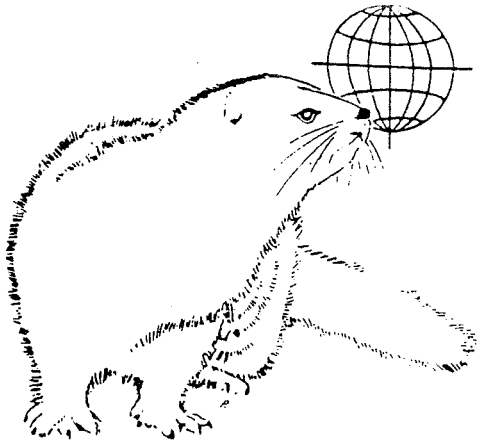

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Titles of other publications - not abstracted

5. Reproduction

Titles of other abstracts - not abstracted

Feed and reproduction technique of Alopex lagopus. *Z. Guanxiang, L. Yanbing, X. Shulin. Forest Science and TEchnoloyg (China), Vol. 18 (6), pp. 38-39, 1993. In CHIN. Code 5-6-14-M.*

The female reproduction system tissue dissect of blue fox. *Liu Yutang. Quarterly of Forest By-Product and Speciality in China (China), No. 2, pp. 5-6, 1993. In CHIN. Code 5-2-F.*

6. Nutrition

Titles of other publications - not abstracted

Study on dry mixed feed in the reproductive period of blue fox. *Zhang Dongqing. Quarterly of Forest By-product and Speciality in China (China), No. 1, pp. 16-18, 1994. 5 tables. In CHIN. Code 5-7-F.*

Influence of feeding on ultrastructure of stomach and intestines in caged sables. *L.K. Khabibullina. Sbornik Nauchnyc Trudov-Moskovskaya Veterinarnaya Akademiya No, 128, pp. 17-19, 1987. In RUSS. Code 6-2-O.*

7. Veterinary

Titles of other publications - not abstracted

Veterinary care and the welfare of furbearing animals. *J. Dousek, V. Pistekova. Veterinarstvi 45, 7, pp. 327, 1995. In CZECH. Code 10-11-14-M-F-O.*

Some biological characteristics of chinchillas in relation to veterinary practice. *J. Konrad. Veterinarstvi 45, 7, pp. 317-320, 1995. In CZECH. Code 2-3-9-14-O.*

Recurrent mycobacterium bovis infection following a ferret bite. *J. Wynne Jones, J.V.S. Pether, H.A. Rainey, C.R. Swinburn. Journal of Infection (UK), Vol. 26 (2), pp. 225-226, 1993. 7 refs. Code 9-O.*

Complex ceruminous gland adenocarcinoma in a brown-footed ferret (*Mustela purorius furo*). *Daniel G. Rudmann, Melvin R. White, Joanne B. Murphey. Laboratory Animal Science, 44, 6, pp. 637-638, 1994. 10 refs. Code 9-O.*

New discoveries and future outlook on Aleutian disease of mink. *Y.L. Ji. Maopi Dongwu Siyang, no. 1, pp. 42-44, 1991. In CHIN. Code 9-M.*

Cure of self-biting disease using DMPS (dimercaptopropanesulfonate sodium) in mink. *Chen Weiyan. Maopi Dongwu Siyang, No. 4, pp. 10-11, 1994. In CHIN. Code 9-11-12-14-M.*

IFASA

NOTES
SCIENTIFUR
Vol. 21, No. 1

Dear readers,

First of all we wish to thank our many contributors and readers for your many Christmas and New Year Greetings from which we understand that many of you really appreciate SCIENTIFUR. That is nice reading for us.

After a very promising year, seen from the point of view of fur animals producers, we now enter 1997 and volume 21 of SCIENTIFUR. Thanks to the contributions from many of you and the very important sponsorship of CEFBA (The Council of European Fur Breeders Associations) and hence from the individual member associations we take this step with a lot of optimism and confidence for the future.

In this issue of SCIENTIFUR we bring the last original report in the series entitled: "Evolutionary-genetic and genetic-physiological aspects of fur animal domestication". The series will now be assembled in a booklet to be published by Scientifur. Further information on this question later. In the meantime, I wish to thank all our colleagues at the Institute of Cytology and Genetics at the Russian Academy of Science, Novosibirsk, for their contributions.

As advertised in Notes, Vol. 20, No. 4, we have some problems with our administrative system, because our former pilot - Jytte - has finished her excellent work with SCIENTIFUR and IFASA. The invoices for 1997 will therefore be delayed, so please make your payment as soon as you receive the invoice. As usual all subscribers receive No. 1 of SCIENTIFUR but not the remaining 3 issues of Vol. 21, if payment has not been received here before May 15.

From January this year SCIENTIFUR will be printed at The OSLO FUR CENTRE, because they have now invested in printing equipment of the same quality as the printer at the COPENHAGEN FUR CENTRE. This is very practical because it is door-to-door with the editor's office.

We wish to thank the DANISH FUR BREEDERS ASSOCIATION and the dedicated staff at COPENHAGEN FUR CENTRE for 20 years of service which was one of the reasons why it was possible to publish SCIENTIFUR within a reasonable budget and in the best possible quality based on the raw material received from the editor.

Shortly the SCIENTIFUR ELECTRONIC INDEX 1996 is ready for distribution. It covers approx. 8,000 titles from the first 20 volumes of SCIENTIFUR and can be ordered at the editor's office. With prepayment, the price is NOK 200.- for upgrading of existing indexes. New indexes cost NOK 350.- for IFASA members and NOK 500.- for others, all including postage.

1997 will also be historic in relation to SCIENTIFUR because The Fur Animal Division of the Scandinavian Association of Agricultural Scientists (NJF) will be celebrating its 50th anniversary. At the same time 21 years have passed since the same organisation arranged the 1st International Scientific Congress in Fur Animal Production, at which occasion SCIENTIFUR was founded.

It was published by NJF until 1990, when the newly founded international scientific association IFASA took over the responsibility. We congratulate The Fur Animal Division of NJF with the anniversary and express our thanks for a good childhood under the wings of this association. The celebration of the 50th anniversary will take place in October in Helsinki, the birthplace of the International Scientific Congresses in Fur Animal Production and SCIENTIFUR.

Still only a few of you remember to send reprints of your reports published elsewhere to SCIENTIFUR to be abstracted here. Many of the abstracts therefore appear extremely late in relation to time of publication (up to 2-3 years), and this is too long for our readers to wait for important scientific news. PLEASE PUT SCIENTIFUR ON YOUR MAILING LIST TO ENSURE QUICK INFORMATION.

Have a good year!

Your editor,
Gunnar Jørgensen

VIth IFASA CONGRESS
AUGUST 21 - 23, 1996
WARSAW POLAND

LETTER TO THE EDITOR

Proceedings from the VI IFASA Congress, Warsaw 1996

Dear Doctor Jørgensen

I am glad to inform you that the proceedings of VI IFASA Congress are still available and can be ordered at Polish Society of Animal Production by fax: 0-048 22 22 17 23. Prepayment should be made by bank transfer to: Polish Society of Animal Production, Kaliska 9, 02-316 Warszawa Bank Gdánski SA IV O/Warszawa account no: 300009-6969-132.

The price of the material is 45.- USD - for a set of three parts, plus a charge for mailing costs 6.- USD.

Regards,

Sincerely yours

Anna Zabłocka

Warszawa, 20.11.1996r.

im. Michała Oczapowskiego

Polish Society of Animal Production ● Польское Зоотехническое Общество
02-316 Warszawa, ul. Kaliska 9, 22-17-23

Original Report

A comparative study on the effects of different housing methods and diets on growing chinchillas (Chinchilla laniger)

József Lanszki and Péter Horváth

Small Animal Department, Faculty of Animal Sciences, PANNON Agricultural University, P.O.Box 16, H-7401 Kaposvár, Hungary

Summary

The animals were kept on wire netting floor (n = 27) and on bedding cage (n = 24) individually. Mix types were: I: chinchilla mix (c.protein: 22.6; c.fat: 5.6; c. fibre: 9.8 % and DE: 10.16 MJ/kg), II: chinchilla mix (17.5, 3.1, 12.6 % and 8.9 MJ/kg, resp.), III: rabbit mix (16.5, 2.7, 15.5 % and 10.3 MJ/kg, resp.).

The body weights of the chinchillas at 7 months of age were 555 and 552 g on bedding and wire netting floor and the daily feed intake from 2 to 7 months of age averaged 15.7 and 15.8 g, respectively. These means do not differ significantly. The pellet waste was 1.1-1.6 times higher on wire netting floor and fur staining at 7 months of age was significantly higher on bedding ($p<0.01$).

The body weights according to pellet types (I., II. and III.) at 7 months of age were 584, 490 and 542 g ($p<0.01$) the total feed intakes from 2 to 7 months were 5.81, 4.30 and 4.85 kg ($p<0.01$) and the pellet wastes were 1.51, 2.66 and 4.41 kg ($p<0.05$), respectively.

The fur of the chinchillas at 7 months of age on slatted floor is less contaminated than on bedding ($p<0.01$).

Introduction

Breeders support different opinions concerning the best method of rearing growing chinchillas after weaning, i.e. on bedding or on slatted floor. Our preliminary study has revealed that the type of floor has an influence on the growth rate and diet consumption of the chinchillas, diet wastes (better on bedding), and the contamination of the fur (worse on bedding).

There are numerous chinchilla diets available commercially (or through integrating organisations). On some farms, however, the chinchillas are fed rabbit diets. Taking all this into consideration, our experimental design included different housing methods (i.e. slatted floor and bedding tray) and different diets (i.e. two chinchilla mixes and one rabbit mix). Both the combined and the separate effects of these "treatments" were investigated.

Table 1. Composition of the experimental mixes

Chemical composition, price	Designation of the mixes		
	I	II	III
Dry matter (%)	91.4	86.0	86.0
Crude protein (%)	22.6	17.5	16.5
Crude fat (%)	5.6	3.1	2.7
Crude fibre (%)	9.8	12.6	15.5
Methionine + cystine (%)	0.61	0.78	0.58
Lysine (%)	0.70	0.66	0.68
Ca	1.02	1.11	1.8
P	0.88	0.63	0.5
DE (MJ/kg)	10.16	8.9	10.3
Pellet price (HUF/kg)	70	29.5	29.5

Materials and method

The examinations were carried out on the Experimental Farm of the Faculty of Animal Science of the Pannon Agricultural University using a standard chinchilla stock.

The breeding chinchillas were accommodated in a closed room, which was fitted with windows and heated in winter, in a three-floor cage system, on bedding. The growing animals were housed individually, in a traditional four-floor cage system (the basic area of the cages was 40x65 cm and their height was 35 cm), either on wire slatted floor (hole size 1.5x1.5 cm) or on bedding (on a tray). The progeny were weaned when they were 8 weeks old, and their type was classified at the age of 200-210 days (7 months) according to the relevant Hungarian Standard (1988). The body weight categories were established as follows: females: Cat.1: 600 g<, Cat.2: 500-600 g, Cat.3: 450-500 g, Cat.4: 430-450 g, Cat 5: <430 g; males: Cat.1: 550 g<, Cat.2: 480-550 g, Cat.3: 430-480 g, Cat.4: 410-430 g, Cat.5: <410 g.

Altogether, 51 chinchillas were involved in the experiment. Body weight was measured once a month, and diet consumption was monitored for one week every month, on an individual basis. Measuring the hay consumed was not feasible technically (it is to be mentioned that sometimes chinchillas consume bedding shavings to satisfy their need for fibre).

The growing animals received the mix and the grass hay by free choice (ad libitum) between the ages of 2 to 7 months. They had free access to the chinchilla self-drinkers fitted with rubber teats. Two different chinchilla mixes (indicated as I and II) and one rabbit mix (III) were fed; the nutrient content and digestible energy content of these are shown in Table 1.

Fur contamination was evaluated by scoring according to the size of the contaminated surface (C): 0: no contamination, 1: C<2 cm2, 2: 2<C<3, 3: 3<C<5, 4: C>5 cm^2.

The calculations were carried out by using the MANOVA (diet x keeping interaction) and ANOVA (diets) methods, the t-test (versions of keeping) and χ^2 -test (fur contamination, categories of body weight at 7 months of age, sexes) by applying the Statgraphics 5.0 (MS Office, 1994) programme.

Results and discussion

Body weight

The combined effect of diet mix and keeping as "treatments" was not significant ($p>0.25$). The difference between males and females was not significant at the age of 7 months, either ($p>0.2$).

The type of floor (i.e. bedding or slatted floor) did not affect the weight of the growing chinchillas significantly (Table 2, Figure 1): those kept on bedding performed better than those kept on slatted floor by 5 % at 7 months of age. Between the ages of 2 and 7 months the daily weight gain of the chinchillas proved to be 1.91 g on bedding and 1.75 g on slatted floor.

At the beginning of the investigation the average body weight of the experimental groups did not differ significantly. By feeding different mixes the weight gain diversified to a statistically provable extent ($p<0.05$-0.01) until 7 months of age (Table 2, Figure 1). At 7 months of age the weight of the group receiving Mix I exceeded that of the other groups (Mix II and Mix III) by 14% and 5%, respectively. Considering the weight measured at 2 months of age as 100% the gain detected until 7 months of age was found to be 209 %, 204 % and 208 %, respectively. The daily weight gains of the growing chinchillas were 1.99 g, 1.60 g and 1.84 g, respectively, between 2 and 7 months of age.

Feed intake

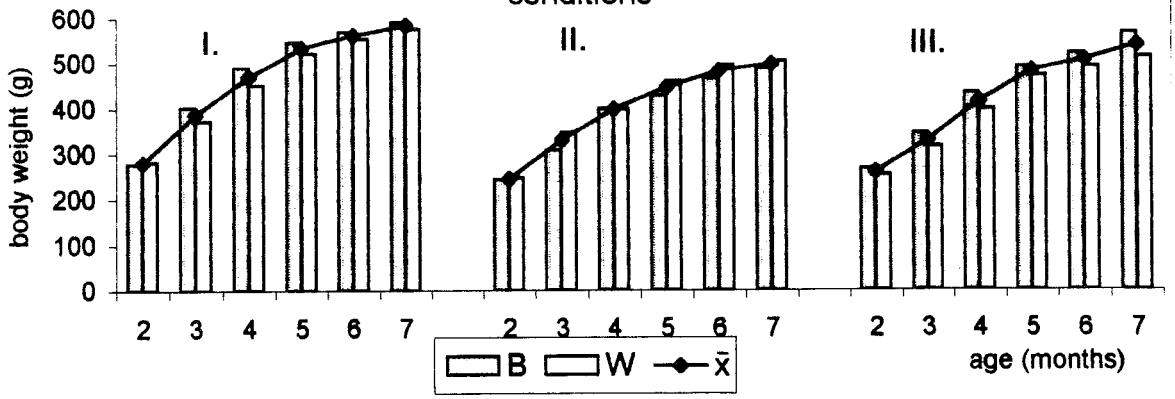
Although the mix consumption of the chinchillas kept on bedding was 2-15 % more than that of the others, this "treatment" (i.e. type of floor) did not show a significant effect on the intake. This finding can partly be traced back to the fact that the animals kept on bedding were heavier (NS). The efficiency of the feed taken in was determined as 15.7 g/g and 15.8 g/g on average in the groups kept on bedding and on slatted floor, respectively.

Table 2. Body weight of growing chinchillas

Cage system (n)		1. day	Age (months) 2	3	4	5	6	7
		Body weight (g)						
B	M	45	263	352	443	492	522	555
(24)	SD	7	59	78	67	79	74	70
W	M	44.7	261	346	418	488	516	529
(27)	SD	7	48	65	51	48	57	68
p <		NS	NS	NS	NS	NS	NS	NS
Mix								
I	M	47	280	**387^{a}**	**471^{a}**	**534^{a}**	**562^{a}**	**584^{a}**
(16)	SD	5	27	40	41	41	37	37
II	M	43	245	331^{b}	399^{b}	448^{b}	483^{b}	490^{b}
(19)	SD	7	48	65	41	44	48	53
III	M	46	261	330^{b}	416^{b}	483^{ab}	508^{ab}	542^{ab}
(16)	SD	8	72	88	70	75	79	85
p <		NS	NS	0.05	0.01	0.0001	0.01	0.01

Marks: p = level of significance; NS = non-significant difference; a-b-c = in the columns the differences between groups marked with different letters are significant; M = mean value; SD = standard deviation; n = number of animals. Cage floor systems: B = on bedding; W = on wire netting. Mixes: I = mix for chinchillas, II = mix for chinchillas, III = mix for rabbits.

Figure 1. Body weight of growing chinchillas in various keeping and feeding conditions



Floor cage systems: B = on bedding; W = on wire netting floor
Pellets: I, II = mix for chinchillas, III. = mix for rabbits; $\bar{x}$ = mean

At 2 months of age the highest consumption was observed in the second group (22.2 g/day). This is due to the fact that these animals were not exposed to a change of diet after weaning (every group received Mix II before weaning). From the 3rd month on, the intake from Mix I and Mix III became higher as can be seen in Table 3 and Figure 2. There was a significant difference in feed consumption between the ages of 3 and 7 months ($p<0.01$-0.0001). The highest quantity of feed was consumed by the animals of Group I. During the period between the 2nd and 7th months the feed consumption of the groups was as follows: Mix I: 5.81 kg, Mix 2: 4.30 kg and Mix III: 4.85 kg. The relevant data on feed efficiency were the following: 14.8 g/g, 14.3 g/g and 12.7 g/g, respectively. Here, however, the hay intake of the animals, although not measured, cannot be neglected, either. The crude protein content of the mixes was satisfactory as compared to the need of the chinchillas for crude protein (14-17 %). The crude fat content, however, was lower than needed (5-6 %, Pereldik et al., 1987), except for Mix I. The requirement of 18-21 % for crude fibre cannot be fulfilled by giving just a mix. This is why hay supplementation is by all means necessary, otherwise serious digestive disorders may occur. Chinchillas show a very efficient fibre digestion due to the considerable size of their appendix (the capacity of the appendix is approx. 120 ml; that of the stomach is 60 ml, the proportion of the intestinal tube to the body length is 15:1).

Wasting of feed

Only the feed collected from the bedding tray(there was a tray under the slatted floor, too) and the feed not consumed, i.e. the feed really wasted, were considered as dispersed and wasted feed. This amount affects the costs of feeding.

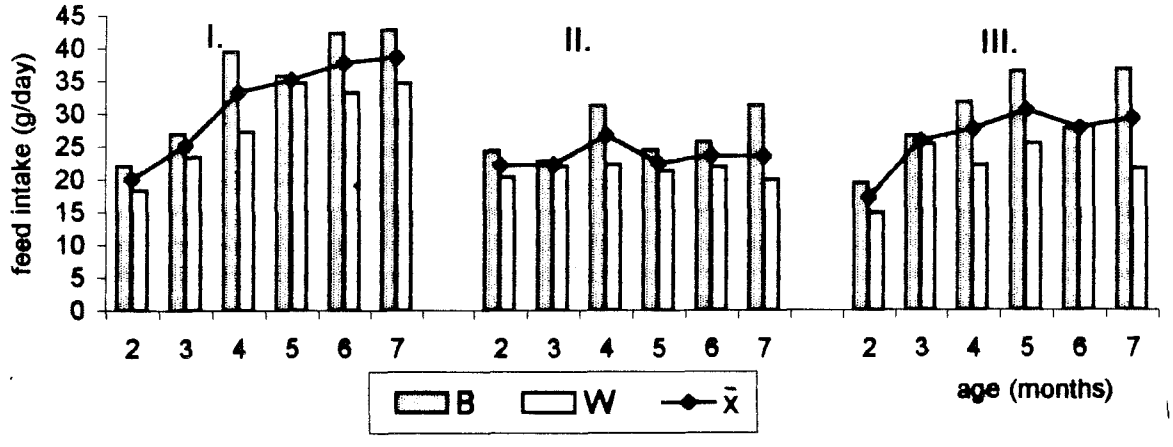
The amount of feed wastes is influenced by the type of the keeping unit. The animals kept on slatted floor dispersed more feed throughout the whole time, although the difference from the other version (bedding) was not significant except for in the 6th month ($p<0.0001$), (Table 4, Figure 3). The chinchillas kept on slatted floor are also able to pick up the granule from the tray placed under the floor, but with more difficulty than the others. Dispersing of the feed may also be explained by the lack of homogeneity and lack of palatability of the feed.

Table 3. Feed intake of growing chinchillas

Cage system		Age (months)					
		2	3	4	5	6	7
		Daily feed intake (g)					
B	M	21.9	25.7	34.5	33.3	32.5	37.9
	SD	8.8	6.6	9.6	8.4	13.2	15.7
W	M	20.6	24.4	30.0	32.8	29.2	34.7
	SD	9.3	7.0	7.1	10.7	13.1	13.0
p <		NS	NS	NS	NS	NS	NS
Mix							
I	M	20.1	25.2	33.4	**35.3^a**	**37.9^a**	**38.7^a**
	SD	9.0	5.0	10.8	10.3	14.2	14.4
II	M	22.2	22.3	26.8	22.5^b	23.7^b	23.6^b
	SD	8.7	9.0	8.2	4.5	12.3	12.5
III	M	17.2	26.0	27.8	**30.7^a**	28.0^b	**29.4^a**
	SD	7.6	5.5	9.0	10.7	10.0	14.1
p <		NS	NS	NS	0.0001	0.01	0.01

For marks see Tab. 2.

