fox vixens treated in two different ways in relation to human contact: group 1 (G1, N=14) got a tidbit two times a week during pregnancy, while group 2 (G2, N=14) got the same amount of human contact without any tidbit. Earlier experiments indicate that the silver foxes fear of humans is reduced with use of tidbits. Number and sex of cubs were recorded during the first hours after delivery. The cubs were weighed at delivery, at thirty days of age and at weaning (49 days old). Behaviour tests were done when the cubs were 30 days of age with the same methods as presented in Bakken (1992). There were no differences between the two groups of vixens (G1, G2) in relation to number of cubs born (4.9 ± 0.3 versus 4.8 ± 0.5 , NS) or number of cubs at weaning (4.1 ± 0.4 versus 3.8 ± 0.4 , NS), but the G1 vixens had a significantly higher proportion of male cubs in their litter both at delivery (64% ♂ versus 51% ♂, $p < 0.05$) and at weaning (68% ♂ versus 56% ♂, $p < 0.05$) than G2. At delivery there were no significant weight differences between the cubs from the two groups or between the male and female cubs. But at weaning the female cubs from G2 were lighter than the male cubs from both groups ($p < 0.05$) and the female cubs from G1. At weaning there were no significant weight differences between the female cubs from G1 and their brothers or the male cubs from G2. At thirty days of age the female cubs from G1 were more active ($p < 0.05$) and less fearful ($p < 0.05$) than the female cubs from G2.

Corresponding differences were not found between the male cubs. These results indicate that reduced fear of humans or reduced human stress during pregnancy affects both the silver fox vixens parental investment in male and female cubs and, perhaps most importantly, the female cubs' growth and behaviour ontogeny. Seen in relation to earlier findings that active female cubs at thirty days of age wean more cubs during their first parity and are less often infanticidal than inactive cubs, this

result indicates that environmental effects during pregnancy do not only affect the farmed silver fox vixens own reproduction but also their female cubs during their first parity.

Proc. 28th International Congress of the ISAE, Research Centre Foulum, Denmark 3-6 August 1994, pp. L1.8. Only abstract received.

Heart rate of blue fox (*Alopex lagopus*) in normal and simulated situations of farm life

M. Harri, T. Korhonen, J. Mononen

Heart rate (HR) is affected by the animal's activity, metabolic rate and emotional state. Because of the short latency between stimulus and response, HR can provide valuable information about the aversiveness of a particular situation as experienced by an animal. We measured HR of five adult farmbred blue fox females with unrestrained radiotelemetry. We recorded the basic HR values for the total daily 24-h periods to characterize the range of HR during different "normal" behavioural states. As expected, HR increased with increasing locomotor activity from 70-90 bpm of a sleeping animal to the highest value of 150-175 bpm during the most vigorous walking observed. However, the following according to human evaluation, were neutral and not necessarily associated with any major locomotion: grooming (150-200 bpm), circling before lying down (160-220 bpm), scratching the cage (170-230 bpm), alert observing (175-225 bpm), and standing on hindlegs (175-260, max 355 bpm). Furthermore, we recorded the responses of HR to situations supposed to be pleasant (feeding) or unpleasant (capture with neck tongs, man standing in front of the cage) to the foxes. Each situation was replicated several times. This was extremely important as the reactions were very variable both interindividually and intraindividually. Feed delivery and the following eating and capturing with neck tongs incurred variable and always short-lasting changes in HR. Sometimes the approach of the feeder stimulated HR more than the actual feed delivery and eating. A man unknown to the animal stimulated HR more than one the fox knew. The responses were dependent on starting situation. For instance, during two test situations the HR of fox C was about 120-130 bpm initially and rose to

about 140 bpm for the whole 30 min. when the unknown man stand in front of its cage. In the third test, fox C was sleeping before the test with its HR about 80 bpm, and its HR rose to about 140 bpm when the man positioned himself in front of the cage. But after 14 mins, HR of fox C slowed down to below 80 bpm and it fell asleep despite the man still standing in front of it for another 16 mins. For comparison, the HR of fox C exceeded 200 bpm prior to and after feed delivery, and rose to 240 bpm when a titmouse was flying inside the shed house. The results stress that caution should be used when applying HR as an indication of welfare in farmed foxes.