Figure 2. Feed intake of growing chinchillas in various keeping and feeding conditions



If the feed is not suitable for the needs of the chinchillas (or it was not prepared for chinchillas), more dispersing may occur. Wasting of the feed may also be influenced by an environment which lacks stimuli. Such a situation may lead to the evolving of bad habits, of which feed dispersing is an example. The great variance refers to this factor. 1.1-1.6 times more feed was found in the case of the groups kept on slatted floor than in the case of those kept on bedding.

Irrespective of the diet, the wasting of the diet by dispersing was significant ($p<0.05$-0.0001) from the beginning to the end of the experiment (Table 4, Figure 3). Between the

ages of 2 and 7 months the amount of wasted feed was lowest (1.51 kg) in the case of Mix I and highest (4.41 kg) in the case of Mix III. The figure was 2.66 kg in the case of Mix II. These findings show that Mix I was the most suitable diet for chinchilla (both body weight and feed consumption were highest in this group). On the contrary, the dispersed quantity of Mix III was almost equal to the quantity consumed (4.85 kg).

Contamination of the fur

The contamination of the fur is harmful to "colour clarity", and is, as such, undesirable. Clarity is one of the economically most important characteristics of the chinchilla fur coat. It is genetically strongly determined, but is also affected by environmental factors, especially by the way of keeping. The contamination caused by improper keeping (e.g. brownish or yellowish discolouring shade on the belly or around the tail head) cannot be removed entirely during currying, and contamination is a factor that has an impact on the purchase price of the fur. It was only practical to evaluate the contamination of the fur according to the way of keeping, during the type conformation carried out at 7 months of age.

In our observations the ratio of clean (free of contamination, score 0) furs was 55.5 % on slatted floor and 31.6 % on bedding (Figure 4). The proportion of animals that scored 1 and 0 was 85 % on slatted floor and half of that (42 %) on bedding. There was no animal with score 4 among those kept on slatted floor. At the same time, the ratio of animals with score 4 was one-third (37 %) in the other group. These results call the attention to the two facts that: 1. contaminated furs may also occur on slatted floor (caused by a bad habit, i.e. that the chinchilla may rest at the place where it voids), but also: 2. clean furs can be obtained even if the animals are kept on bedding on the condition that the bedding material is replaced frequently enough. As a rule of thumb, however, fur of chinchillas grown on slatted floor is less contaminated than fur of those kept on bedding. There is a significant difference between the two groups ($p<0.01$).

Table 4. Pellet waste of growing chinchillas

Cage system		Age (months)					
		2	3	4	5	6	7
		Daily wasting of mix (g)					
A	M	10.4	10.2	12.4	16.1	**12.8^{a}**	17.2
	SD	9.3	12.8	14.3	16.7	13.6	18.2
R	M	16.3	15.5	15.1	18.1	21.1^{b}	21.2
	SD	10.7	13.7	10.2	13.6	11.6	15.6
p <		NS	NS	NS	NS	0.0001	NS
Mix							
I	M	**7.5^{a}**	**7.00^{a}**	**6.1^{a}**	**6.6^{a}**	**10.7^{a}**	**11.9^{a}**
	SD	4.1	8.9	4.9	5.6	9.2	11.5
II	M	12.9^{ab}	**11.3^{a}**	**11.1^{a}**	16.6^{b}	16.6^{ab}	18.8^{ab}
	SD	11.3	15.5	10.3	14.1	14.7	16.5
III	M	19.3^{b}	21.5^{b}	26.8^{b}	29.1^{b}	26.1^{b}	21.9^{b}
	SD	10.7	11.5	11.9	14.1	11.1	18.3
P <		0.01	0.01	0.0001	0.0001	0.01	0.05

For marks see Tab. 2.

Figure 3. Wasting of feed of growing chinchillas in various keeping and feeding conditions

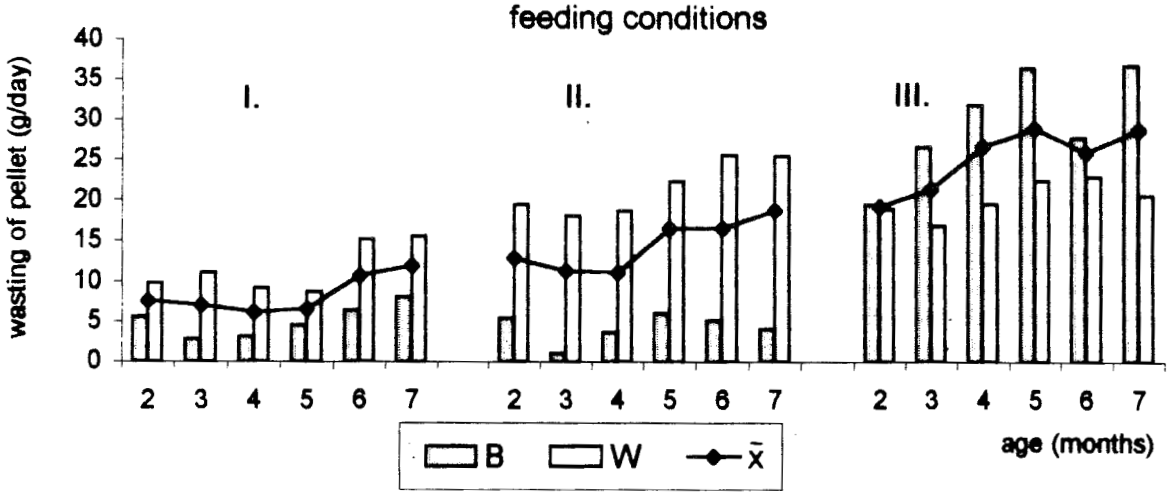
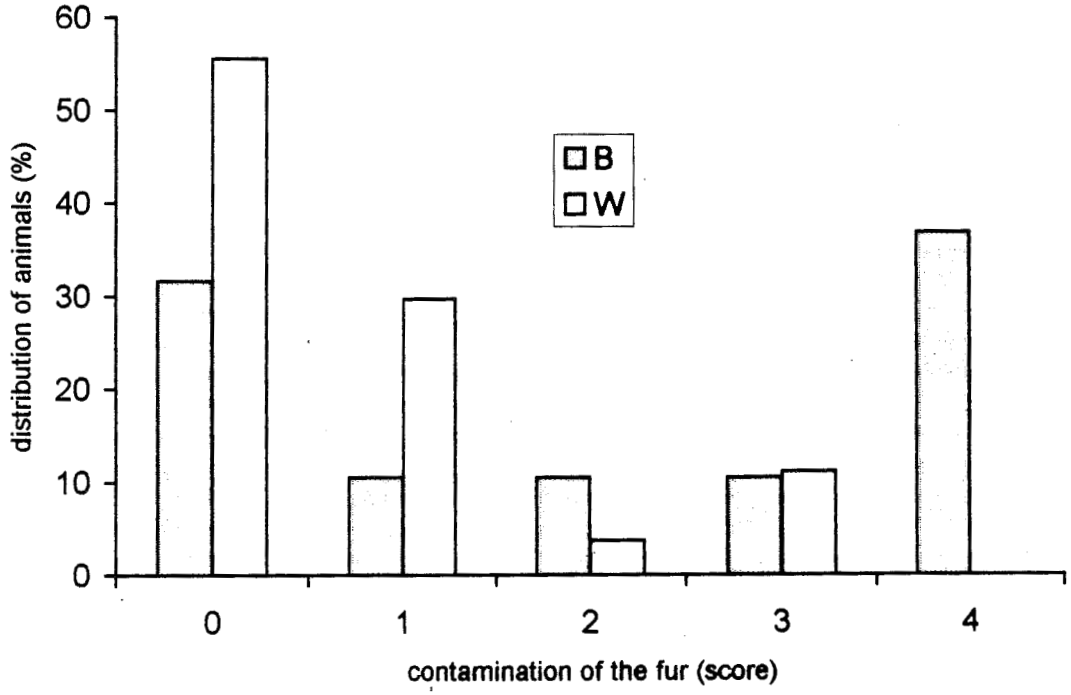


Figure 4 Contamination of the fur of growing chinchillas on bedded (B) and on wire netting floor (W) cage system (0 = clean; 4 = most contaminated fur)



Conclusions

The body weight, feed consumption and feed dispersing of growing chinchillas did not differ considerably depending on the way of keeping, although the animals kept on bedding became heavier by 7 months of age, consumed more feed and dispersed less feed than those maintained on slatted floor. Heavier animals are larger, and so they produce longer furs, which allows for higher prices. Nevertheless, the fur of the

animals grown on bedding becomes much more contaminated, and this is unfavourable for clarity and, therefore, for fur price.

Feed quality has an influence on the body weight, feed intake and feed dispersing of chinchillas. The highest body weight at 7 months, highest intake and lowest wastes were detected in the group receiving chinchilla Mix I. This mix was the most appropriate for the biological needs of the chinchillas. Chinchilla Mix II proved in some cases better (feed dispersing), in other cases worse (body weight) than rabbit Mix III.

From the economic point of view, the per animal costs of feeding amounted to 513 HUF (Mix I), 506 (Mix III) and 491 (Mix II) during the period between 2 and 7 months of age.

References

Hungarian Standard 1988. Type classification of chinchillas

MS Office 1994. Version 4.3. Microsoft Corporation

Pereldik, H.S., Milovanov, L.V., Erin, A.T. 1987. Nutrition of fur animals, V.O. Agropromizdat, Moscow

Ecological characteristics of the raccoon dog in Finland

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Game Division
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Finland

New doctor in the family. We congratulate Dr. Kaarina Kauhala with the fine thesis and the new title.

This thesis is based on the following studies, which are referred to in the text by their Roman numerals:

I Helle, E. and Kauhala, K. 1991. Distribution history and present status of the raccoon dog in Finland. Holarctic Ecology 14: 278-286. *In present issue of SCIENTIFUR.*

II Kauhala, K. and Helle, E. 1990. Age determination of the raccoon dog in Finland. Acta Theriologica 35: 321-329. *SCIENTIFUR, Vol. 20, No. 3, pp. 262.*

III Helle, E. and Kauhala, K. 1992. Age structure, mortality, and sex ratio of the raccoon dog in Finland. Journal of Mammalogy (in press). *SCIENTIFUR, Vol. 20, No. 3, pp. 263.*

IV Helle, E. and Kauhala, K. 1992. Reproduction of the raccoon dog in Finland. Manuscript. *SCIENTIFUR, Vol. 20, No. 3, pp. 263.*

V Kauhala, K. 1992. Growth, size, and fat reserves of the raccoon dog in Finland. Manuscript. *SCIENTIFUR, Vol. 20, No. 2, pp. 186.*

VI Kauhala, K., Kaunisto, M. and Helle, E. 1992. Diet of the raccoon dog, *Nyctereutes procyonoides*, in Finland. Zeitschrift für Säugetierkunde (in press). *SCIENTIFUR, Vol. 20, No. 3, pp. 294.'*

VII Kauhala, K., Helle, E. and Taskinen, K. 1992. Home range of the raccoon dog in southern Finland. The Journal of Zoology, London (in press). *SCIENTIFUR, Vol. 20, No. 3, pp. 262.*

Summary
The distribution history, ecological characteristics and population dynamics of the raccoon dog (*Nyctereutes procyonoides*) was studied in Finland in 1986-91. Since the first regular observations in the most south-easterly part of Finland in the mid-1950s, the raccoon dog spread through the southern and central parts of the country in about two decades. The population reached its carrying capacity in the 1980s. The present density is highest in southern Finland, the northern distribution limit lying between 65°N and the Arctic Circle. The mean temperature of the year explained well the regional variation in the present raccoon dog density, because primary production, and

hence the abundance of food is greatly affected by climate. The annual variation in numbers is mainly affected by food availability.

The sex ratio of the population was 1:1 possibly due to the monogamous breeding system. The annual mortality rate of the population was 81%, being about 54% for adults and 88% for juveniles. Seventy-eight per cent of females reproduced annually, the mean birth litter size was 8.8 and the mean productivity 6.9. Productivity increased with age, and there were both annual and regional differences in productivity. The monogamous breeding system, omnivory and the habit of sleeping during the winter result in the high productivity of the raccoon dog in Finland. Climate explained well the regional variation in productivity; the length of the snow-free period affected the weight of juveniles in late autumn and this, in turn, explained most of the regional variation in the proportion of reproducing females.

Thesis, pp. 19, 2 tables, 7 figs., 55 refs. + appendix with appr. 130 refs. Author's summary.

Distribution history and present status of the raccoon dog in Finland

Eero Helle, Kaarina Kauhala

The raccoon dog *Nyctereutes procyonoides* Gray was introduced from the Far East in several areas of the USSR, mainly the European part, in 1929-55. The first raccoon dogs were seen in Finland in the latter half of the 1930s, and by the mid-1950s, the frontier of the first regular observations had reached the most south-easterly parts of the country. Since then, the raccoon dog dispersed through southern and central Finland at an average annual rate of 20 km. The rate of population increase, as well as present density, has been highest in southern and south-eastern Finland, and lowest in the northern parts of the distribution area. The northern limit of the distribution lies nowadays in southern Lapland, only a little further north than two decades earlier, when most of southern and central Finland was already inhabited.

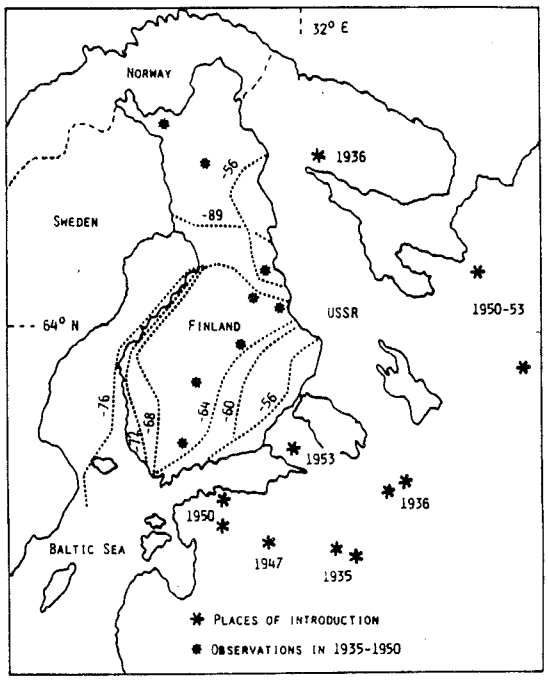

Fig. 1. Raccoon dog introductions in the north-western USSR (Lavrov 1971), the first observations of the species in the present territory of Finland and expanding of the frontier of the distribution across Finland.

The length of the growing season seems to explain most of the variation in the population density between the provinces. The longer the growing season, the better the raccoon dog manages; in southern Finland where the summers are longer, the juveniles have enough time to grow and gather fat reserves before hibernation. Therefore, many of them survive the winter and even breed in the following spring. In the north, in contrast, juvenile mortality is high during the first winter because of the short summer. The food availability, the yield of wild berries and the abundance of small rodents, is

mostly responsible for the annual variation in the population density. Near the northern limit of the distribution, climate may also cause some of the annual variation in population density.

Holarctic Ecology 14: 278-286. 4 tables, 5 figs., 18 refs. Authors' summary.

Acid-base status and cardiovascular function in mink (*Mustela vison*) anaesthetised with ketamine/midazolam

S. Wamberg, P. Svendsen, B. Johansen

Heart rate, arterial blood pressure and blood acid-base status were determined in 18 adult female mink (mean±SEM) body weight 1052±34 g) during long-term anaesthesia with either controlled ventilation (n=12) or spontaneous respiration (n=6). Surgical anaesthesia was induced by intramuscular injection of ketamine hydrochloride (Ketaminol Vet®, 40.0±1.7 mg/kg) and midazolam hydrochloride (Dormicum®, 2.8±0.1 mg/kg) and maintained for at least 5 h by continuous intravenous infusion of this drug combination in 0.9% saline. For all animals, the mean rates of infusion of ketamine and midazolam were 48.4±1.6 and 1.61±0.12 mg/h, respectively.

Following continuous infusion of the anaesthetics in isotonic saline, at a rate of 20 ml/h, a moderate 'dilution acidosis' developed, which could be corrected by replacement of part of the saline with sodium bicarbonate to a final concentration of approximately 25 mmol $NaHCO_3$ per litre.

However, when the animals were allowed to breathe spontaneously, an increase in heart rate and a combined respiratory and metabolic acidosis occurred, due to severe respiratory depression. Apart from these effects and a few cases of increased salivation, no adverse effects over time were observed on the arterial blood acid-base status and cardiovascular function of the animals during ketamine/midazolam anaesthesia. It is concluded that the procedure described for long-term anaesthesia in mink is convenient and safe for acute physiological experiments in this species, provided normal body temperature and pulmonary gas exchange is sufficiently maintained. Thus, the need for an adequately controlled artificial ventilation is strongly emphasised.

Finally, a proposal for the composition of an intravenous solution, containing ketamine and midazolam hydrochloride, and sodium bicarbonate in saline, suitable for long-term anaesthesia in adult mink is presented.

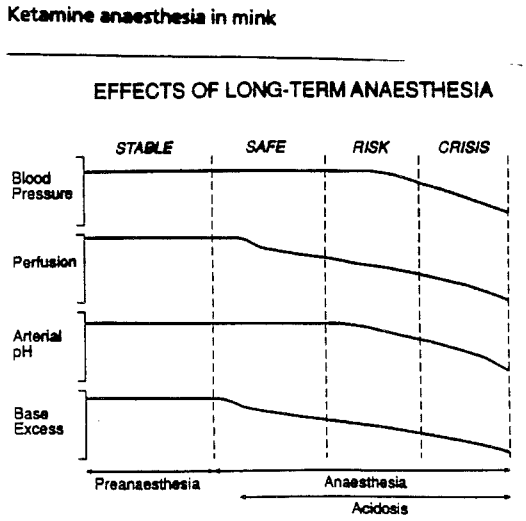

Fig. 6. The effects of long-term anaesthesia in experimental animal physiology. Theoretical outline, originally designed by Danielson et al. (1975), which shows the changes expected in 4 critical parameters of cardiovascular and metabolic function during the different states of long-term anaesthesia. Note that the change in blood base excess is usually found to be the earliest marker of impaired peripheral perfusion in the anaesthetised animal.

Laboratory Animals, 30, pp. 55-66, 1996. 4 tables, 6 figs., 39 refs. Authors' summary.

Seasonal testicular and moulting cycles in the adult male raccoon dog (*Nyctereutes procyonoides*) and the effects of melatonin implants

Yongjun Xiao

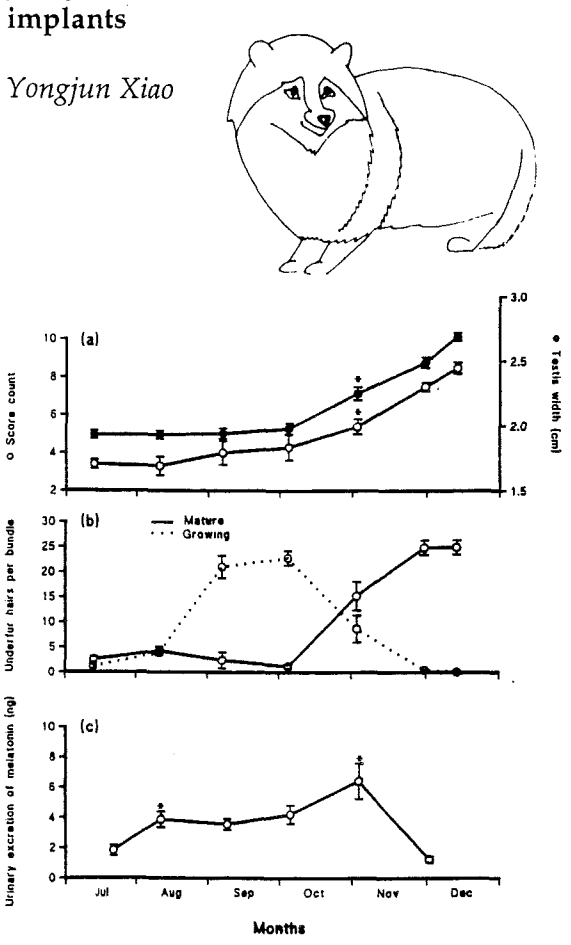

Fig. 8. Variations in (a) testis width and score count of spermatogenesis, (b) number of growing and mature underfur hairs per bundle and (c) urinary excretion of melatonin between 15:00 and 9:00 h in 6 adult male raccoon dogs under natural condition.

The raccoon dog, due to its popular fur and good suitability for farming, is now one of the most important farmed fur animals in some Asian and European countries. However, the characteristics of seasonal reproduction and moulting are still not well understood in this species because of its short farming history. The present study was designed to investigate the annual cycles of testis and moulting and the effects of melatonin on these features in the adult male raccoon dog. Testicular activity showed considerable seasonal variation. Testicular recrudescence began in autumn. Mature-phase spermatozoa were produced from December to April, while the mating periods occurred in February and March. Testis maintained quiescence during May and October. Testicular size was closely related to the changes in spermatogenetic activity. Serum concentrations of testosterone also showed seasonal variation, with the highest values in the early breeding season. The males with higher serum concentrations of testosterone in the early breeding season appeared to enter the mating period earlier than those with lower serum concentrations.

Moulting of the underfur hairs was characterised by heavy loss of old winter hairs in spring and intensive growth of new winter hairs in autumn. The new guard hairs started to grow in spring and all the new guard hairs had been initiated by the end of June. About 7 or 3.5 months were needed for all new guard hairs or all winter underfur hairs to grow. At the end of November the winter fur was mature. A clear seasonal change was shown in the dermal thickness and skin colour, with maximal during autumn moult. In the control animals, the increase in urinary excretion of melatonin in early autumn coincided with the period of initiation of winter underfur hairs. The further increase in November coincided with the significant elevation in testis width and score count of spermatogenesis. These results suggest a role of autumn increase in endogenous melatonin secretion in the initiation of winter underfur hairs and testicular recrudescense under natural conditions.