Proc. 28th International Congress of the ISAE, Research Centre Foulum, Denmark 3-6 August 1994, pp. L1.9. Only abstract received.

Open field behaviour is not related to brain weight in farmed silver fox (*Vulpes vulpes*)

J. Mononen, T. Rekilä, M. Harri

Domestication leads to less reactive and more tolerant animals, i.e., the behaviour of a species gradually changes in the course of domestication. This change is due to reduction in the information acquisition and processing systems of the animals. Brain size can be used as a rough measure of the efficiency of the latter (Hemmer, 1990). In the present study, an attempt was made to find out whether there are relations between brain weight and behaviour in farmed silver foxes.

Six to eight month-old silver foxes (27 males, 10 females) were tested for their behaviour in an open field (OF). The latency variables used were: the latency to enter the OF, to reach the furthest end of the 5 m long OF, to sniff the feed available in the farthest end of the OF and to start eating. In addition, the spatio-temporal activity in the OF was measured (originally 40 variables). The brain weights and the lengths of the left tibia (as a measure of body size) of the foxes were measured after pelting at the age of nine to ten months.

There was a correlation between the brain weight and the tibia length: $r=+.47$, $p<0.01$ (Pearson's

correlation). The males were bigger, and, thus, tended to have bigger brains than the females (Table 1).

Table 1. Tibia length and brain weight (mean±SD) in male (n=27) and female (n=10) silver foxes

	Males	Females	P	Statistical test
Tibia length (mm)	153±6	147±6	0.02	T-test
Brain weight (g)	46.9±3.0	44.8±2.5	0.07	T-test
			0.37	ANCOVA

A factor analysis revealed that none of the variables measured in the open field test correlated with the brain weight. Of the males, 85% and 50% of the females sniffed the feed available in the open field ($p < 0.05$, Chi-square-test). This was the only difference in the open field behaviour between the sexes.

The variation in the open field behaviour could not be explained by the brain size.

Proc. 28th International Congress of the ISAE, Research Centre Foulum, Denmark 3-6 August 1994, pp. P1.6. Only abstract received.

Environmental enrichment in fox farming

Leif Lau Jeppesen

Fox farming is widely criticized for many reasons. Some of the reasons concern the welfare of the farm fox. Since the early eighties welfare has been the subject of a great number of scientific studies, especially in the scandinavian countries.

The present communication reviews some of these studies and presents new data from choice experiments. The review includes the following subjects: Effects of whole year shelters, improvement of breeding boxes, man-animal relationships including early handling, and animal-animal relationships. The choice experiments concern aspects of the cage environment. During a series of long lasting experiments the percentage of scanning observations spent near or in a certain cage equipment was

measured as an expression of preference. In this way the experiments showed that adults from both species preferred a nest box in a high position as compared to a low position, and a nest box with more rooms as compared to one room. In spite of this general preference adult silver foxes spent more time in a cage in which one nest box room was substituted by an observation platform. Blue foxes did not behave this way. Adults from both species did not differentiate significantly between nest boxes with transparent versus solid roof, or between cages with wire net versus solid floor. Cubs from both species clearly avoided wire net floors with conventional mesh size. As cubs grew older this avoidance was reduced, especially in blue foxes.

Many studies suggest means of improving the welfare of farm foxes, and these means are now tried out under practical farm conditions in the form of a comparison of three different housing systems: (I) The traditional cage system, (II) an enriched cage system, and (III) an enriched enclosure system with concrete floor. The two alternative systems include whole year nest boxes designed to facilitate proper early experience, observation platforms and resting shelves. They differ with respect to size and floor type. The first results of the testing of the three different housing systems will be communicated.

Proc. 28th International Congress of the ISAE, Research Centre Foulum, Denmark 3-6 August 1994, pp. L2.2. Only abstract received.