Melatonin implants highly elevated serum concentrations of melatonin for several months and temporally suppressed prolactin secretion. The implants in late March slowed the testicular regression, inhibited the initiation of some guard hairs and stimulated the growth of some underfur hairs. The implants in July induced an early testicular recrudescence, an early growth of

winter underfur hairs and an early maturation of both underfur and guard hairs. In addition, melatonin implants appeared to influence urine output and body weight of the animals.

Thesis, Kuopio University Publications C. Natural and Environmental Sciences 39, 1996, 59 pp. 3 tables, 8 figs., 110 refs. Author's abstract.

Effects of melatonin implants on winter fur growth and testicular recrudescence in adult male raccoon dogs (*Nyctereutes procyonoides*)

Yongjun Xiao, Mats Forsberg, Jarmo T. Laitinen, Maija Valtonen

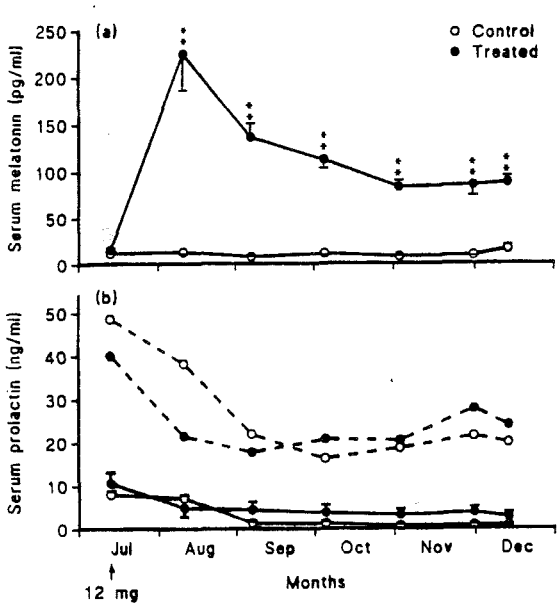

Fig. 1. Variations in serum concentrations of (**a**) melatonin and (**b**) prolactin in six adult male raccoon dogs treated with a melatonin implant and in six untreated controls. Data of serum prolactin on two individuals, one in the control group and another in the treated group, are presented separately (dotted lines). The arrow indicates the date of melatonin implantation. Asterisks indicate significant differences between two means on the sampling day (*:P<0.05; **: P<0.01).

The effects of melatonin implants were investigated on winter fur growth, monitored by counting growing and mature hairs per bundle and testicular recrudescence, judged by testis width, score count of spermatogenesis, and serum testosterone in the adult male raccoon dogs.

Melatonin administration in July highly elevated melatonin concentrations in serum and urine and induced an earlier decrease in prolactin secretion (August in the treated group vs. September in the control group), winter fur growth (July-beginning of November in the treated group vs. August-end of November in the control group) and testicular recrudescence (October in the treated group vs. November in the control group). In the control animals, urinary excretion of melatonin between 1500-0900 hr increased during autumn followed by a rapid fall in winter. The increase from July (1.8±0.4 ng) to August (3.9±0.5 ng) and the subsequent unchanged levels until October coincided with the period of winter fur growth. The further increase in November (6.5±1.2 ng) coincided with the significant elevation in both testis width and score count of spermatogenesis.

These results suggest a role of the increase in endogenous melatonin secretion during autumn in the growth of winter fur and testicular recrudescence in this species under natural conditions. Relatively high serum concentrations of prolactin were shown in two animals, one in the control group and another in the treated group. However, the parameters for testis and winter fur growth in the two cases were similar to those in the remainder of the animals. Thereby, the role of prolactin in the winter fur growth and the initiation of testicular recrudescence, if it is truly involved, is manifested through its decreasing secretion rather than the actual blood concentrations.

J. Pineal Res. 20: 148-156, 1996. 4 figs., 40 refs. Authors' summary.

Seasonal moulting in adult male raccoon dog (*Nyctereutes procyonoides*)

Y. Xiao

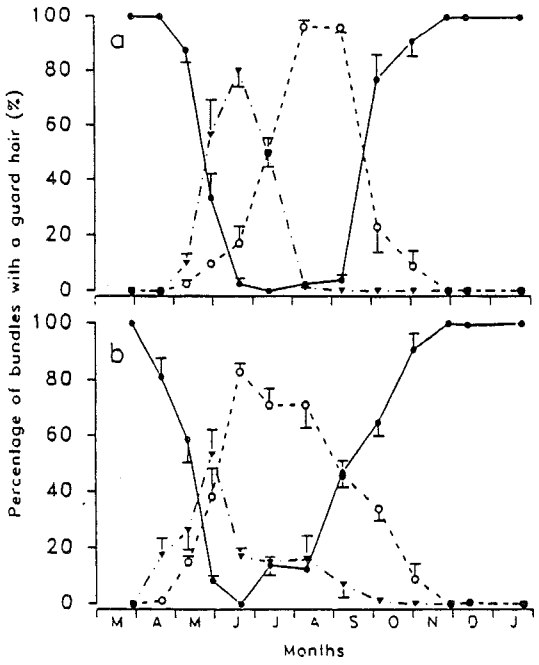

Fig. 2. Seasonal changes in the percentages of bundles with a mature (●), mature-growing (▼) or growing (○) guard hair in adult male raccoon dogs. (a) bundles with a large guard hair; (b) bundles with an intermediate guard hair. All the bundles in the visual field (4 ×) were used in a cross-section for calculating the percentages. Three to five cross-sections were observed per sampling date. The skin samples were taken from the hip area. (Mean ± SE.)

Seasonal moulting was studied by quantitative histology and external observations in adult male raccoon dogs. Moulting of the underfur hairs is characterised by a heavy loss of old winter hair in spring and an intensive growth of new winter hair in autumn. Only few mature and growing underfur hairs were found in the hair cover in summer. The new intermediate and large guard hairs started to develop in April and May.

All the new guard hairs had developed by the end of June. About 7 and 3.5 months were needed for the growth of new winter guard and underfur hairs respectively. At the end of November the winter fur was mature. The bundles with an intermediate guard hair contained more underfur hairs than the bundles with a large guard hair in the mature winter fur. The thickness of dermis and the grade of skin colour peaked in the autumn moult, indicating a close relation to the activity of hair follicles.

Acta Agric. Scand, Sect. A, Animal Sci. 45, pp. 186-190, 1995. 4 figs., 18 refs. Author's summary.

Tissue retention and metabolism of 2,3,4,3',4'-pentachlorobiphenyl in mink and mouse

E. Klasson Wehler, L. Lindberg, C.-J. Jönsson, Å. Bergman

2,3,4,3',4'-Pentachlorobiphenyl was retained as the unmetabolised parent compound in liver and fat from mouse and mink. In contrast, in mouse plasma - 4-hydroxy-2,3,5,-3',4'-pentachlorobiphenyl - was present in concentrations 15 times higher than that of the parent chlorobiphenyl. In mink plasma the parent compound and the 4-hydro-xylated metabolite were present in similar concentrations. Faeces was the major excretion pathway in both animals. Both the mouse and the mink excreted mainly the parent compound accompanied by trace amounts of hydroxylated metabolites but the mink also excreted significant amounts of hydrophilic metabolites, that gave hydroxylated products after acidic hydrolysis. Five hydroxylated metabolites, 4-hydroxy-2,3,5,3',4'-pentachlorobiphenyl, 4-hydroxy-3,5,2',3',4'-pentachlorobiphenyl, 2-hydroxy-3,4,2',3',4'-pentachlorobiphenyl, 5-hydroxy-3,4,2',3',4'-pentachlorobiphenyl and 5-hydroxy-2,3,4,'3,4'-pentachlorobiphenyl, were identified in excreta of mink and mouse.

Chemosphere, Vol. 27, No. 12, pp. 2397-2412, 1993. 1 table, 5 figs., 43 refs. Authors' abstract.

Geographic variation of lean body mass and a model of its effect on the capacity of the raccoon to fatten and fast

John N. Mugaas, John Seidensticker

In the eastern United States, apparent lean body mass (ALBM) of raccoons (*Procyon lotor*) increased from south to north, and appeared to follow Bergmann's rule: subtropical Key Vaca, females = 2.0 kg, males = 2.4 kg; mild temperate south-eastern United States, females = 3.2 kg , males = 3.5 kg; harsh to severe temperate Michigan and Minnesota, females = 4.5 kg, males = 5.0 kg.

We postulated that selection has favoured large lean mass in the cold parts of the raccoon's range because it provides greater fasting endurance. In mammals, as lean body mass (LBM) increased, the potential to store energy as fat ($F_s = LBM^{1.0}$) increases out of proportion to the cost of basal metabolism ($H_b = mass^{0.75}$). Thus, big fat raccoons should be able to fast for a longer period of time than small fat ones. We modelled these relationships for raccoons. We found that each increase in ALBM substantially increased the length of time they could fast. Since the increased fasting times were necessary for their winter survival, the model supported our hypothesis. We also concluded that the northern edge of their range is determined by the limits of their genetic potential to increase ALBM. The amount of fat deposited in the fall also varied geographically: subtropical raccoons achieved 14 to 17% apparent body fat (ABF), those from Florida to Virginia 19 to 42% ABF, and those around the Great Lakes 31 to 50% ABF. Geographic variation in ABF suggests that seasonal lipogenesis is coupled, via neuroendocrine mechanisms, to environmental cues that stimulate the appropriate degree of fat deposition in each local area. The data also suggest that there may be geographic differences in the capacity to fatten.

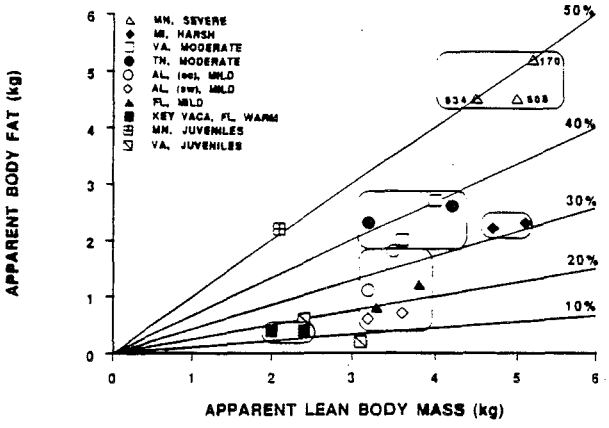

Fig. 4. Relationship between apparent body fat and apparent lean body mass for *Procyon lotor*. The lowest apparent lean body mass value for each pair of symbols represents females, and the highest value males. Symbols for adults from each climate type are surrounded by a line. Symbols for Minnesota are for individual animals. The diagonal isolipid lines represent 10, 20, 30, 40, and 50% body fat.

Bulletin of the Florida Museum of Natural History (USA), Biological sciences, Vol. 36 (3), 22 pp, 1993. 2 tables, 6 figs., 55 refs. Authors' abstract.

PCBs in European otter (*Lutra lutra*) populations

M.D. Smit, P.E.G. Leonards, B. van Hattum, A.W.J.J. de Jongh

The Dutch government has adopted a policy plan aiming at the return of the otter (*Lutra lutra*) in The Netherlands. Pollution by polychlorinated biphenyls (PCBs) is considered to be a major factor in the otter's decline. From this perspective the government has commissioned the research project: "Development of Otter-based Quality Objectives for PCBs (DOQOP)". This project aims to determine environmental safe levels of PCBs otter, fish and sediment, which permit the survival of viable otter popula-

tions. In a wider context, the project will generate data which may be of importance for the development and evaluation of quality objectives for contaminants which exhibit secondary poisoning in top predators.

This report presents part of the preliminary phase of the DOQOP project: a compilation of presently available data (both published and unpublished) on the contamination of European otters and their environment with polychlorinated biphenyls (PCBs). The objective of this study was to examine if existing data were sufficient to derived otter-based quality objectives for PCBs, and, if not, which type of additional information would be required.

Several authors have suggested that PCBs are one of the causes of the decline of the otter in large parts of Europe. This suggestion was based on an observed negative correlation between PCB levels in otter tissues and the status of other populations: high PCB levels in otters were associated with declining or endangered populations, while in thriving populations PCB levels were generally low. A level of 50 mg PCBs/kg lipid, being the level at which a closely related mustelid species, the American mink, experienced reproductive failure in laboratory studies, is generally assumed to be a critical level for the otter as well.

Data on PCB concentrations in European otter tissues from different studies are difficult to compare. Variations are found in the organs selected for analysis, the analytical method, and format of reported data (e.g. lipid weight vs. fresh weight; congener specific versus cumulative concentration indices). This complicates a comparison of reported data.

Another complicating factor in comparing the data is that in most studies on PCBs in otter only total-PCBs are reported, congener-specific studies being quite rare. Information on levels of non-ortho congeners (the most toxic ones) is even more limited. As PCBs congener patterns can vary between individual otters, the total-PCB concentration may not be an appropriate estimator of PCB toxicity. PCB concentrations may be highly variable within otter populations, even between individuals inhabiting the same area. Generally, average PCB levels in otters appear to be highest in areas where the species is in decline (mean PCB levels ranging from 50 to 180 mg/kg fat) and thriving otter populations are correlated with low mean PCB tissue concentrations (mean PCB levels below 30 mg/kg). However, in some recent studies relatively high PCB levels were found in thriving otter populations, notably in Spain (mean PCB level 100 mg/kg fat) and in Scotland (especially Shetland: mean PCB level 140 mg/kg fat). However, based on literature data presented in this report, it is neither possible to dismiss the role of PCBs in the otter's decline as suggested some authors, nor to assume the role of PCBs as completely proven.

In order to make a more final assessment of the impact of environmental PCB levels on the performance of otter populations and to derive environmental quality objectives for PCBs in sediment (for use by nature and water management authorities) a further elucidation is required of toxicokinetic and toxicodynamic processes. In general, the following process should be studied: bioaccumulation of sediment-bound PCBs in prey organisms, food chain transfer of PCBs to the otter, induction of sublethal physiological effects and finally effects on the population status.

Recommendations are made regarding new areas of research. In view of the uncertainties regarding the feasibility of extrapolation of mink data to the otter, priority should be given to research into physiological effects of PCBs on the otter itself (enzyme induction, depression of vitamin A and thyroid hormones). This type of research may further yield indications about the ecophysi-

ological differences between otter and mink and, therefore, may facilitate extrapolations between both species. Furthermore, toxicokinetic processes (assimilation, metabolization, elimination) of PCB congeners in otters should be studied. The transfer of sediment-bound PCBs to otters may best be studied in a restricted geographical area.

In the proposed second phase of the DOQOP research project, the above mentioned aspects will be studied by conducting congener-specific PCB analyses of otter, fish and sediment samples from north-western Denmark. Furthermore, vitamin A and thyroid hormone levels in blood of captive and feral otters will be related to concentrations of PCB in blood. The correlation between hepatic PCB levels and vitamin A storage in the liver will be investigated. This may contribute to a further clarification between cause-effect linkages of PCBs in otters (including secondary poisoning), and the derivation of environmental quality objectives.

This publication can be ordered at: V.U. Boekhandel/Uitgeverij, De Boelelaan 1105, 1081 HV Amsterdam, The Netherlands, Tel. 020-444 9410, ISBN 90-5383-335-8, 44 pp. 24 tables incl. appendix, 26 figs, 194 refs.

Evaluation of dose-response relationships for the effects of PCBs on the reproduction of mink (*Mustela vison*)

Pim E.G. Leonards, Maarten D. Smit, Addy W.J.J. de Jongh, Bert van Hattum

Presently, the otter is extinct in the Netherlands. Effects of PCBs on reproduction are assumed to be one of the main factors which contributed to the decline of the otter in the Netherlands and other European countries. In national policy plans repopulation experiments with otters are seriously considered for selected aquatic habitats. The assessment of reliable environmental quality objectives for contaminant exposure in otter habitats is of great importance for the evaluation of the feasibility of intended repopulation experiments. However, no experimental toxicity data are available for the effects of PCBs on otters.

The objective of this study, which is part of the first phase of the DOQOP project (Development of Otter-based Quality Objectives of PCBs), was to review available data in the literature on the effects of PCBs on the reproduction of mink (*Mustela vison*), a mustelid species related to the otter, and to analyse the variability of reported effect levels in relation to the composition of technical PCB mixtures and experimental conditions. Transformation from dose levels to predicted internal concentrations of mink with congener or isomer specific one-compartment bioaccumulation models was used to correct for differences in experimental conditions and administered technical mixtures. In order to correct for the variation in toxic potency among PCB congeners and technical mixtures. TCDD-equivalents (TEQ-equivalents) were calculated. Common dose-effect relationships, between estimated internal concentrations of PCBs and TEQ and the reproduction effect endpoints (relative litter size or kit survival) were estimated using a logistic model.

From these dose-effect models congener-specific median effect levels (EC_{50}) and virtual no-effect levels (in this study approximated by EC_5 and EC_1 values) were estimated. Risk levels expressed on the basis of mink tissue residues were extrapolated to concentrations in prey organisms (fish). Congener specific effect levels were extrapolated to concentrations expressed as different cumulative indices (Σ PCBs, PCB 153, TCDD-equivalents or TEQ). Finally, the thus derived no-effect and critical levels were compared with effect levels reported for other aquatic predators and recently proposed environmental quality objectives.
The dose-effect curves between calculated internal concentrations and reproduction showed steep slopes. The mink tissue resi-

due based EC_{50} concentrations for Σ PCBs were found to be 1.2 µg/g wet weight for relative litter size and 2.4 µg/g wet weight for kit survival. The EC_{50} value for PCB 153 for relative litter size is 0.16 µg/g wet weight and for kit survival 0.22 µg PCB 153/g wet weight. Expressed as TCDD-TEQ the EC_{50} values were estimates as 160 pg TCDD-TEQ/g wet weight and 200 pg TCCDD-TEQ/g wet weight respectively (TEF-system Safe 1993). The proposed no-effect levels (EC_1) were 0.47 µg Σ PCB/g (wet weight, relative litter size) and 1.3 µg Σ PCB/g (wet weight, kit survival). The no-effect level for relative litter size based on the non-*ortho* and mono-*ortho* PCBs was 105 pg/g (ww) TCDD-TEW (TEF system of Safe, 1993).

Extrapolated to concentrations in prey organisms (fish), no-effect levels for relative litter size are proposed of 145 µg PCB/kg fresh weight food. For kit survival a higher level was calculated to be 399 µg PCB/kg fresh weight. The diet based no-effect levels expressed as TCDD-TEQ were 50 pg/g fresh weight (relative litter size, TEF system of Safe, 1993) and 17 pg/g TCDD-TEQ fresh weight (kit survival).

The proposed effect levels are in agreement with values reported for other sensitive piscivorous mammals and birds. The proposed diet based no-effect levels are close to maximum tolerable risk levels for aquatic predators recommended in Dutch policy documents and are five times higher in comparison to the target values stated in the Otter Protection Plan. Assuming that the mink-based no-effect levels for PCBs may be extrapolated to the otter, the results from this study indicate that with respect to PCBs the concentrations in fish from the Oude Venen probably are sufficiently low to consider potential future repopulation experiments.

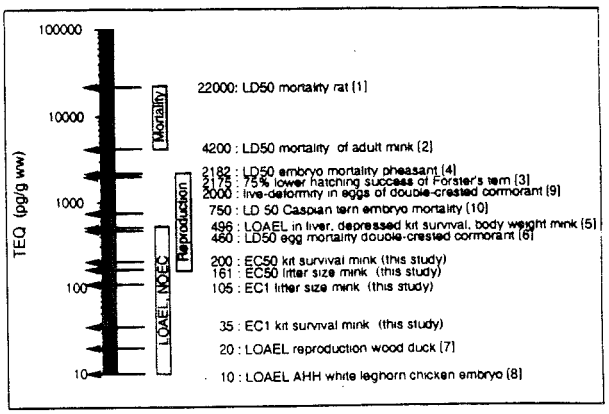

Fig. 10. Reported effect levels in toxic equivalent concentrations (TEQ, wet weight) in mammals and birds, in comparison to the estimated no-effect and critical effect levels. TEQ, for mink reported in this study. [1] McConnell, 1978; [2] Hochstein et al., 1988; [3] Kubiak et al. 1989; [4] Nosek et al., 1993; [5] Heaton, 1992; [6] Tillitt et al., 1992; [7] Henshel et al. 19??; [8] Tanabe et al., 1987; [9] Yamashita et al., 1993; [10] Tillitt et al., 1989.

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The decline of mink in Georgia, North Carolina, and South Carolina: The role of contaminants

S.L. Osowski, L.W. Brewer, O.E. Baker, G.P. Cobb

Since the 1960s, mink (*Mustela vison*) populations in Georgia, North Carolina, and South Carolina have declined, especially in the coastal plain. A prior study suggested that the decline may stem from environmental contaminants. Based on water quality data from each state, we identified 17 substances potentially related to the decline: aldrin, dieldrin, endrin, DDD, DDE, DDT, PCBs, chlordane, alpha-BHC, toxaphene,

dibenzofuran, copper, chromium, cadmium, lead, arsenic, and mercury. Mink livers were analysed for PCB and orga-nochlorine pesticides, and kidneys and femurs were analysed for metals. Reference sample concentrations from piedmont, mountain, and foothill locations were compared to state coastal plain totals and counties. PCBs for Georgia, dieldrin for South Carolina, and endrin and aldrin for North Carolina were significantly higher than the piedmont reference group. Liver PCB concentrations were higher than those known to cause mink reproductive dys-function. Mercury concentrations were sig-nificantly higher in coastal plain mink from all three states and were in the range of those known to cause impacts to re-production, growth, and behaviour to wild mink. It is unknown what concentrations of cyclodienes cause reduced reproduction or other physiological effects in mink, but the levels reported here probably indicate background concentrations that do not contribute to the decline.

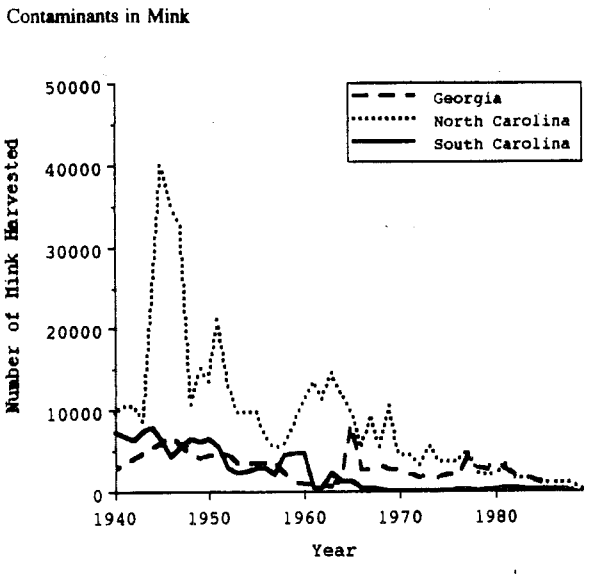


Fig. 1. Historical mink harvest 1938-89 (GADNR, unpubl. data; NCWRD, unpubl. data; SCWMRD, unpubl. data ; Novak 1987).

Arch. Environ. Contam. Toxicol. 29, p. 418-423, 1995. 2 figs., 2 tables, 34 refs. Authors' abstract.

Stereotypies in ranch mink: the effect of genes, litter size and neighbours

C.P. Bjelke Hansen

This study was conducted on two generations of ranch mink to test the hypothesis that the behaviour of stereotypy (SY) in ranch mink is subject to heredity. Two groups of 14 females were selected as low stereotyping and high stereotyping individuals as extremes from 61 females. They were observed in two periods, one before mating and one after mating. The selection was based upon four SY frequencies of which two excluded the parameter "Pendling". The kits of the two groups of females were also observed and the difference in level of SY between the two groups of mothers was upheld in the next generation. Combined with the finding of a positive, though not significant, correlation between the SY frequency of mothers and the mean frequency of litters this indicated a genetic effect upon the level of SY. A positive correlation between the litter size and the mean SY level of the litters was found. Though not significant it was considered important. A neighbour effect on the SY level in farm mink could not be found. All these results were obtained regardless of whether or not Pendling was incorporated into the SY frequency indicating that Pendling is induced by the same factors as other SYs.

Behavioural Processes, 29, pp. 165-178, 1993. 5 tables, 2 figs., 32 refs. Author's summary.

Stomach ulcer and adrenal weight as indices of stress in farm mink

M. Harri, L. Numinen, T. Filén

Stress induces in the organism several adaptive responses which are unspecific but related to the severity of the stress eliciting them. These responses can be measured and

used as an index of the stressfulness of the environment the animal in question has lived in. In this study we assessed the incidence of stomach ulcers and the size of adrenal glands as indices of stressing farm mink.

The present results show that stomach ulcers are not very common in farm mink although the mink is sensitive to stomach ulceration. Only 2 out of 35 untreated farm mink had stomach ulcers. The resulting ulcers were not due to starvation. Immobilisation stress for 5 hours induced stomach ulcer in 5 out of 10 mink, whereas one single hour in restraint or repeated one hour exposures to the restraint stress were ineffective. The frustration of being left without feeding while the neighbours were fed was stressful; one half of these mink developed ulcers. All the ulcers found were scored at 3 or less on a 6-point severity scale. While the stomach ulcer is a response to acute stress, its usefulness as an indicator of stressfullness of long-term housing conditions is limited.

The size of the adrenal glands was not related to the incidence of stomach ulceration and there was a large individual variation in adrenal sizes. On the other hand, in response to chronic stress, adrenal size increases but its usefulness as an indicator of acute stress may be doubtful. Moreover, the method of expressing the size of the adrenal glands may be misleading. In our study, bigger animals had bigger adrenal glands. Thus the actual adrenal size overestimates the stress of big animals. However, adrenal to body weight ratio overestimates the adrenal size in smaller animals and in females. When an animal loses weight the actual weights of adrenal glands or brains do not change, but the adrenal weight relative to body weight of course increases. Use of relative adrenal sizes can be especially misleading in farm mink whose body fat content is very high. The dependence of adrenal weight on body weight must be taken into account but not by the misuse of the ratio, rather by the use of the analysis of covariance.

Suomen Elainlaakarilehti, 100, 2, pp. 127, 1994. Only abstract received. Authors' abstract.

Resting shelves for farmed blue foxes: usage and effect on behaviour and welfare

Hannu Korhonen, Paavo Niemelä

Two experiments were performed on the use of shelves by farmed blue foxes. In Exp. 1, the use of three different shelf types (L, E, V) was studied from weaning until pelting in juveniles. Type V was the most favoured, with amount of use being 34.1%, Types E and L were used 12.3% and 22.6%, respectively. There occurred great individual variation in the amount of shelf usage. Foxes that were interested in the shelves used them for 307 ± 184 min/24 h on average. Females used the shelves more than males. Shelf usage in general was highest in summer and declined significantly towards winter. The colder the ambient air temperature was, the less the shelves were used.

The shelves remained rather clean and unbitten throughout the experiments. The extent of wearing of the ventral side in the furs of shelf foxes was twice as much as that of the controls. Exp. 2 lasted from midwinter to weaning in July. Males typically used shelves less than females. The use of shelves was very slight (8.1%) between January and March. Those foxes that were interested in the shelves used them for 54 ± 133 min/24 h on average (median 18 min/24 h). Thereafter, usage markedly increased being 20.2% in males and 18.1% in females, respectively, in June. Shelf use dramatically decreased after whelping nest boxes were given to the females as they preferred the nest box roofs. The locomotor activity of the shelf foxes was somewhat less than that of the controls. No marked differences existed in the whelping results

between the groups. The foxes did not markedly utilise the shelves for observation or as a hiding place. The question of whether shelves affect the temperament or well-being of foxes remained partly open.

Suomen Elainlaakarilehti, 100, 2, pp. 125, 1994. Only abstract received. Authors' abstract.

Importance of resting platforms to farm foxes

Mikko Harri, Jaakko Mononen, Teppo Rekilä

In response to public criticism about barren wire mesh cages, the European convention (1991) recommended resting platforms for foxes kept for farming purposes. We have tried to find out the importance of these constructions for foxes. The results and their conclusions were more or less similar for both blues foxes (*Alopex lagopus*) and silver foxes (*Vulpes vulpes*). The first idea that platforms would protect the animals against cold was not supported by our studies.

Physical measurements showed that platforms, in fact, promoted heat loss of the animal, rather than decreased it. This was due to the compression of the fur against a solid surface and the high heat capacity of the wet and icy platform. In addition, behavioural observations confirmed decreasing use of the platforms with approaching winter and decreasing temperature. The result that open platforms (without walls) were preferred to ones with solid walls does not support the role of the platform as a hiding place. On the other hand, this result supports the role of the platform as an observation place, explaining also the eagerness of the foxes to spend their time on the roof of, rather than inside a nest box, and their preference for a sleeping place on that part of the cage floor from which they can observe the surroundings.

However, the large individual variation in daily use points out that no single factor can account for the whole matter. There were a few animals who spent hours on the platforms, while a majority of them used the platforms only little or not at all. With time the eagerness of use of those few animals declined, rather than that of all individuals.

Early experience of platforms seems to be of crucial importance. Blue foxes that had platforms as adults only occasionally used them. Use of the platforms in the presence of man only very roughly predicts the 24-h use. This again demonstrates that the hiding function of the platforms is not of major importance. Small animals use the platforms more than bigger ones, explaining, at least partially, why smaller females use the platforms more than males. There is a positive correlation between the time the animal spent in activity in the evening and at night and the use of platforms in the presence of man on one hand and number of times the animal jumps on the platform and total daily use of platforms on the other hand.

However, only sleeping on the platform can result in total daily use of several hours. It seems obvious that the animal does not jump onto the platform with the purpose to start sleeping there; rather it sleeps on the platform because it happens to be there.

Recently it has been found that blue foxes with platforms spend less time in locomotion than do animals without them. The calming effect of the platforms is thus not excluded. It is concluded that the foxes themselves do not find the same functions for the platforms as the European convention defines. This does not exclude the possibility of other purposes from the foxes' point of view.

Suomen Elainlaakarilehti, 100, 2, pp. 125, 1994. Only abstract received. Author's abstract.

Comparison of daytime use between platform types, materials, ceilings and experiences in juvenile blue foxes (*Alopex lagopus*)

Hannu Korhonen, Elise Ketoja, Paavo Niemelä

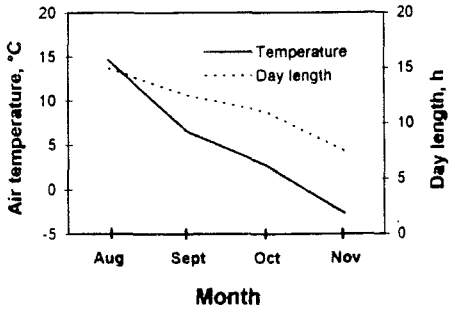


Fig. 1. Mean temperatures and day lengths at the experimental farm. Only those days when scanning observations were performed are included in each month.

The current European recommendations require that each weaned fox shall be provided with a resting platform in its cage. In the present study, daytime platform use between two platform types (wooden side-U (n=58) vs. Wooden corner flat (n=38), materials (wood (n=112), vs. Net (n=38), ceilings (23 cm (n=112) vs. 30 cm (n=36) and pre-weaning platform experiences (experience (n=58) vs. No-experience (n=54)) were compared in juvenile blue foxes (*Alopex lagopus*) (total number of animals, n=264). The statistical analyses were based on the mixed-model approach to the repeated measurements. The type comparison indicated that platform type significantly affected the amount of its use. The wooden side-U was highly preferred by the test animals but use of the wooden corner flat was minimal. Net proved to be a suitable platform material because use of net platforms was not substantially lower than that of the corresponding wooden ones and furthermore, foxes' faeces do not accumulate on them. In both material groups platform use declined similarly from the beginning of August until mid-November. The low ceiling was slightly preferred by females over the high ceiling even after the effect of weight on platform use had been eliminated. In males no such preference was observed. Pre-weaning platform experience increased post-weaning platform use significantly in the wooden corner flat group but not unambiguously in the wooden side-U group. The present results support the conclusion that the recent recommendations of European Convention should be subjected to reconsideration in order to provide more specific guidelines.

Applied Animal Behaviour Science 45, pp. 125-138, 1995. 2 tables, 4 figs., 29 refs. Authors' abstract.

Comparison between the use of open and walled platforms by juvenile blue foxes (*Alopex lagopus*)

Hannu Korhonen, Paavo Niemelä

The current European recommendations require that platforms in the cages of farm foxes should have solid sides. The present study aimed to clarify how such a obstructed view affects platform use in farm-bred blue foxes (*Alopex lagopus*). Experimental groups with open (16 males, 14 females) and walled (16 males, 14 females) platforms were compared from weaning to pelting. Both platform types were 110 cm long x 20 cm wide. Walled platforms had 23 cm high walls at the ends and rear, but open ones were without walls. Data were collected by daytime scanning observations and 24-h video recordings. Results for both sexes were parallel, showing that foxes significantly ($P<0.001$) prefer open platforms over walled types. Video recordings revealed a significantly ($p<0.01$) greater use of open platforms for jumping and resting (short duration 1-10 min on platform) compared to walled platforms. A rather parallel conclusion was found for sleeping also. The only exception was in September when females given both platform types slept on them for

the same amount of time on average. The disturbance test showed that foxes supplied with open type platforms jumped onto them significantly ($p<0.05$) more often (62.5% of males, 85.7% of females) than those given the walled type (25.0% of males, 35.7% of females). It can be concluded that foxes avoid platforms with walls because such platforms prevent observation of the surroundings and therefore the possibility to adjust their distance to danger.

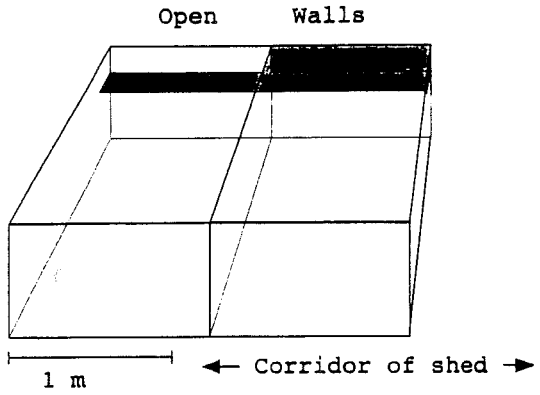


Fig. 1. Schematic picture of the platform types studied.

Agricultural and Food Science in Finland, Vol. 5, pp. 177-184, 1996. 3 figs., 23 refs. Authors' summary.

Seasonal changes in platform use by adult farmbred silver foxes (*Vulpes vulpes*)

Hannu Korhonen, Paavo Niemelä

Seasonal changes in platform use (Wooden U-type platform, area 3090 cm^2) were studied during one year in adult farmbred silver foxes (*Vulpes vulpes*) by daytime scan sampling observations and 24-h video recordings. Platform use was found to be lowest during the coldest part of the year (winter, late autumn) and highest in mid-summer (July). The seasonal pattern in platform use obtained by the scan samplings was in agreement with that obtained by video recordings. Platform use was sex-related being significantly ($p<0.001$) higher in females than males. Circadian distribution of platform use was quite similar for both sexes. Hourly use was highest from 4 to 5 a.m. and lowest at about 8-9 a.m. when farm work started. Platforms were mostly used for sleeping and the least for jumping. The animals' needs for rest, observation and seclusion required by the European Convention were met fairly well by the presently studied platform type. This is demonstrated by its rather high amount of general use, and because it functioned appropriately as a place for observation and rest. Based on the present data, wooden U-type platforms can be recommended for practical farming purposes, particularly outside the winter period.

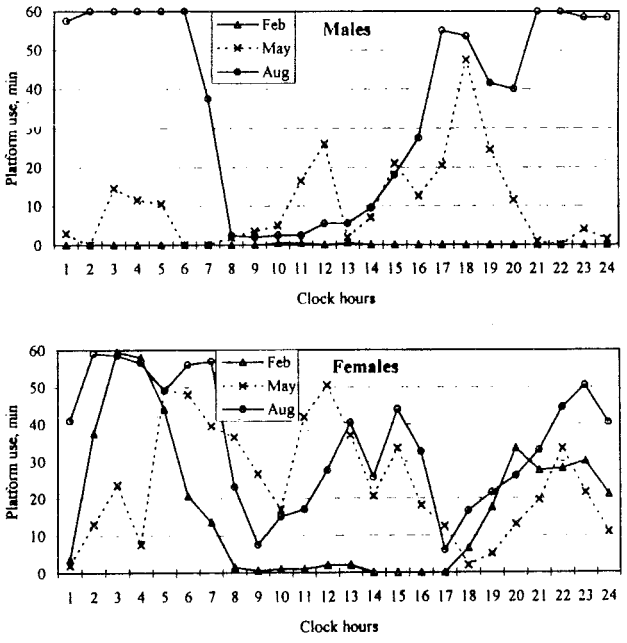


Fig. 6. Selected examples for circadian distribution of platform use (min/h) during three different months.

Agricultural and Food Science in Finland, Vol. 5, pp. 3-15, 1996. 6 figs, 31 refs. Authors' summary.

Seasonal changes in platform use by farmed blue foxes (*Alopex lagopus*)

Hannu Korhonen, Paavo Niemelä, Hannu Tuuri

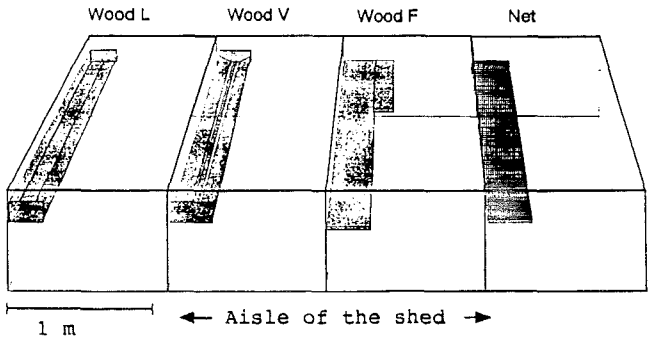


Fig. 1. Schematic picture of the platform types studied.

Seasonal changes in platform use were investigated in farm-raised blue foxes (*Alopex lagopus*) by daytime scan sampling observations and 24-h video recordings. Seasonal comparisons were made in both sexes, but other experimental treatments were applied mainly to females. Platform use was minimal in Jan.-Mar. (Period I) and Nov.-Dec. (Period IV). During the whelping season (Period II: Apr.-Jul.) the amount of use by males and non-breeding females was high, but lower in breeding and lactating females, which preferred either the roofs or interiors of nest boxes. Platform use by all experimental animals was high during Period III (Aug.-Oct.). The scan sampling and video data indicated parallel seasonal trends. Platforms were mainly used for sleeping but the amount of use for jumping and lying was slight in comparison. All of these activities showed seasonal variations. The pattern of a total 24 h of sleep was constant throughout the year, but during Periods I and IV the animals preferred to sleep on the cage floor instead of on the platforms. The platform model affected the level of use but not the seasonal variation pattern. Platforms made of net material were favoured over wooden ones. The platform ceiling height did not essentially influence use. Melatonin treatment significantly increased the animals' autumn body weight but did not decrease platform use. On the basis of the present data, platforms can be recommended for practical farming purposes particularly during the spring and summer.

Applied Animal Behaviour Science 48, pp. 99-114, 1996. 6 figs., 20 refs. Authors' summary.

Temperament and reproductive success in farmbred silver foxes housed with and without platforms

H. Korhonen, P. Niemelä

Human, strike, pencil, confrontation, feeding, and disturbance tests were used to study fear-motivated behaviour in farmed silver foxes (*Vulpes vulpes*), housed with and without wooden platforms. The results showed that the number of fearful animals was highest and lowest in the confrontation and feeding tests, respectively. Foxes that had used platforms most frequently before the behavioural tests, were also most often found on platforms during the tests. Temperament differences between control and platform animals were slight. Only the human test gave statistically significant ($p<0.05$) confirmation that animals housed with platforms were less fearful of humans than those housed without platforms.

The fear index (FI), based on all other tests except for the disturbance test, showed that the number of fearless individuals was equal (FI=0.50) in both the platform and control groups. Regardless of the testing, breedings and whelpings succeeded equally well in fearful and fearless vixens. During severe disturbances, 47.4% of the experimental animals used the platforms for hiding. It is obvious that the temperament of farmed silver foxes is not substantially affected by the presence of a platform in the cage, but that platforms would otherwise promote animal welfare by providing the

possibility for more complex behaviours and a place of refuge.

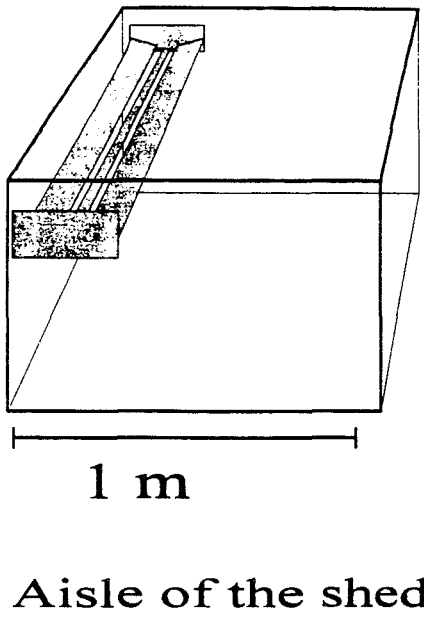


Fig. 1. Schematic illustration of the platform type studied.

J. Anim. Breed. Genet. 113, pp. 209-218, 1996.5 tables, 1 fig., 23 refs. Authors' summary.

Extinction dynamics in the American Marten (*Martes americana*)

Richard R. Schneider, Peter Yodzis

We constructed a model of marten population dynamics and used it to investigate extinction processes across a wide range of parameter values. The model was based on rules governing the behaviour and physiology of individual martens and focused on energy balance. Spatial dynamics and demographic and environmental stochasticity were incorporated. The outcome was the probability of extinction and quasiextinction (20 females remaining) over 500 years. Three qualitative forms of extinction were delineated. The first was deterministic extinction, associated with those parameter combinations leading to a negative population growth rate. The second was probabilistic extinction in systems with a strong positive growth rate but restricted population size due to habitat constraint. The transition from 100% persistence to 100% quasiextinction, as the input habitat size was decreased, was abrupt. The final form of extinction was in systems with a growth rate of approximately zero. Prey availability maintained an upper limit on these populations, but otherwise fluctuations in population size were essentially random, leading to nontrivial probabilities of extinction in even relatively large populations. A number of issues requiring further empirical research were identified. These included the relationship between habitat quality and marten reproduction, dispersal patterns and dispersal mortality, the effect of habitat edge on marten reproduction and mortality, and the characterisation of the severity and frequency of catastrophic mortality as experienced by marten populations.

Conservation Biology, Vol. 8, No. 4, pp. 1058-1069, 1994. 9 figs., 2 appendix, 33 refs. Authors' abstract.