Study on factors affecting platform use in blue and silver foxes

Hannu Korhonen, Paavo Niemelä

The European Convention has recommended that foxes should have a more enriched housing environment, including resting platforms. Factors affecting platform use were studied in silver (N=120) and blue foxes (N=300) by monitoring the animals either (1) with 24-hour video measurements or (2) daily visual scanning observations. Both year-round and 5-month-long seasonal experiments with various types of platforms were done. There was great individual variation in the amount of use

($p < 0.001$). In both species, however, females used the platforms significantly more ($p < 0.05$) than males. Previous platform experience and the platform ceiling influenced use ($p < 0.05$) only during the first two study months. Platform type affected useage significantly ($p < 0.001$). The platform most favoured was the V-type, whose shape resembles that of the sleeping hole foxes use in the wild. Platform use varied significantly ($p < 0.001$) year around, being the lowest during winter, and the highest in summer. During early winter, a significant regression was found between daily use (y) and air temperature (x) as follows: $y = 0.43x + 24.1$ ($p < 0.05$, silver foxes) and $y = 0.35x + 37.7$ ($p < 0.05$, blue foxes). During this period, the heaviest foxes used the platforms most and vice versa. Platform use dramatically decreased after females were given whelping nest boxes as they preferred the nest box roofs. The locomotor activity of platform foxes was somewhat less ($p < 0.05$) than that of the controls. Platforms were most frequently utilized for sleeping and the least for jumping or other short-term visits. It seems obvious that the main function of platform use is not limited to that of an observation post alone. The question of whether platforms affect the temperament or well-being of foxes remained open.

Proc. 28th International Congress of the ISAE, Research Centre Foulum, Denmark 3-6 August 1994, pp. P2.9. Only abstract received.

Effect of cage environment on temperament and general activity in blue foxes (*Alopex lagopus*)

T. Rekilä, J. Mononen, M. Harri

Although experiments from domestic and laboratory animals have shown that the housing environment can have a major impact on animal temperament, experiments on farmed furbearers are few and the results are controversial. In this study the effect of housing environment inside (nest box vs resting platform in the cage vs empty cage) and outside the wire-mesh cage on temperament and general activity was assessed in farmed blue foxes ($n=45$). The temperament of the animals was assessed in a novel environment (open field) and in a home cage (capture time, reaction when captured, latency to eat in the presence of man).

The results show that the environment of the cage interior neither had an effect on the animals temperament nor on their general activity. On the other hand, the environment outside the cage was more important. The animals nearest to the door of the shed were most active during the 24-h measurements in their home cage ($p < 0.001$) and in the open field ($p < 0.001$). The general activity in the home cage explained a significant proportion (30%, $p < 0.001$) of the variance of the activity in the open field. The animals near to the door also actively resisted capture while the animals farther from the door were more submissive.

The present results demonstrate that, unexpectedly, the unintentional experimental set-up (environment outside the cage) affected the behaviour of the blue foxes whereas the intentional set-up (cage interior) did not. The importance of careful experimental design cannot be over-emphasized.

Proc. 28th International Congress of the ISAE, Research Centre Foulum, Denmark 3-6 August 1994, pp. P2.13. Only abstract received.

Changes of daily rhythm of locomotor activity in silver foxes (*Vulpes vulpes*) during domestication

I.Z. Plyusnina

Little is known about the modifications of daily rhythms, including the rhythms of motor activity, in the process of domestication. The aim of this study was to compare the daily rhythms of motor activity in foxes selected for domesticated behaviour (22 animals), those selected for aggressive behaviour (18 animals), and those unselected from the population bred for commercial purposes (8 animals). The motor activity was recorded by a fully automatic method in 8 animals simultaneously in summer and was determined within every 10-minute intervals during 24 hours, and estimated by the percentage of time the animal was moving. Three groups of animals were found: foxes having a sharply expressed phase of motor activity (at the level of 80-100%), moderately expressed (up to 50%) and arrhythmic ones (those without any periodicity in locomotion), among aggressive and unselected foxes. No animals with sharply

expressed nocturnal phase of locomotion were discovered and a clear tendency was found for the number of arrhythmical animals to increase among the domesticated foxes (63.7%). The aggressive and unselected foxes did not differ in all the characteristics of nocturnal phase but they had differences in the time of beginning of locomotion and its duration from domesticated foxes ($p < 0.05$). In the latter the phase began earlier and was prolonged.

Proc. 28th International Congress of the ISAE, Research Centre Foulum, Denmark 3-6 August 1994, pp. P3.8. Only abstract received.