The comparative metabolism of diiso-propyl methylphosphonate in mink and rats

D.J. Weiss, R.S. Geary, W. Wustenberg, T.J. Bucci, V. Perman, I.P. Baumel, J.C. Dacre

This study reports the metabolism of carbon-^{14}labeled diisopropyl methyl-phosphonate (DIMP) in mink and rats, undertaken to better understand the dose-related mortality reported for mink in a previous study. In both male and female mink and rats, DIMP was rapidly absorbed after oral administration; it was metabolised by a saturable pathway to a single metabolite, isopropyl methylphosphonate (IMPA), which was rapidly excreted, primarily in the urine (90%). Faecal radioactivity, also identified as IMPA, was 1.7-3.1% of the administered dose. Female rats had a slower rate of conversion of DIMP to IMPA and less total excretion of IMPA than male rats. Metabolism of DIMP administered intravenously

was not very different from that given orally in both species. These data indicate that mink absorb, metabolise, and excrete DIMP (as IMPA) in a manner very similar to mice, rats, and dogs.

Arch. Environ. Contam. Toxicol. 27, pp. 420-425, 1994. 5 figs., 15 refs. Authors' abstract.

Assessment of experimental data on PCB-induced reproduction inhibition in mink, based on an isomer- and congener-specific approach using 2,3,7,8-tetrachlorodibenzo-*p*-dioxin toxic equivalency

Pim E.G. Leonards, Theo H. De Vries, Wim Minnaard, Suzanne Stuijfzand, Pim de Voogt, Wim P. Cofino, Noco M. Van Straalens, Bert van Hattum

This paper describes an attempt to derive a median effect level (EC50) of PCBs for reproduction of mink based on experimental literature data. Unfortunately, the con-ditions of the mink studies carried out during the last two decades vary widely, which makes it difficult to establish unequivocal dose-effect relationships. This study describes an attempt to correct for the differences in exposure time using a one-compartment bioaccumulation model. This model estimates the whole-body concentration of PCBs in mink. Two approaches are tested. First, the whole-body concentration of 10 isomer groups of PCBs in mink were estimated and compared with reproduction data to calculate an EC50 value. Alternatively, estimates for the whole-body concentration in mink of 11 individual biologically active PCB congeners were made. With these, the toxic equivalent concentration (TEC) in mink was estimated using the 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (TCDD) equivalent factor (TEF) approach. Whole-body dose-effect relationships were estimated and EC50 values for litter size and kit survival were calculated. The application of the one-compartment bioaccumulation model of the first approach resulted in a significant improvement in the dose-effect relationship in comparison to the raw data set. A further improvement in this relationship was achieved using the congener-specific bioaccumulation model in combination with the TEF approach. This study proposes a critical body residue (EC50) for mink litter size of 1.2 µg/g (total PCBs/wet weight). From the second approach a critical body residue (EC50) expressed in TCDD equivalency for litter size of 160 pg/g (TCDD equivalence/wet weight) and 200 ng/g (TCDD equivalence/wet weight) for kit survival is proposed.

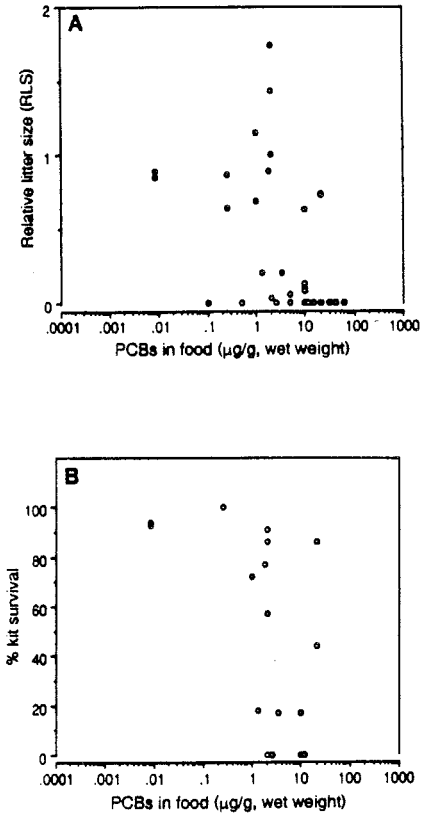


Fig. 1. Overview of mink litter size (A) or kit survival (B) as a fraction of the control vs. Concentration of PCB in the food of mink reported in the literature. Some data points are overlapping in the figure.

Environmental Toxicology and Chemistry, Vol. 14, No. 4, pp. 639-652. 6 tables, 6 figs., 60 refs. Authors' abstract.

Studies on the quality of fur coat of farm fitches (*Mustela putorius furo*)

Stanislaw Niedzwiadek, Malgorzata Piorkowska, Grazyna Palimaka-Rapacz

The studies concerned a total of 72 skins of young farm fitches of both sexes, which were sacrificed after reaching the desired fur quality. It was found that their fur coat was characterised by high resilience (total SGM-16.2 mm) the thickness of underfur being similar to that in mink, however, exceeding by far that of nutria and rabbits.

Compared to other species of animals, based on the measurement of underfur and fur hair lengths, the fur coats of farm fitches should be assigned to the group of medium-length hair. Underfur density was low, being estimated at ave. 4.61 thous./1 cm^2 of skin, while that of the fur coat was relatively high - above 200 pcs. The proportion of underfur hairs in the fur coat was estimated at c. 36%.

Roczniki Naukowe Zootechniki 20, 1, pp. 75-85, 1993. In POLH, Su. ENGL, GERM, RUSS. 1 fig., 6 tables, 15 refs. Authors' summary.

Taxonomic notes on the yellow-throated marten (*Martes flavigula*)

V.V. Rozhnov

The taxonomy of yellow - throated marten *Martes flavigula* (Boddaert, 1785) from Vietnam is analysed. Two forms are noted in the mammalian fauna of this country, *flavigula* and *indochinensis*. The presence of an alternative feature in the examined samples made it possible to distinguish three species of *M. flavigula* s. 1., i. e. *M. flavigula* s. s. With the subspecies *aterrima, flavigula, chrysopila* and *hainana, M. lasiotis* with the subspecies *indochinensis, peninsularis* and *lasiotis* and *M. gwatkinsi* (the monotypic species).

The superspecific category was used in this case. The distinguished species are considered as allospecies.

Zoologichesky Zhurnal, Vol. 74 (2), pp. 131-138, 1995. In RUSS, Su. ENGL. 2 figs., 1 table, 22 refs. Author's summary.

Comparative anatomy of the vomeronasal cartilage in mammals: mink, cat, dog, pig, cow and horse

Ignacio Salazar, Pablo Sánchez Quinteiro, José M. Cifuentes

The vomeronasal cartilages of mink, cat, dog, pig, cow and horse were studied by dissection, microdissection and by means of series of transverse sections. In all the species studied the cartilage is of hyaline type and the medial sheet is well-defined and perfectly moulded to the adjacent bone.

However, interspecies differences are apparent in the manner in which the medial sheet associates and eventually fuses with the cartilage of the incisive duct; the morphology of the horse vomeronasal cartilage is particularly distinctive in this respect. The lateral sheet of the vomeronasal cartilage, although always present, has a different arrangement in each species studied. Similarly, the gaps in the lateral sheet (corresponding to the opening of the vomeronasal organ) differ among the species studied in form, location and number.

Annals of Anatomy, 177, pp. 475-481, 1995. 9 figs., 27 refs. Authors' summary.

Morphology of cuticular cells of guard hairs of the adult polar fox *Alopex lagopus* (Linné, 1758) in the scanning electron microscope (SEM)

Milan Vanek, Albert Keller

The shape and arrangement of cuticular cells of guard hairs of adult *A. Lagopus* are described with SEM photographs. Theoretical aspects are considered and auxiliary criteria for specific determination are provided. This method may be useful for estimation of fur quality of the polar fox.

Revue Suisse de Zoologie, 100 (4), pp. 899-903, 1993. In FREN, Su. ENGL. 1 fig., 20 refs. Authors' abstract.

Towards better pelts from possums; mite fauna of *Trichosurus vulpecula*

I. McK. Clark

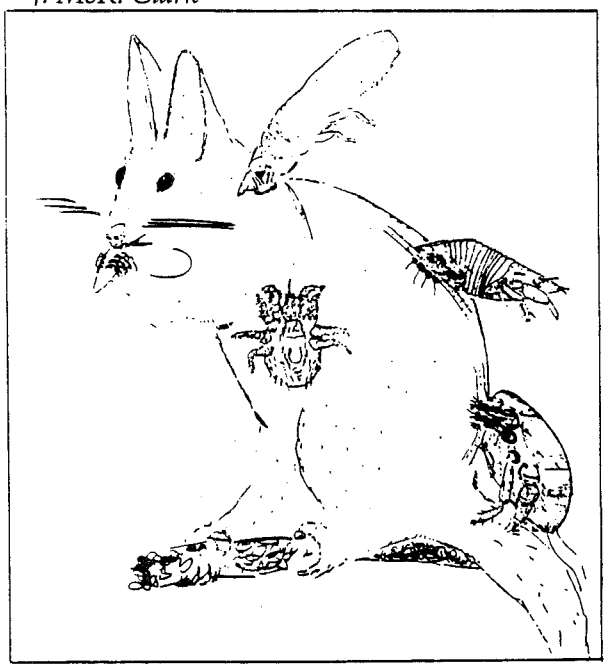


Fig. 2. Different species of possum parasitic mites occupied different parts of the pelt. They are shown here in their favoured positions. Shoulder - female *Murichirus* sp. Back - Male Dyce's fur mite *P. dycei*. Rump - Male *A. papilio*. Body - Female *T. crassipes*. This mite did not have a clumped distribution on the host.

Seven possums from north Taranaki were collected in November and December 1991. They were skinned and the skin was divided into 5 parts; the fur was sliped and hydrolysed to leave mites for counting by 10% aliquot. Fur mites (Listrophoridae) comprising 3 species made up 1005 (94%) of the 1069 adult mites counted. They appeared to remain at their favoured position on the possum after death. A *Murichirus* species of fur mite comprised 34% of the total count and was mostly confined to the shoulders of the host. *Atellane papilio* Domrow (17% of total) was confined to the posterior dorsal (rump) region and *Petrogalochirus (Austrochirus) dycei* (Domrow) Fain the most numerous mite at 45% of the total, favoured the host's anterior. All 3 species of fur mite stick their egg to the host fur. *Trichosurolaelaps crassipes* Womersley contrasted with the fur clasping mites in being rare at 6% (64/1069) of the total count and showing no preferred pelt part. *T. crassipes* and *A. papilio* are the mite species most likely to degrade pelts.

New Zealand Entomologist, Vol. 16, pp. 84-90, 1993. 1 table, 2 figs., 12 refs. Author's abstract.

The use of bathing sand for chinchillas

J. Saly, M. Puzder, R. Kopin, J. Jantosovic, F. Lesnik, M. Kozák, M. Stefanko

The usability of bathing sand Perlit L (produced by Ceramic Works - the research-developmental base for ceramics and pearlite, Michalovce) was observed on 25 mature and 33 young chinchillas (*Chinchilla laniger*) during 94 days.

The quality of bathing sand was evaluated according to its physical properties using bacteriological and mycological examinations. Its effect on the health status of chin-

chillas was estimated according to clinical examinations, using bacteriological and mycological examinations of hair, skin and mucosa.

The physical properties of bathing sand did not exhibit any changes in the parameters required. No pathogens or fungi were found by the microbiological and mycological examinations. No changes in the health status of the chinchillas were found during the experiment. Laboratory examinations of skin and mucosa for pathogens of bacteria and fungi were negative.

The chinchillas showed a good affinity to bathing sand. With regard to the hygiene and technology of chinchilla breeding, bathing sand conforms to requirements and is suitable for use in chinchillas.

Slovensky Veterinarsky Casopis, 20, 3, pp. 148-149, 1995. In SLOVAK, Su. ENGL. 8 refs. Authors' summary.

Dry-season food habits of the gray fox (*Urocyon cinereoargenteus fraterculus*) in the Belizean Peten

A.J. Novaro, R.S. Walker, M. Suarez

We examined dry-season food habits of the gray fox (*Urocyon cinereoargenteus fraterculus*) in north-western Belize through analysis of 267 feces. Fruits were the most common food item (present in 96% of the feces), followed by arthropods (66%) and vertebrates (48%). We discuss the potential role of the gray fox in seed dispersal and/or predation in the area.

Mammalia, Vol. 59, No. 1, pp. 19-24, 1995. 3 tables, 26 refs. Authors' summary.

Sustainability of harvest of culpeo foxes in Patagonia

Andres J. Novaro

Wildlife hunting, for meat and skins, is an important component of the rural economy in Argentinean Patagonia. Every year thousands of fur-bearing mammals are killed and the impact of this on their populations is unknown. This paper reports on the results of a preliminary investigation into the sustainability of the harvest of culpeo foxes *Dusicyon culpaeus* in a 1000-sq.-km area of Neuquen Province. Monitoring of fox densities and harvest rates over 5 years on six ranches revealed that, despite intense hunting, the numbers of foxes remained little changed. On the other hand, life-table analysis suggested that the levels of hunting pressure on four ranches were too high to allow fox populations to persist unless they were boosted by immigration. The findings have applications for wildlife managers in establishing sustainable harvest rates and optimal spatial distribution of those rates.

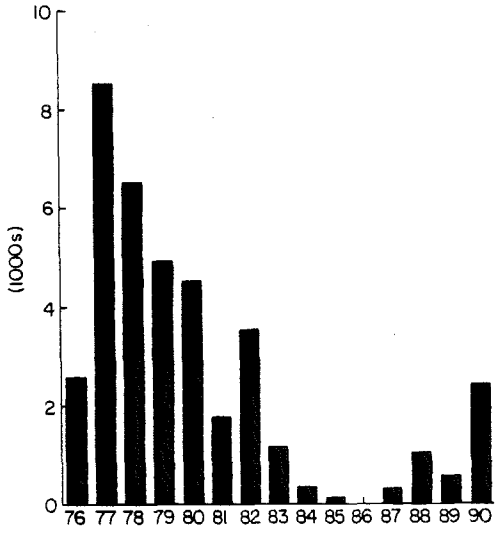


Fig. 1. Exports of culpeo foxes *Dusicyon culpaeus* from Argentina between 1976 and 1990 (from Garcia Fernandez, 1991).

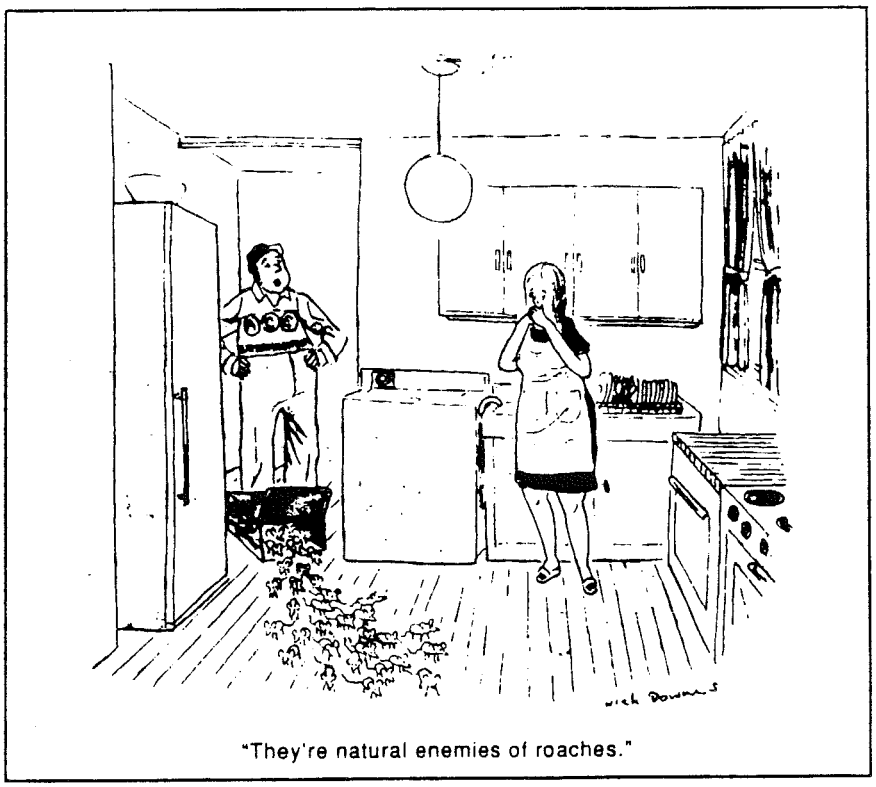
Oryx, Vol. 29, No. 1, pp. 18-22, 1995. 5 figs., 17 refs. Author's summary.

Scent-station visits as an index to abundance of raccoons: an experimental manipulation

Winston Paul Smith, Diane L. Borden, Keith M. Endres

We tested the premise that rates of visitation by raccoons (*Procyon lotor*) to scent stations vary directly with population density by manipulating the density of an island population of this carnivore in middle Tennessee. Despite its widespread use, the scent-station index to population size has not been validated. General protocol for scent stations followed previous investigators; radiotelemetry was used to monitor individual behaviour of raccoons. We determined minimum population size from the records of known captures and compared them with visits to scent stations recorded twice monthly during an initial period with no manipulation (May 1987 - August 1988); similar procedures were used during an experimental period (September 1988 - August 1989) when raccoons were removed and held on the mainland for appr. 1 month during each season and then returned to the island. Abundance of raccoons on the island ranged from 32 to 42 when estimated twice each month; computed indices of relative abundance varied from zero to 286. Rates of visitation by raccoons were highest in spring and summer during both the baseline and experimental period. Visits to scent stations were independent of density throughout the study. During the experimental period, both the largest and smallest observed indices of relative abundance occurred when an estimated 25% of the population had been removed and when all known animals (n=40) occurred on the island. Local fluctuations of populations may precipitate changes in behaviour of raccoons that preclude the use of scent stations to index abundance, particularly in heterogeneous habitats.

Journal of Mammalogy, 75 (3), pp. 637-647, 1994. 2 tables, 41 refs. Authors' summary.



"They're natural enemies of roaches."

Original Report

A rise of new colour phases in American mink (*Mustela vison Schreber*) in the course of selection for domestic behaviour

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Abstract

The consequences of domestication for fur colour character were described in the American mink. Two colour phases were obtained *de novo* during selection for tame behaviour - *Black crystal* and *Silvery*. A silent feature of the *Black crystal* mutant is the appearance of white guard hairs as a veil-like covering of the body. The mutant gene is designated as *Black crystal* and symbolised by *Cr*. Coat colour is of the *Himalayan* type in the *Black crystal* homozygote. *Silvery* mink are characterised by extensive white spotting in heterozygotes and by extreme depigmentation of the body in homozygotes. The mutant gene is designated as *Silvery* and symbolised by S^{w}. Breeding data demonstrate that both novel colour phases are inherited as a monogenic autosomal semidominant trait. The coat colour mutations *Silvery* and *Black crystal* obtained *de novo* during selection for tameness make it possible to create other new colour forms by combining them with each other and with other well known mutations. The new coat-colour varieties attracted considerable attention among specialists at the Exhibition of National Economic Achievements and at the International Fur Auction held in St. Peterburg (Russia).

Introduction

The first mink kept in captivity were captured wild mink in the 19th century in different parts of North America. In the beginning, depending on the place of origin of the mink, variation in characteristics such as size, fertility, fur colour and fur quality could be found. It was shown that coat colour mutations in mink were accumulated in natural populations and preserved as recessives in heterozygotes (*Castle et al., 1946; Shackelford, 1948; Belyaev, 1959*). Restriction of free mating and inbreeding under conditions of commercial farms have resulted in homozygotization of these mutations. The first recessive colour mutation - *Silverblue (p/p)* - was recorded in 1929 (*Shackelford, 1941*) on a mink farm in the USA and many others followed in the 1940s and 50s. The

newly arisen genetic changes, as well known, are extremely rare. To our knowledge, from the end of the sixties to the present time only a few have been added to the list (for example - *Wild glow* r^d/r^d - *Nes et al., 1988*).

Long-term selection of the silver fox (*Vulpes vulpes*) and the American mink (*Mustela vison*) for tame behaviour have been carried out at the experimental farm of this Institute. The idea of these experiments, the results and elicited correlated responses have been described (*Belyaev, 1969; Belyaev et al., 1974, 1979, 1981; Trapezov, 1987, 1991, 1994; Trut, 1988*).

Evidence was presented indicating that selection for tame behaviour gives rise to new physiological and morphological changes in populations of fur animals (*Belyaev, 1979; Belyaev et al., 1981*). The *de novo* appearing colour mutants: *Black crystal* and *Silvery* in the mink population we subjected to domestication are good examples of correlated responses to selection. The suggestion that the occurrence of coat colour variation is a correlated response to selection for behavioural traits is justified as follows: *Black crystal* and *Silvery* are inherited as the incompletely dominant mutation, the heterozygotes and homozygotes are phenotypically quite different from *Standard*. Consequently, it cannot be hidden in a wild phenotype and made apparent through inbreeding as is often the case with recessives.

The mutations we designated *Black crystal* and *Silvery* are novel and the description with genetic analysis of these mutants are given in this paper.

Material and methods

This study was performed at the experimental fur farm of our Institute. Three hundred *Standard* females and 150 males are maintained for domestication at the farm. These mink annually produce about 1,500 offspring. Mink have been selected for behaviour, i.e., amenability to domestication from 1980.

At the farm, 1,200 *Standard* females and *Standard* males are bred also, and they are not subjected to selection for behaviour but bred for commercial purposes only. The selected and unselected for behaviour populations are maintained under the same conditions. The unselected mink served as controls.

To study the genetics of mutation of *Black crystal* and *Silvery* coat patterns, 463 different crosses were done. As a result, 2,003 offspring showing variations in coat pattern were obtained.

The differences between the observed and expected segregation were tested for significance by the chi-square test.

Results and discussion

It will be recalled that the pelage of the standard colour of farm-bred mink is dark brown, underfur is slightly more brownish. Heaviness of pigmentation may vary, a distinctive feature is guard hair being consistently of darker coloration than underfur. Ventral white spotting depigmented areas of different size are scattered on chin, throat, and belly conforming to classical description (*Castle et al., 1949*). Standard dark and standard brown as a result of special selection are of the same genetic colour but with a different heaviness of pigmentation of the fur and skin.

A novel coat colour - *Black crystal*

In 1984, there appeared 4 mink showing deviations from standard coloration in unrelated litters produced by a mink population undergoing selection for domestic behaviour. In these individuals, completely white guard hairs varying in amount were scattered predominantly on the spine and the head (Fig. 1). Although similar to the well known dominant mutation with re-

spect to reduction of pigment of guard hairs, the new mutation we observed was outstanding in an entirely white coloration on the head. In fact, the *de novo* mutant had the appearance of wearing a "white hat". This is a feature distinguishing these animals from *Bluefrost* heterozygotes. The *de novo* arisen mutant had just as distinctive ventral white spots as *Bluefrost* individuals. The mutant gene which appeared in the course of domestication is designated as *Black crystal* and symbolised by *Cr* (in the Russian system of gene symbols).

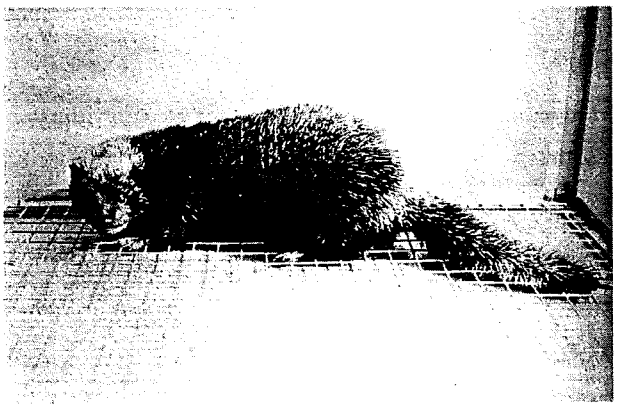


Fig. 1. Heterozygous *Black crystal* (*Cr*/+) mink appeared under selection for domestic behaviour, with white spotting on the ventral side, white guard hairs as a veil-like covering of the body and a higher density of white guard hairs, especially on the head ("white hat").

To elucidate the inheritance pattern of *Black crystal* the novel mutants were mated to *Standard* mink. The relevant data are given in Table 1. From the ratio of *Black crystal* to *Standard* in offspring, it was inferred that the *Black crystal* is determined by a single semidominant gene. The results from direct and reciprocal crosses allowed us exclude sex-linked inheritance. *Black crystal* x *Black crystal* produced litters with another colour colour variation resembling *Himalayan type* with pigmented tips of face, tail, and legs (Fig. 2). Individuals bearing resemblance to *Himalayan type* have a few pigmented guard hairs, their eyes are dark brown like those of *Standard* and *Black crystal* mink.

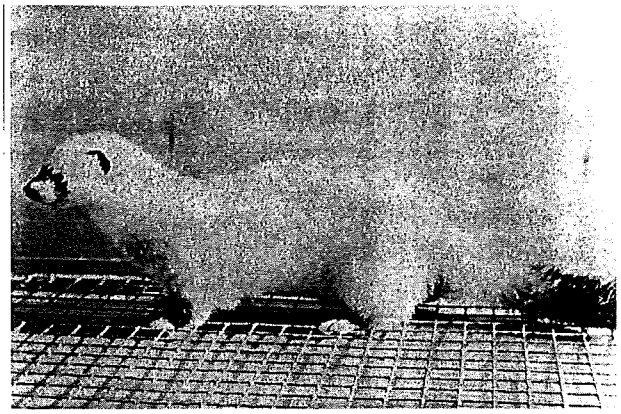


Fig. 2. Homozygous, *Himalayan type (Cr/Cr)* have pigmented tips of face, tail, ears and legs.

Test crosses of these individuals of *Himalayan type* demonstrated that they are homozygotes for the semidominant mutation *Black crystal* (Table 1).

Comparison of direct and reciprocal *Cr/Cr* x +/+ revealed that maternal homozygosity has a pleiotropic embryonic effect on neonatal viability of heterozygous offspring. Kits born from *Cr/Cr* dams all die by the age of 20 days. It may be suggested that the *Cr* mutation exerts a recessive effect on embryonic development.

A number of mutations in coat pattern similar to *Black crystal* are known. One such mutation is *Bluefrost* (*Hodgson, 1945*). A member of the *Black cross* multiple allelic series, the semidominant mutant *Royal silver* (*Hodgson, 1945*) is also similar when heterozygous and produces white spotting with single white guard hairs scattered over the body.

Unfortunately, in our collection we have only $S < S^k$ *(Evsikov, 1987)* $< S^h$ *(Nes, 1963)* mutations belonging to the members of the *Black cross* series. The *Black crystal* was subjected to allelic tests to reveal its relationship to this series. As the data of Table 2 show, test crosses demonstrated that *Black crystal* and *Black cross* are not alleles, being members of different linkage groups.

Table 1. Segregation ratios in different crosses with *Black crystal* mink

Crosses		Offspring		Genotypes				
Female	Male	Litters	Total number	Standard (+/+)	Black crystal (*Cr*/+)	Himalayan (*Cr*/*Cr*)	χ^2	P
Black crystal (*Cr*/+)	Standard (+/+)	82	354	168	186	0	0.92	0.25-0.5
Standard (+/+)	Black crystal (*Cr*/+)	114	514	247	267	0	0.78	0.25-0.5
Black crystal (*Cr*/+)	Black crystal (*Cr*/+)	49	210	48	119	43	3.92	0.1-0.25
Standard (+/+)	Himalayan (*Cr*/*Cr*)	70	297	0	297	0	-	-
Himalayan (*Cr*/*Cr*)	Standard (+/+)	15	18	0	18*	0	-	-

* Pups died soon after birth

Table 2. Results of allelic test between mutations *Cr* and *S*

Crosses		Offspring		Genotypes					
Female	Male	Litters	Total number	*S*/+ +/+	*S*/+ *Cr*/+	*Cr*/+ +/+	+/+ +/+	χ^2	P
S/+ +/+	*Cr*+ +/+	12	56	15	12	10	19	3.28	0.25-0.5
S/+ *Cr*/+	+/+ +/+	7	38	8	7	10	13	2.21	0.5-0.75
+/+ +/+	*S*/+ *Cr*/+	6	27	7	5	6	9	1.29	0.5-0.75

The variations in coat colour produced by *Black crystal* and *Bluefrost* are very similar; the "white hat" distinguished the (*Cr*/+) from the (*F*/+) mutation. I can propose that

there is only the possibility that the *Black crystal* mutation may be a member of the *Bluefrost* series. Unfortunately, there are no *Bluefrost* and *Stewart* mutations in the genetic collection in our experimental mink farm.

A novel coat colour - *Silvery*

In the domesticated population some white-spotted mink have unpigmented patches which cover the throat, chest, stomach, extremities of the limbs and often the tip of the tail; on the back single white guard hairs are common (Fig. 3).

Fig. 3. Heterozygous *Silvery* ($S^W/+$) mink with unpigmented patches which cover the throat, chest, stomach, extremities of the limbs.

Crossing these animals with eachother gives three phenotypes in the offspring: standard, extensive white spotting, and a new phenotype - "silvery" (Fig. 4). "Silvery" mink are characterised by very extensive depigmentation of the body, and a much weaker pigmentation on the sides of the body. Genetic analysis has shown that the "silvery" pattern is due to a homozygous manifestation of the semidominant mutation gene. White spotted animals are heterozygotes for this gene. As shown in Table 3 when the hetrozygous "silvery" and normal mink are crossed, half of the offspring are spotted and half normal. If, on the other hand, normal mink are crossed with homozygous "silvery" all the offspring are alike: they all have strong spotting (Fig. 3). The mutant gene which appeared in the course of domestication is designated as *Silvery* and symbolised by S^W (in the Russian system of gene symbols).

Fig. 4. Homozygous *Silvery* (S^W/S^W) mink are characterised by very extensive depigmentation of the body, and a much weaker pigmentation on the sides of the body.

The *Silvery* was subjected to an allelic test to reveal its relationship to the *Black cross* multiple allelic series. As Table 4 shows, crosses between homozygotes (S/S) x (S^W/S^W) yielded animals (S^W/S) which can be compared phenotypically closely to the heterozygous form of *Black cross* ($S/+$).

Table 3. Segregation ratios in crosses of *Silvery* with *Standard* mink

Crosses		Offspring		Genotypes				
Female	Male	Litters	Total number	Standard (+/+)	Spotted (S^W/+)	Silvery (S^W/S^W)	χ^2	P
Standard (+/+)	Spotted (S^W/+)	15	62	29	33	0	0.26	0.5-0.75
Spotted (S^W/+)	Spotted (S^W/+)	39	159	38	74	44	0.62	0.5-0.75
Standard (+/+)	Silvery (S^W/S^W)	8	40	0	40	0	-	-

Table 4. Results of allelic test between mutations S^W and *S*

Crosses		Offspring		Genotypes				
Female	Male	Litters	Total number	S^W/S	S^W/+	S/+	χ^2	P
Black cross homozygous (S/S)	Silvery (S^W/S^W)	8	38	38	0	0		
Standard (+/+)	(S^W/S)							
		38	180	0	87	93	0.2	0.5-0.75
S^W/S	Standard (+/+)							

Test cross (S^W/S) animals revealed that the *Silvery* (S^W) and *Black cross* (S) mutations are compounds being a member of the *Black cross* multiple allelic series:

$S^W < S < S^k$*(Evsikov; 1987)* $< S^h$*(Nes, 1963).*

The *Silvery* mutation is extremely similar phenotypically to the well known for us *Royal silvery* allele, and I can propose that there is a high probability that the *Silvery* mutation may be a real *Royal silvery* which appeared *de novo* in the course of our long-lasting experiment for domestication. Unfortunately, we have no *Royal silvery* mutations in the genetic collection on our experimental mink farms and it is impossible now to test this hypothesis.

The coat colour mutations *Silvery* and *Black crystal* obtained *de novo* during selection for tameness make it possible to create other new colour forms by combining them with each other and with certain other well-known mutations. The new coat-colour varieties attracted considerable attention among specialists at the Exhibition of National Economic Achievements and at the International Fur Auction held in St. Petersburg (Russia).

Literature cited

Belyaev, D.K. 1959. Genetic principles of mink breeding. Bull. Moskow. obchshestva ispitateley prirody. 3:103-116 (in Russian).

Belyaev, D.K. 1969. Domestication of animals. Science 1:47-52.

Belyaev, D.K., Khvostova, V.V. 1974. Domestication, Plant and Animal. In: Encyclopedia Britannica. Chicago a.o., USA: Helen Hemingway Benton 5:936-942.

Belyaev, D.K. 1979. Destabilizing selection as a factor in domestication. Journal of Heredity 70:301-308.

Belyaev, D.K., Trut, L.N. 1981. Accelerating evolution. Science in USSR 5:24-64.

Castle, W.E., Moor, L. 1946. Mutation in mink under domestication. Journal of Heredity 37:137-145.

Evsikov, V.I. 1987. Genetical and evolutionary aspects of the problem of mammalian fertility homeostasis (mink as a model). Genetika 6:988-1002 (in Russian).

Hodgson, R.G. 1945. The mink book. Fur Trade Journal of Canada, Toronto. 286 pp. Sec. ed.

Nes. N.N. 1963. An investigation of the relation of the *Heggedal* factor to the *Black cross* factor. Acta Agric. Scand. 13(b):359-370.

Nes, N.N., Einarson, E.J. Lohi, O., Jørgensen, G. 1988. Beautiful fur Animals - and Their Colour Genetics. Glostrup, Denmark: Scientifur.

Shackelford, R.M. 1941. Mutation in mink. Trans. Wis. Acad. Sci. Artni-Lett., 34:45.

Shackelford, R.M. 1948. The nature of coat color differences in mink and foxes. Genetics 33:311-336.

Trapezov, O.V. 1987. Selection-induced modification of defense reaction towards man in the American mink (*Mustela vison Schreber*). Genetika 6:1120-1127 (in Russian).

Trapezov, O.V. 1994. Selection for domestic behaviour induced the arisal of new colour phases in the mink. In: 28th Internat. Congr. of Internat. Soc. Appl. Ethology, Foulum, Denmark, August 3-6, pp. 172.

Trut, L.N. 1988. The variable rates of evolutionary transformations and their parallelism in terms of destabilizing selection. J. Anim. Breed. Genet. 105:81-90.

Interindividual and intercellular polymorphisms of Ag-NOR pattern in mink embryo siblings

G.K. Isakova

The variability of the silver-staining pattern of the nucleolus organising regions (Ag-NOR pattern) was studied in hepatocytes from 9 mink embryo siblings, including a pair of monochorionic (presumably monozygotic) co-twins. Both the number of Ag-NORs and the mean size of Ag-spots per cell were found to be identical in monochorionic twins. All other sibs had patterns different from each other and from co-twins. Intercellular variation of both the number and size of Ag-stained regions, as measured by the coefficient of variation, was similar only in monochorionic twins. The data indicate that both the interindividual and intercellular variations of the Ag-NOR pattern are highly heritable. The mechanisms underlying the Ag-NOR pattern polymorphisms are discussed. It is proposed that at least 2 independently inherited routes for the variable expression of the ribosomal gene system exist: 1) polymorphism for rDNA array; and 2) polymorphism for rRNA gene expression.

Genet Sel Evol 26, pp. 475-484, 1994. 2 figs., 4 tables, 35 refs. Author's summary.

The XY pair of mink (*Mustela vison*) during different periods of testicular activity

W. Koykul, P.K. Basrur

Synaptonemal complexes of the mink (*Mustela vison*) were examined during different stages of testicular activity to determine whether the distribution of prophase substages and the configuration of the sex complement are altered during prequiescent and regenerative phases compared to those detected during the breeding period. Spermatocytes obtained during prequiescence showed no differences from those of the breeding season in terms of substage distribution, whereas those from regenerating testes were mainly in zygotene and early pachytene substages, reflecting the high mitotic activity of spermatogonia and their subsequent transit to meiosis. Based on the location of kinetochores on the sex complement, the synapsed segments were identified as the short arm of the X (Xp) and the long arm of the Y (Yq), although pairing of the X and Y beyond the "pseudo-autosomal region" was frequently observed. In some spermatocytes, the entire Y chromosome synapsed with the X or split into two strands with only one strand "paired" with the X while the other remained unpaired. It is not clear at present whether the Y chromosome splitting is part of the mechanisms that prevent crossing over in the non-homologous segments of the sex complement that often undergo synapsis or a post-crossover phenomenon unrelated to pairing mechanisms.

Hereditas 122, pp. 169-176, 1995. 3 figs., 1 table, 31 refs. Authors' summary.

Karyological studies of the South American rodent *Myocastor coypus* Molina 1782 (Rodentia: Myocastoridae)

Susana Gonzalez, Nadir Brum-Zorrila

A cytogenetic study of "feral" and "cognac hybrid" phenotypes of Uruguayan *Myocastor coypus* rodent was performed with the purpose to investigate its evolution and systematics position. The karyotype 2n=42; FN=80 was integrated by biarmed chromosomes. The sexual X chromosome was a metacentric one and the Y was a small acrocentric. Mitotic chromosomes using G, C and Alu I endonuclease banding were analysed. The NOR localisations and meiotic chromosomes were examined. The comparison between "feral" and "cognac hybrid" individual showed no notorious differences. For testing the chromosome variability between our results and published data of specimens from introduced populations, a karyological comparative analysis was per-

formed. The difference obtained may be interpreted as subspecific variations or as a chromosomal evolution process.

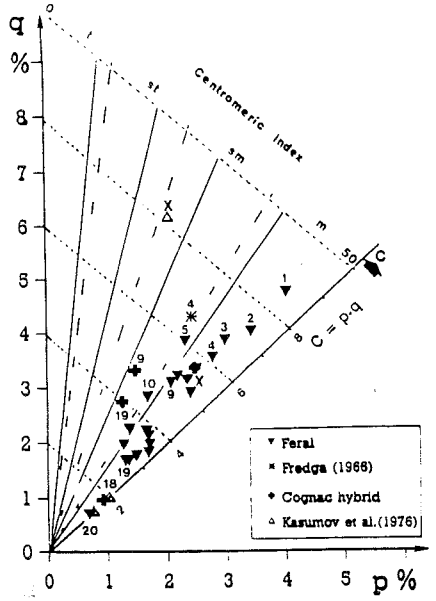


Fig. 2. Karyoidiogram. The nutria feral chromosome set (haploid female) is shown. Differences found among "cognac hybrid" phenotype (5, 9, 19 and 20), element 4, (Fredga 1966) and X, 18 and 19 chromosomes (Kasumove et al., 1976) are indicated.

Revista Chilena de Historia Natural 68 (2), pp. 215-226, 1995. 1 table, 7 figs., 30 refs. Authors' abstract.

Occurrence of constitutive heterochromatin in the karyotype of the coypu (*Myocastor coypus*)

Aldona Pienkowska, Marek Switonski, Jacek Rzepny

The studies were carried out to extend our knowledge on the karyotype of the coypu (*Myocastor coypus*) with reference to the occurrence of constitutive heterochromatin. An analysis covered 30 individuals. Conventional Giemsa staining and C-banding were performed. All individuals had a normal diploid chromosome number (2n=42). The obtained results showed a highly specific C-banding pattern for this species distinguishing it from other comparable rodents. These studies have made it possible to arrange chromosomes in four groups separated on the basis of the banding pattern specificity associated with the occurrence of centromeric and/or telomeric heterochromatin. The X chromosome has a centromeric band and a less stainable interstitial band on the p-arm. The subtelocentric Y chromosome was found to have three bands: one covering the short arms (p) and two on the long arms (q). Besides that, the C-banded polymorphism in this species, consisting in size differences of telomeric C-bands, is suggested.

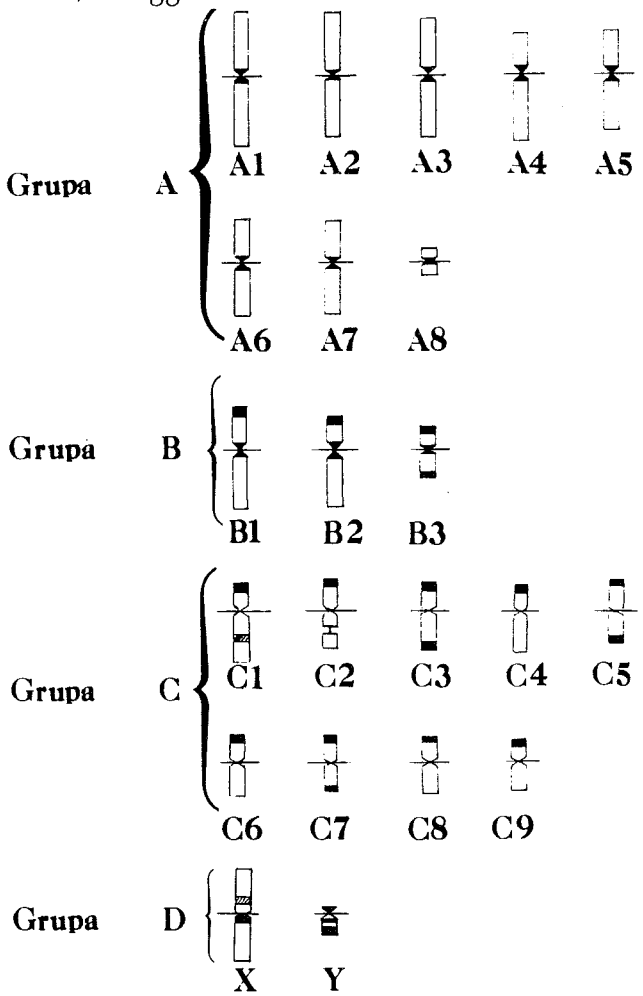


Fig. 4. An idiogram presenting distribution of constitutive heterochromatin in coypu karyotype. The C2 chromosome has a marked place of the nucleolar organising region.

Genet. Pol. 35 (3), pp. 205-210, 1994. 4 figs., 13 refs. Authors' abstract.

Failure of loop diuretics to induce nursing sickness in mink at weaning

Otto Hansen, Søren Wamberg, Tove N. Clausen

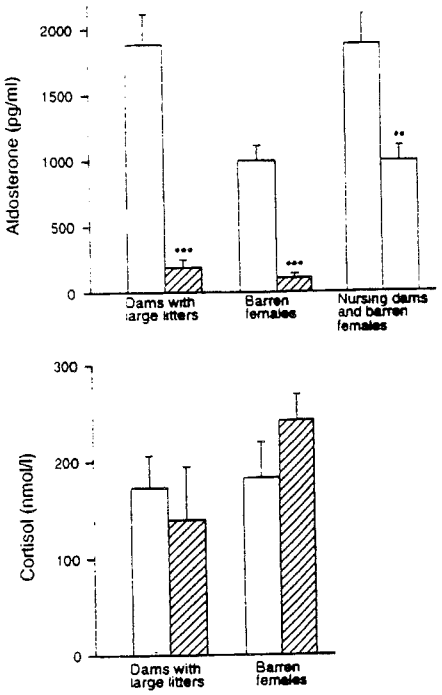


Fig. 3. Plasma aldosterone and plasma cortisol in nursing mink (n=9) and in barren females (n=4) 4 h after last injection of furosemide compared with nursing (n=5) and barren (n=5) controls. Hatched columns (groups 1 and 3) are the untreated controls and blank columns (groups 2 and 4) are the furosimide-treated individuals. Bars indicate SEM. Asterisk indicates values in furosemide treated females significantly different from untreated controls or furosemide treated dams significantly different from furosemide treated barren females.