Selection for domestic behaviour induced the arisal *de novo* of the new colour phases in the mink

O.V. Trapesov

Some data on polymorphism of the reaction towards man among the mink bred at farms and some selection-induced behaviour changes in these animals are presented. Three types among 32000

farming animals at the age of 6 months, both males and females, were distinguished: cowardly (79%), aggressive (17%) and calm (4%) exploratory reactions. The mean score of aggressive reaction increased during 11 years of selection from -0.29 ± 0.008 in the S_0 to -2.22 ± 0.04 (females) in S_{11} and from -0.14 ± 0.008 (S_0) to -2.23 ± 0.04 (males) in S_{11} . In the group bred for domestic behaviour, the respective scores were $+2.79 \pm 0.2$ in females and $+3.11 \pm 0.2$ in males (S_{11}) against -0.29 ± 0.008 and -0.14 ± 0.008 (S_0). The consequences of transformation of behaviour during selection for fur colour character variability among 15000 animals were analyzed. It was shown that in the course of selection for behavioural traits there was a noticeable increase in the amount of variants of piebald spotting. The offspring with domestic behaviour had the highest variation in piebald spotting and 4 new semi-dominant fur colour mutations ("silvery", "black-crystal", "star", "blue") were registered. On the basis of these new mutations 8 new colour phases were synthesized.

Proc. 28th International Congress of the ISAE, Research Centre Foulum, Denmark 3-6 August 1994, pp. P5.27. Poster. Only abstract received.

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FERTILITY AND INFERTILITY IN DOGS, CATS AND OTHER CARNIVORES

Proceedings of the Second International Symposium

on

Canine and Feline Reproduction

held at

the University of Liège, Liège, Belgium

August 1992

Edited by P. W. Concannon, G. C. W. England, J. P. Verstegen

and H. A. Russell

First published 1993

© 1993 by the *Journals of Reproduction and Fertility Ltd*
22 Newmarket Road, Cambridge CB5 8DT, UK

ISSN 0449 3087
ISBN 0 906545 26 9

Published by **The Journals of Reproduction and Fertility Ltd.**

Agents for distribution: **The Biochemical Society Book Depot, P.O. Box 32, Commerce Way, Whitehall Industrial Estate, Colchester, CO2 8HP, Essex, UK.**

Printed in Great Britain by
Henry Ling Ltd, at
The Dorset Press, Dorchester, Dorset

These proceedings contain 30 invited papers, 60 submitted papers and 13 free communications. These are arranged under the headings (1) ovarian cycles and ovulation; (2) fertilization, embryo development and pregnancy; (3) andrology, semen evaluation and AI; (4) methods for oestrus induction, contraception and pregnancy termination; (5) reproductive abnormalities and mammary disease, (6) abstracts, and (7) free communications. Most of the papers deal with domestic dogs and cats, but there are a few papers on mink, blue foxes and silver foxes. There are author and subject indexes to the papers.

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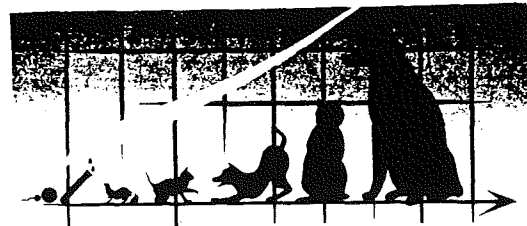
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Parasitoses of fur-bearing animals

Toivo Järvis

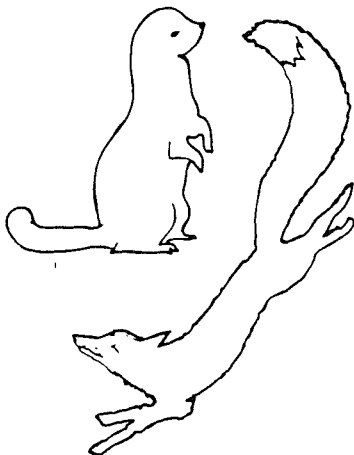
This issue is the study aid for veterinary students as well as the manual for veterinarians and fur animal breeders.

There is presented the taxonomy of fur animals and their parasites. Sporozoses, trematodoses, cestodoses, nematodoses, akantiocephaloses, acaroses and entomoses of fur animals are described.

The definition, ethiology, life cycle, epidemiological data, injury to host, clinical signs, pathological findings, diagnosis and control (prophylactic measures, metaphylactics and treatment) for each parasitosis are specified.

In. ET. Book, 103 pp, 30 refs. Author's summary.

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