Nursing sickness in mink is thought to be precipitated by inadequate salt intake, whether this is due to inadequate salt levels in the diet or inadequate total dietary intake. To test this hypothesis, lactating females raising large litters were given 2 daily intramuscular injections of the loop diuretic furosemide (Lasix, 4 + 4 mg/kg/day) for 2.5 d during the normal weaning period 6 wk after parturition or served as untreated controls. Following the same protocol, barren mink (i.e. unsuccessfully mated females) were treated similarly. Dams were carefully inspected for clinical signs of nursing sickness during and after the treatment. Urinary osmolality and concentrations of sodium, potassium, chloride, creatinine and carbamide (urea) were measured prior to treatment (day 1) and on day 3, immediately before and 4 h after the final diuretic treatment. Plasma concentrations of aldosterone and cortisol were determined by radioimmunassay 4 h after the last injection with furosemide on day 3. Biochemical changes in urine (a low osmolality, low concentrations of carbamide and creatinine, and extremely low sodium concentrations) and in plasma (aldosteronism) similar to those found in nursing sickness were elicited in the nursing dams. Nevertheless, none of the dams developed overt clinical signs of nursing sickness. It is concluded that the biochemical signs of volume and salt depletion associated with nursing sickness are sequelae rather than etiological factors of this disorder.

Can J Vet Res 60, pp. 277-280. 1996. 1 table, 3 figs., 7 refs. Authors' abstract.

Incidence of nursing sickness and biochemical observations in lactating mink with and without dietary salt supplementation

Tove N. Clausen, Søren Wamberg, Otto Hansen

The impact of dietary sodium on the incidence of nursing sickness in mink dams and on the average litter biomass of 28 and 42 day old kits was studied. One group (n=115 including 12 barren females) was given a standard feed mixture with a natural content of 0.53 g NaCl/MJ and another group (n=115 including 8 barren females) was

given the same feed mixture supplemented with NaCl to a final content of 1.00 g/MJ.

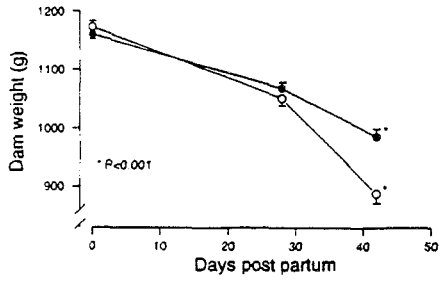


Fig. 1. Live weight changes in nursing mink during the six-week lactation period. Closed symbols denote dams given a salt supplemented diet (group 2; n=107) and open symbols dams given a non supplemented diet (group 1; n=103). Bars denote SEM.

The average dam weight at weaning was significantly lower (P<0.001) and the incidence of nursing sickness during the last part of the lactation period 3 times higher in the nonsupplemented group. The average litter biomass at weaning did not differ between the 2 experimental groups. A number of biochemical markers of preclinical nursing sickness, e.g. plasma aldosterone and osmolality, Na^+ and Cl^- concentrations in plasma and urine, were studied during the last part of the lactation period and at weaning in 20 dams of the nonsupplemented group, in 10 dams of the salt supplemented group and, for comparison, in 5 + 5 barren females on the day corresponding to day 34 after parturition in nursing mink. The nonsupplemented group had significantly lower concentrations of sodium and chloride in plasma and urine and a significantly higher concentration of plasma aldosterone as compared to the salt supplemented group. Distinct signs of relative salt deficiency and preclinical nursing sickness thus characterised the nonsupplemented group throughout this period, while more blurred hints of electrolyte imbalances were noticed in the sodium chloride supplemented group at weaning. A beneficial effect of salt supplementation on the incidence of nursing sickness was shown; however, it remains unclear whether salt deficiency can cause nursing sickness or whether salt acts as an appetite stimulant preventing inanition and the development of the disorder.

Can J Vet Res 60, pp. 271-276, 1996. 5 tables, 5 figs., 11 refs. Authors's abstract.

Development of immortalized endometrial epithelial and stromal cell lines from the mink (*Mustela vison*) uterus and their effects on the survival in vitro of mink blastocysts in obligate diapause

Geneviéve M. Moreau, Ali Arslan, Deborah A. Douglas, Jianhua Song, Lawrence C. Smith, Bruce D. Murphy

Mink endometrial cell lines were established by stable transfection of a plasmid vector encoding the SV40 large T antigen driven by the human β-actin promotor. A second plasmid vector, pSV2neo was employed for selection of transfected cells. Specificity and homogeneity of consequent cell lines were evaluated by immunocytochemistry employing antibodies against cytokeratin, desmin, and vimentin. Cytokeratin was found exclusively in epithelial cells, whereas vimentin appeared primarily in stromal cells. Neither cell line showed detectable desmin activity. These cell lines along with Buffalo rat liver (BRL) cells were employed in coculture with mink embryos in obligate diapause. Mink stromal and BRL cell lines were most effective in enhancing embryo survival in vitro.

The percentages of cocultured embryos that survived for 72 h or more were 65% with

epithelial cells, 75% with stromal cells, 68% with the combination of stromal and epithelial cells, and 93% with BRL cells. Only 23% of the embryos cultured without cells survived beyond 48 h. Embryo growth was also observed; some embryos in coculture showed trophoblastic outgrowth and adhesion to the cell surfaces.

These results demonstrate that mink embryos in obligate delay can survive and develop in culture and that coculture with uterine or BRL cells increases the length and frequency of survival.

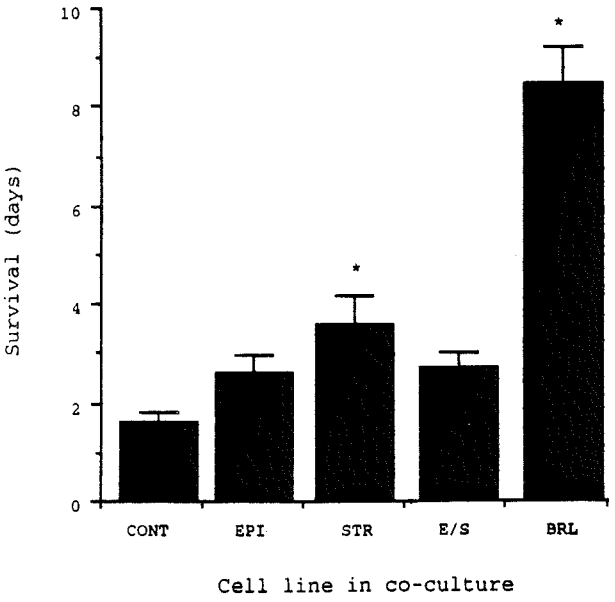


Fig. 4. Mean (±SEM) survival, in days, of mink embryos collected in obligate diapause and placed in coculture with endometrial or hepatic cells. Epithelial cells (EPI, n=20 embryos), stromal cells (STR, n=20), epithelial and stromal cells (E/S, n=19), hepatic cell line (BRL, n=30), and control (CONT, n=30). *Significantly different from the control at $p<0.05$.

Biology of Reproduction 53, pp. 511-518, 1995. 5 figs., 46 refs. Authors' abstract.

Embryonic diapause in vertebrates

Rodney A. Mead

Embryonic diapause occurs in many species of vertebrates, but the physiological mechanisms which control this fascinating process are exceedingly different in the diverse groups which employ this reproductive strategy.

In non-mammalian species and some bats, reduction in rate of embryonic development is temperature dependent, but this is not the case in most mammals. Development becomes arrested at the blastocyst stage of embryogenesis in mammals which exhibit delayed implantation, whereas postimplantation development is continuous but retarded in species exhibiting delayed development. The hormonal control of diapause is remarkably different in the various species.

Pituitary secretion of prolactin prevents implantation in the tammar wallaby but hastens renewed development and implantation in the mink and spotted skunk. Ovariectomy results in the eventual death of blastocysts in mustelids but induces renewed development and implantation in the armadillo. Luteal function, as evidenced by elevated progesterone secretion, is essentially constant in the roe deer and armadillo, whereas the luteal cells fail to complete their differentiation and secrete low levels of progesterone in carnivores.

Progesterone will induce implantation in the tammar wallaby, but estrogen is required to induce renewed development and implantation in rodents. Neither progesterone and/or estrogens appear to be capable of stimulating implantation in carnivores. The uterus plays an important role in maintaining the embryos in a viable state throughout the period of diapause. In many

species the uterus undergoes histological changes and secretes increased amounts of protein, yet we still do not understand the role, if any, these proteins play in initiating renewed embryonic development. Thus the phenomenon of embryonic diapause still holds many mysteries for scientists to solve.

The Journal of Experimental Zoology 266, pp. 629-641, 1993. Review, 185 refs. Author's abstract.

Changes in uterine estrogen and progesterone receptors during delayed implantation and early implantation in the spotted skunk

Rodney A. Mead, Victor P. Eroschenko

Although the exact cause(s) of embryonic diapause in the western spotted skunk and other carnivores remains unknown, it has been hypothesised that it may be due to levels of ovarian hormone secretion that are insufficient to promote a uterine environment conducive to continuous embryonic development and implantation. Immunocytochemistry was used to determine whether changes in abundance or distribution of estrogen receptors (ER) and progesterone receptors (PR) may be associated with the cessation or renewal of embryonic development. Thirty pregnant skunks were killed during delayed implantation and periimplantation periods. ER and PR were detected in luminal and glandular epithelium, endometrial stroma, vasculature, and myometrium of the uterus during the period of delayed implantation. There was a significant reduction of both ER and PR receptors during the periimplantation period. The most pronounced change was the complete loss or reduction in staining intensity for PR and ER in the luminal epithelium during the first 2-3 days after implantation. These findings suggest that the failure of skunk blastocysts to undergo continuous development and implant without a prolonged period of diapause is not the result of an insufficient number of ER or PR in the uterus. The data also indicate that renewed embryonic development and implantation is not associated with an increase in these uterine steroid receptors.

Biology of Reproduction 53, pp. 827-833, 1995. 1 table, 2 figs., 23 refs. Authors' summary.

Ultrasonographic analysis of gestation in mink (*Mustela vison*)

J.H. Song, P.D. Carriére, R. Léveillé, D.A. Douglas, B.D. Murphy

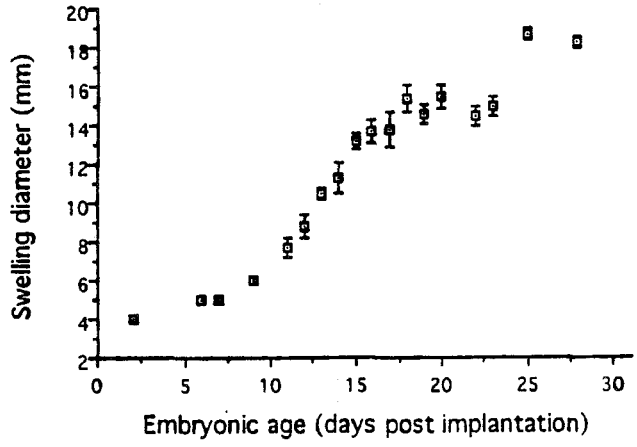


Fig. 2. Mean (±SEM) changes in uterine swelling diameter during post implantation pregnancy in ranch mink. Data were collected from a single ultrasonographic scan of 55 mink. Post implantation age was calculated based on interval of 31 d from implantation to whelping (7,9,12).

Mink are seasonal breeders that display an obligate delay preceding implantation and a post implantation gestation of 31 d. The purpose of this study was to evaluate gestational parameters in mink by ultrasonography. A total of 92 female mink were mated twice during the period from March 2 to 20. The mink were scanned once and

allowed to whelp (n=55); or scanned at 3 to 5-day intervals until parturition (n=13); or immediately subjected to autopsy (n= 24) after scanning. Embryonic age was calculated from the date of parturition or from crown rump length. Uterine swelling diameter and fetal head size were correlated with embryonic age. The gestational sac grew rapidly once implantation had occurred. Uterine swellings of 4 to 5 mm in diameter were found on Days 2 to 4 post implantation and increased through Days 18 to 20, at which time they began to elongate due to the longitudinal growth of the fetus. Fetal cardiac activity could be detected on Days 10 to 12 post implantation in live embryos. The heart frequency was 198 ± 3.0 beats per minute and did not vary from Days 12 to 30 post implantation. Fetal head diameter of 5 mm was first detected on Day 19 post implantation and grew gradually to 9 to 10 mm at parturition. It was not possible to accurately assess the number of conceptuses in utero. We conclude that ultrasonography can be employed in mink to diagnose pregnancy, to predict the parturition date and to determine the presence of live fetuses.

Theriogenology 43, pp. 585-594, 1995. 5 figs., 19 refs. Authors' abstract.

Patterns of melatonin secretion during sexual maturation in female ferrets

Kathleen D. Ryan, Etta A. Volk

These studies were an examination of the changes in function of the pineal gland and its secretory product, melatonin, during sexual maturation induced by stimulatory photoperiod in ferrets. Plasma melatonin patterns were determined for 48-h intervals in ferrets undergoing photoperiod-sti-mulated sexual maturation. Sampling regimens were conducted when ferrets were 10, 15, 16, and 23 wk of age. Clear daily rhythms in melatonin concentrations were apparent in ferrets as young as 10 wk of age. Melatonin secretion increased with the onset of darkness each day and fell with lights-on the next morning. When the photoperiod was changed from a short day (8L:16D) to a long day (16D:8D) at 15 wk of age, the melatonin rise did not contract immediately to the shorter dark phase for at least the first two nights. By 1 wk after imposition of the new, long-day photoperiod, however, the pattern of melatonin concentrations in plasma was synchronized to the new photoperiod. These studies show that ferrets can detect photoperiod at a much younger age than that at which they can respond to long days with accelerated maturation and further, that while the pineal gland mediates the photoperiod-induced maturation of ferrets, other factors are involved in the 5-6 wk interval between the onset of long days and the maturational response of the hypothalamo-hypophyseal-gonadal axis in this species.

Biology of Reproduction 53, pp. 1251-1258, 1995. 5 figs., 36 refs. Authors' abstract.

Expression of epidermal growth factor receptor in the preimplantation uterus and blastocyst of the western spotted skunk

B.C. Paria, S.K. Das, R.A. Mead, S.K. Dey

The western spotted skunk is unique in that its blastocysts undergo a 180-220-day period of arrested development before implantation. We investigated the potential role of epidermal growth factor (EGF)-related growth factors in regulating uterine and embryonic development in this species by studying the status of EGF receptor (EGF-R) in these tissues during delayed implantation and resumption of embryonic development. The cell-specific distribution of EFG binding sites and the expression of EGF-R mRNA were assayed by autoradiography and Northern blot analysis, respectively. The size of EGF-R was determined by affinity cross-linking studies, and its bioactivity was examined by determining EFG-dependent subcellular protein tyrosine kinase (PTK)

activity. EGF binding sites were localised in the uterine luminal and glandular epithelium, endometrial stroma, myometrium, and blood vessels during both stages of pregnancy.

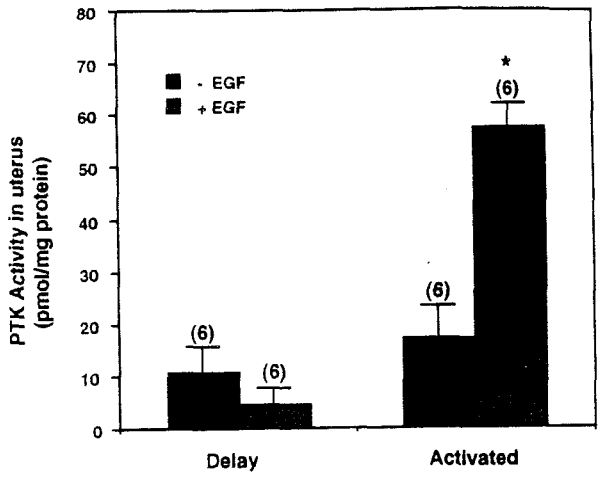


Fig. 6. EGF-dependent protein kinase activity, as indicated by the ability to phosporylate an exogenous substrate, was present in supernatants of skunk uterine homogenates obtained during the periimplantation period but not during delayed implantation. Sample sizes are indicated by the numbers above each bar. Means that are significantly different are indicated by asterisk.

As examined by Northern blot hybridisation, a cRNA probe specific to mouse EGF-R hybridised to poly(A)$^+$ RNA of skunk uteri. Transcripts similar to those of mouse uterine EGF-R were identified. [^{125}I]-EGF was cross-linked to a 170-kDa protein both in the uterus and in blastocysts collect-ed during the delayed implantation and periimplantation periods. However, EGF-induced PTK activity was significantly elevated above background levels during the period of renewed embryonic development, but not during arrested embryonic development. The results suggest that EGF-related growth factors may play an important role in regulating embryonic development in this species and that a change in the num-ber and/or functional status of the EGF-R may be a prerequisite for blastocyst activa-tion and implantation in the spotted skunk.

Biology of Reproduction 51, pp. 205-213, 1994. 7 figs., 60 refs. Authors' summary.

Polyploid mitoses in mink trophoblast cells

E.V. Zybina, T.G. Zybina, G.K. Isakova, I.I. Kiknadze

Mitotic figures in mink placental trophoblasts have been observed under the light microscope using sections and air-dried preparations. The tetra- and octapoloid metaphase chromosome spreads were found on Giemsa-stained air-dried preparations. A high percentage (up to 80%) of abnormal metaphases, including k-mitoses as well as a portion of restitutional anaphases, was revealed on sections of the placental trophoblast suggesting a possible block of mitosis at the meta- and anaphase. Therefore, it is very likely that genome multiplication in a portion of placental trophoblast cells in mink involves block of mitoses at meta- and anaphase followed by restitution.

The chromosomal arrangement on metaphase spreads in parts of the cells showed a degree of separation of the whole di- and tetraploid chromosome sets within tetraploid and octaploid chromosome plates. Several spreads exhibited some allocycly of diploid chromosome sets inside the polyploid metaphases. It is not inconceivable that such an arrangement may reflect some autonomy of low-ploid chromosome sets within the polyploid trophoblast cells in mink.

Tsitologiya 36, 8, pp. 869-873, 1994. In RUSS, Su. ENGL. 14 refs. Authors' summary.

Electroejaculation and seminal characteristics in chinchilla (*Chinchilla laniger*)

V.H. Barnabe, M. Duarte, R.C. Barnabe, J.A. Visintin, M.T.L. de Freitas

Semen collection in chinchilla was attained through electroejaculation with an electrode inserted 3 cm deep in the rectum, utilising a series of 9 shocks of 12.5 mA, 6 shocks of 25.0 mA and 19 shocks of 50.0 mA. Material obtained was considered of good quality, both for freezing and thawing.

Braz.J. vet. Res. anim.SCi., Sao Paulo, Vol. 31, no. 3/4, pp. 295-297, 1994. 1 table, 7 refs. Authors' summary.

Effects of Zearalenone and/or Tamoxifen on swine and mink reproduction

H.-H. Yang, R.J. Aulerich, W. Helferich, B. Yamini, K.C. Chou, E.R. Miller, S.J. Bursian

Tamoxifen (TAM), which binds to estrogen receptors and can act as an estrogen antagonist, was incorporated into the diets of swine and mink to determine if it would ameliorate the effects of the estrogenic mytocoxin zearalenone (ZEN). Sows and female mink were fed diets containing 2 ppm (swine) or 20 ppm (mink) ZEN and/or 10 ppm TAM from day 30 of gestation through weaning (swine) or from 2 months prior to breeding through weaning (mink). The diets containing ZEN and/or TAM did not adversely affect reproduction in the sows. Although some hyperestrogenic effects on testes, uterine and ovarian weights were observed in the F_1 piglets at 21 days of age, subsequent breeding performance was not affected. All the female mink exposed to ZEN mated, but only 25% whelped. No mink fed TAM (singly or in combination with ZEN) mated. Necropsy of these unmated females fed TAM revealed consistent severe pyometra. Histological examination of the reproductive tracts of the ZEN, TAM and ZEN + TAM-treated mink showed similar alterations, including ovarian follicular atrophy and degeneration, and mild to severe uterine atrophy, pyometra and endometritis. The results of these studies indicate that TAM was not effective in ameliorating the hyperestrogenic effects of ZEN in swine and mink, but rather it acted as an estrogen agonist.

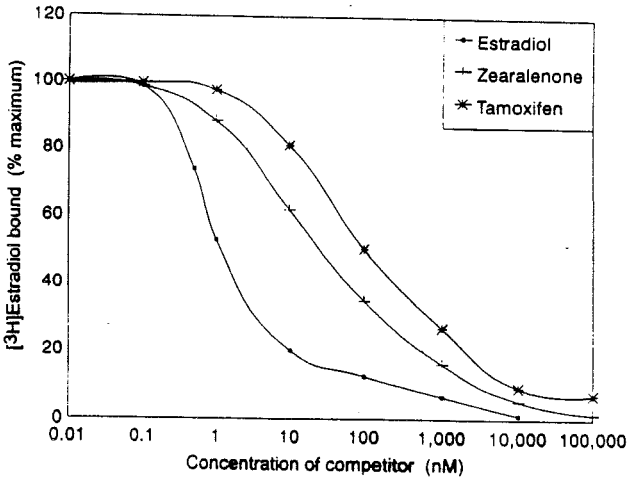


Fig. 1. Competition of estradiol, zearalenone and tamoxifen with [^{3}H]estradiol (1 nM) at the receptor binding sites of the porcine uterus.

Journal of Applied Toxicology, Vol. 15(3), pp. 223-232, 1995. 5 tables, 1 fig., 42 refs. Authors' summary.

The nursing period of the mink

Christian Friis Børsting (red.)

Make the nursing period succeed

The nursing period is essential for a profitable production of healthy mink - but many factors are involved in making the period a success.

For a long time the nursing period has been in focus in mink production, as it is widely agreed that the basis for an efficient mink production without health disturbances is the weaning of big and healthy mink kits. As a rule, such kits will develop into large mink at pelting, and they will more easily

avoid diarrhoea and other health problems during the rest of the year.

A large number of factors are, however, of importance to the development of the nursing period for the females as well as for the kits. The research of recent years with fur animals in Foulum as well as at the Royal Veterinary and Agricultural University and at the Research and Advisory Units of the Danish Fur Breeders Association has tried to clarify some of these factors. Many of these results will be presented at the meeting on the nursing period of the mink to be held on Thursday 18 April at Foulum.

At the meeting results will be presented within the following three main areas: Breeding for better mothering properties, nutritional and physiological conditions in the nursing period and health and management conditions.

The mothering properties of the mink female
Within the area of breeding, research has shown that the mothering properties of the mink, i.e. her ability to produce milk and take care of her kits, have medium heritability (0.2-0.3). It would therefore be possible to select for this property in practice. A higher milk production does, however, present larger demands on the females and increase the risk of high weight losses of these females. Therefore the correlation to this property has also been examined. With the use of DNA-technology it has, furthermore, been possible to isolate the genes for the prolactin and growth hormones which are of importance to milk production and to growth. Through characterization of the individual animal by means of these techniques, it will be possible to breed for animals with a higher growth and milk production potential.

Nutrition and physiology of nursing females
Large litters with fast growing kits make heavy demands on the nutrient metabolism of the female. As the milk contains large amounts of lactose in relation to the low amount of carbohydrates in mink feed, nursing mink females have an increased requirement for glucose metabolism. In experiments with mink females with permanent catheters for repeated blood sampling we found that the total glucose requirement of the mink female is approx. 4 times as high as the amount absorbed from the feed. Therefore the mink herself has to synthesize the remaining amount primarily from amino acids. The energy requirement of the mink during the nursing period has, furthermore, been examined by measuring the heat production of the mink females. When the kits are weaned, their digestion of the feed is still not completely developed. A number of experiments have shown that the lower digestibility in newly weaned kits is caused by the fact that the secretion of digestive enzymes is still insufficient. The content of salt and water in the feed in the nursing period has proved to be essential to the growth and well-being of the females as well as of the kits. If the salt content is too low, the risk increases that the females will develop nursing disease. Addition of extra water to the feed at the end of the nursing period increases the kits' appetite and their growth.

Health and management in the nursing period
It has been examined whether mink females will move so much feed to the kits that feeding on the nest box can be avoided. This would decrease the risk of messing up the nest box. Even though the females moved more feed when no feed was given on the nest box, the growth of the kits in the latter part of the nursing period was still lower with this feeding method, and it can therefore not be recommended.

There will be two presentations for elucidation of the problem with greasy mink kits. The first speaker will show the results from Foulum in 1995 when we divided the greasy litters into three groups depending on the degree of greasiness of the kits before treatment with antibiotics. In general, the greasy litters did not get any more greasy

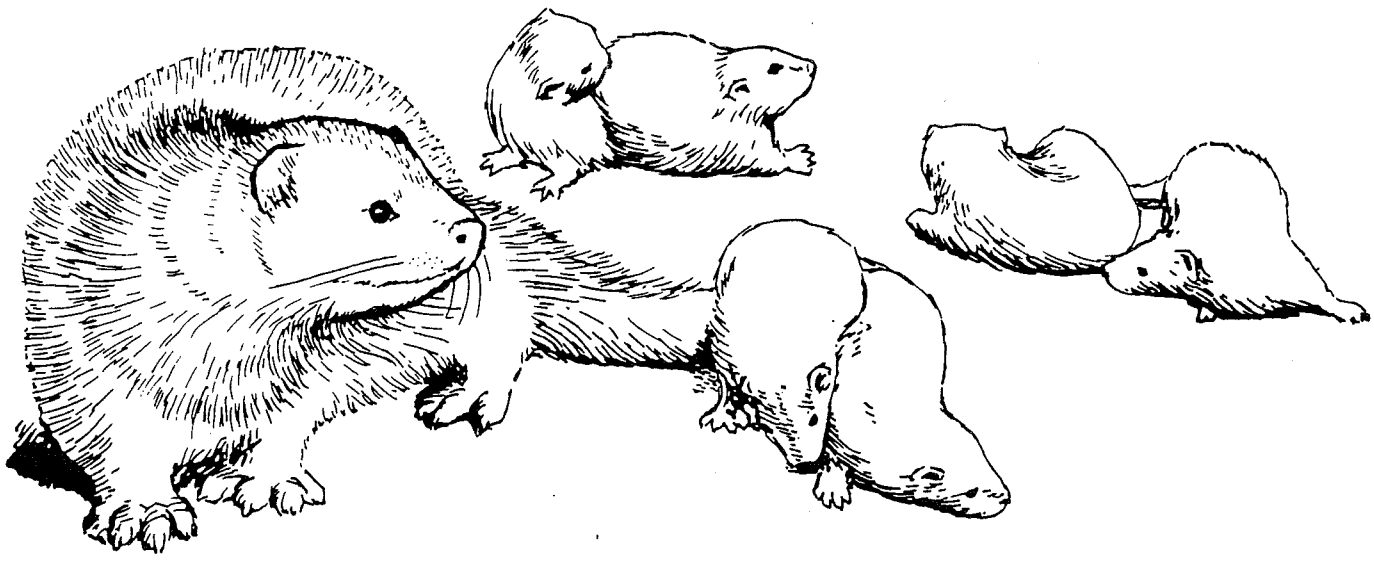
after treatment was started. The litters with the two mildest degrees got well much more quickly than the litters with the severest attacks. The other presentation will give a survey of the preliminary results of the project on greasy kits financed by the fur animal industry. Even though there is hardly any one solution to this multifactorial problem, these presentations will each contribute to the clarification of the many factors increasing the risk of considerable losses in connection with greasy kits.

We hope that the meeting will provide some answers to part of the questions which breeders, feed producers and advisers have regarding this period which is so crucial to mink production. At the same time the meeting will give a status over the many ongoing activities which may be an inspiration to the future work in the practical production as well as within this part of fur animal research.

The summary is based on the following reports:

The mothering properties, pp. 7-22
Nutrition and physiology, pp. 23-40
Health and management, pp. 41-63.

Internal report No. 69, 1996, 63 pp. Research Centre Foulum, April 18, 1996.



Original Report

Reproduction performance and kit growth in mink fed diets containing copper-treated eggs

D.C. Powell, S.J. Bursian, C.R. Bush, A.C. Napolitano, R.J. Aulerich

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East Lansing, MI 48824, USA

Summary

Female mink (*Mustela vison*) were fed conventional diets containing 20% copper (Cu)-treated m (0, 500, or 1000 ppm) raw eggs prior to and during breeding, gestation, lactation, and early kit growth. Microbial analysis was conducted on the Cu-containing eggs to assess the effectiveness of Cu as an anti-microbial agent in non-refrigerated eggs. The results of this study indicate that Cu at a concentration of 1000 ppm is an effective agent for minimising bacterial and fungal growth in eggs for up to one week at room temperatures (50-79°F) and that feeding mink conventional diets containing 20% of a Cu-treated (1000 ppm) raw eggs had no adverse effects on female mink reproductive performance or kit growth and survival.

This research was supported by the Mink Farmers Research Foundation, Corvallis, OR.

Introduction

Conventional mink diets generally contain fresh animal products and by-products. These products are often obtained in large quantities by fur farmers and may have to be stored for several days prior to incorporation in the mink diet. Some means of controlling spoilage is usually necessary since these raw animal products can provide an ideal environment for microbial growth. Refrigeration is typically used, but can be costly in terms of equipment and labour. Alternative methods for minimising microbial growth could be more economical for the fur farmer. Many chemicals have antimicrobial properties, but to be of value for preserving animal products and by-products for feeding mink, they must be inexpensive, palatable, non-toxic, and should not decrease the nutritive value of the feed. The use of acids and fermentation for preserving animal products and by-products has received some attention and studies have been conducted by the Dept. of Farm Management and Services feeding mink raw, fermented fish and poultry by-products (*Urlings et al., 1993*), and sulfuric acid-preserved fish silage (*Poulsen and Jorgensen, 1986a,b*). However, growth depression has been observed in both mink (*Urlings et al., 1993*) and growing-finishing pigs fed acid-

preserved poultry offal (*Van Lunen et al., 1991*). The growth inhibition in mink feed acid-preserved poul-try was attributed to a breakdown of amino acids and the acidic pH of the diets (*Urlings et al., 1993*). Acids (sulfuric or phosphoric) added to fresh, raw eggs at up to four per-cent have been used by mink farmers to suppress bacterial growth for several days. However, these acids, at concentrations ne-cessary to ensure low bacterial growth, react with the albumin in the eggs causing the eggs to solidify resulting in handling and mixing problems.

Copper (Cu) in the form of Cu sulfate and Cu hydroxide has been widely used as a fungicide and bactericide for the control of plant diseases (*Jay, 1986*). Dietary Cu sulfate has also been shown to reduce the number of ureolytic bacteria in swine large intestines (*Varel et al., 1987*). This inhibitory effect of Cu on bacteria in the digestive track is one explanation for the beneficial effects on body weight gain in animals fed diets containing Cu in excess of the animals' requirements. Increases in growth rate have been observed in swine (*Hawbaker et al., 1961; Braude, 1965; Castell and Bowland, 1968; Drouliscos et al., 1970*), poultry (*King, 1972*), rabbits (*King, 1975*), and mink (*Aulerich and Ringer, 1976; Aulerich et al., 1982; Bush et al., 1995*). Supplemental dietary Cu has also been reported to darken the colour of fur of natural dark mink (*Aulerich et al., 1982; Bush et al., 1995*).

The objectives of this study were to investigate the effectiveness of Cu as a short-term preservative for raw eggs and determine whether the addition of Cu to raw eggs has an effect on the reproductive performance of mink. Cu-treated eggs (held at room temperature for up to a week) were incorporated into mink diets at 20% of the diet and fed to mink from prior to the breeding season through the early kit growth period. The reproductive performance of the adult female mink and growth and survival of their kits were determined and compared to the results from mink fed 20% fresh untreated eggs added daily to the diet.

Preliminary microbial analysis and feed consumption trial

Material and methods

A preliminary trial was conducted to check the efficacy of Cu, in the form of Cu sulfate ($CuSO_4 \bullet 5H_2O$; J.T. Baker, Phillipsburg, NJ 08865), as a bactericide for eggs and to determine the palatability of mink diets containing Cu-treated eggs. Three levels of Cu were incorporated into fresh, raw eggs; 0, 250, and 500 ppm Cu/kg eggs (ppm) or 0, 50, and 100 mg Cu/kg diet, respectively.

The eggs were cracked out into plastic containers and stirred with Cu sulfate (Day 0). These egg mixtures were kept at room temperature (≈50-60°F) and stirred continuously for seven days. Samples were collected daily for microbial analysis. Mink (four/treatment group) were fed a diet containing 20% of the experimental egg mixtures to determine feed consumption over the seven-day period. The group of mink fed the 0 ppm Cu diet received fresh eggs which were cracked out daily. The other two groups of mink were fed diets containing 250 or 500 ppm Cu-treated eggs (also used for the microbial analysis) which were held at room temperature for up to seven days.

Results

Eggs containing 500 ppm Cu had consistently fewer bacteria colony forming units (CFU) than eggs containing 250 ppm Cu and eggs containing no Cu (Fig. 1). The addition of eggs containing 250 or 500 ppm Cu and held at room temperature for up to seven days prior to incorporation into the mink diets did not adversely affect mink feed consumption (Fig. 2).

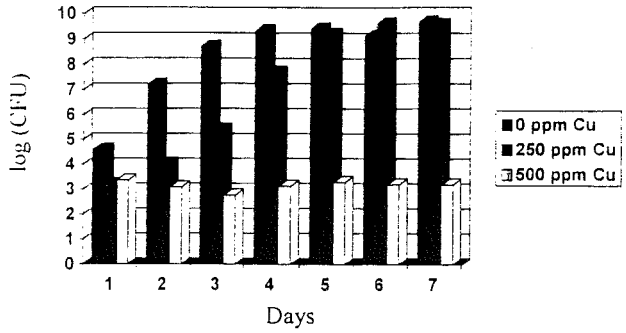


Fig. 1. Bacterial colony forming units (CFU) in eggs treated with 0, 250, or 500 ppm Cu and held at room temperature for seven days.

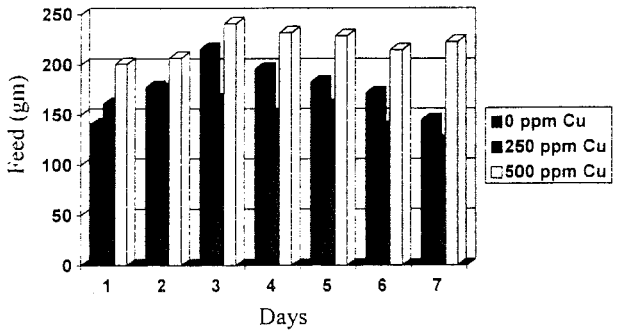


Fig. 2. Feed consumption by mink fed diets containing 20% eggs treated with 0, 250, or 500 ppm Cu. Eggs for the 0 ppm Cu group were cracked out fresh daily. Eggs from the 250 and 500 ppm Cu groups were cracked out on day 0 and held at room temperature for up to a week.

Reproduction feeding trial and microbial analysis

Materials and methods

Animals

Thirty-six pastel female mink (*Mustela vison*) were randomly divided into a control and two Cu treatment groups (12 mink per group). They were housed individually outdoors in wire mesh mink breeder cages (76 cm L x 61 cm W x 46 cm H) at the Michigan State University (MSU) Experimental Fur Farm beginning on February 12, 1996. A wooden nest box (38 cm L x 28 cm W x 27 cm H) was attached to the outside of each cage and bedded with excelsior ("wood wool"). Food and water were provided *ad libitum*. Adult females were weighed biweekly until mated, at whelping, and when their kits were three and six-weeks old.

The females were mated to untreated males between March 4 and 22, 1996. Each female was given an opportunity to mate every fourth day until a successful mating was obtained. All matings were verified by the presence of "normal" appearing, motile, spermatozoa in vaginal aspirations collected immediately after mating. As is a common commercial mink breeding practice, mated females were given an opportunity for additional matings (with different males) the day following the initial mating and/or on the eighth and/or ninth days after the first successful mating.

Nest boxes were checked daily for kits during the whelping period. The gender of the kits was determined at birth, and live and stillborn young were counted. Body weights of live kits were recorded at birth and at three and six weeks of age.

At the termination of the trial, three male and three female kits (7-8 weeks of age) from each group were anaesthetised (ketamine HCl) and a 5 ml blood sample was collected via cardiac puncture. Serum was analysed for Cu, calcium (Ca), chromium (Cr), boron (B), magnesium (Mg), iron (Fe), phosphorus (P), zinc (Zn), sodium (Na), and potassium (K). Serum element concen-trations were determined by inductively coupled plasma-atomic emission spectro-scopy (Jarrel-Ash, model 955, Plasma Autocomp. Direct Reading Spectrometer, Applied Chemical Corp., Waltham, Massachusetss 02154) as described by Braselton et al. (1981). Blood analyses were conducted by the Animal Health Diagnostic Laboratory (AHDL) at MSU.

Egg and diet preparation
There were three levels of Cu in the eggs: 0 ppm (control), 500 ppm, and 1000 ppm. These Cu levels were chosen based on their effectiveness in inhibiting bacterial and fungal growth during pilot microbial plate studies and on the results of the preliminary microbial analysis. The treatment consisting of 1000 ppm Cu in eggs was the maximum treatment level chosen since it equates to 200 ppm Cu in the diet (when eggs comprise 20% of the diet) which has been previously used in mink diets without detrimental effects (*Aulerich et al., 1982; Bush et al., 1995*).

The mink diets consisted of 20.5% cereal, 20.5% poultry by-products, 5.4% fish meal, 4.9% beef liver, 20.0% eggs, 28.7% water, 0.27 mg d-biotin/kg, 4.3 IU vitamin E/kg, 1523 USP vitamin A/kg, and 152 IU vitamin D/kg, "as fed". Proximate analysis of the diet ("as-fed" basis) yielded 58.5% moisture, 8.87% fat, 16.4% crude protein, 1.33% crude fibre, and 3.77% ash (Litchfield Analytical Service, Litchfield, MI). Cu levels in the diets ("as-fed" basis) were determined to be 11, 115, and 192 ppm for the 0, 100, and 200 ppm Cu-egg treatment diets, respectively (Litchfield Analytical Service, Litchfield, MI). The 0, 100, and 200 ppm Cu are the concentrations of Cu in the diets which correspond to 20% of the 0, 500, and 1000 ppm Cu-treated eggs, respectively.

Treatment batches of eggs were prepared every Monday. Eggs were cracked out into plastic containers and stirred with Cu sulfate. These egg mixtures were kept at room temperature (≈50-60°F) and stirred continuously for seven days. Portions of these batches of eggs were used for the daily preparation of the treatment diets. Fresh eggs were cracked out daily for the control diet.

Assessment of microbial population
Samples of the batches of the 500 and 1000 ppm Cu-treated eggs were removed daily for one week each month and plated on tryptacase soy agar to obtain an assessment of the presence of bacteria and fungi using standard microbiological techniques. Weekly samples were taken on the seventh day to assess any changes in the presence of bacteria and fungi over the course of the study.

During the last week of the trial, a group of eggs was sampled to provide information on the microbial content of untreated eggs (0 ppm Cu) left at room temperature (≈70°F) and continuously stirred. Samples of the 0, 500, and 1000 ppm Cu-treated eggs were submitted to the AHDL at MSU for microbial analysis and identification.

Statistical analysis
Categorical data (number of females whelping/number mated; number of kits alive at birth, three, and six weeks of age; and sex ratio) were analysed using contingency tables and the Bonferroni Chi-square table. Body weights and serum element concentrations were analysed using one-way analysis of variance. Daily bacteria CFU were compared using the Mann-Whitney Rank Sum Test because the data were not normally distributed. The level of significance was 0.05.

Results and discussion

The addition of Cu-treated eggs to the mink diets did not adversely affect any of the parameters examined in this study (Table 1).

There was a significant increase in kit survival at birth in the 100 ppm Cu diet when compared to the control. Kit survival to three and six weeks of age was not significantly affected by either the 100 or 200 ppm Cu treatment diets. However, in a similar study in which mink were fed diets supplemented with 25, 50, 100, or 200 ppm Cu there was a trend toward greater kit mortality between birth and four weeks of age with increased Cu supplementation (*Aulerich et al., 1982*).

Table 1. Breeding and reproductive performance of female mink fed diets containing various concentrations of copper and sex ratios, body weights, and survival of their kits

	Dietary treatment (ppm copper)		
Parameter	0 (control)	100	200
No. females	12	12	12
No. females whelped/no. mated	9/11	11/12	11/12
Mean no. verified matings per female/no. attempted matings[a]	1.9/4.9	2.0/4.8	3.3/4.7
Mean gestation[b,c] (days)	48 ± 1.3	51 ± 1.4	49 ± 1.4
Mean litter size/female whelped[c]	6.3 ± 0.60	5.6 ± 0.54	6.2 ± 0.58
Kit sex ratio (% males:females)	58:42	45:55	46:54
No. kits whelped			
Alive	42	58	61
Dead	12	4	7
Kit survival at birth[d] (%)	77.8[A]	93.5[B]	89.7[AB]
Kit survival birth to 3 weeks[e] (%)	95.6	94.8	88.8
Kit survival 3 to 6 weeks[f] (%)	100	98.2	98.2
Kit body weight[c] (g)			
Birth[e]	9.9 ± 0.27 (44)	10.3 ± 0.24 (57)	9.9 ± 0.23 (59)
3 weeks	107 ± 3.6 (43)	106 ± 3.2 (55)	101 ± 3.2 (54)
6 weeks	275 ± 0.1 (43)	285 ± 9.0 (54)	277 ± 9.1 (53)

[a] Matings verified by presence of "normal" appearing, motile spermatozoa in vaginal aspirations taken after mating
[b] Based on date of final confirmed mating
[c] Mean ± standard error of the mean
[d] Means within a row not sharing a common superscript are significantly different ($p<0.05$)
[e] Based on live kits at birth
[f] Based on live kits at 3 weeks

Neither the body weight of the dams nor the kits (Table 1) were significantly affected by the addition of Cu-treated eggs to the diet. Adult female dark mink fed a diet supplemented with 25 ppm Cu for 20 weeks had significantly greater body weights than control mink, but this increase in body weight was not significant at the 50 ppm supplemental dietary Cu level (*Aulerich and Ringer, 1976*).

In another study, 100 or 200 ppm Cu added to the diet had no effect on the body weight of growing female mink fed the treatment diets for approximately 19 weeks (*Bush et al., 1995*). In a reproduction study, four-week-old kits of female mink fed 100 ppm supplemental Cu were significantly lighter than kits of females fed the control diet or 200 ppm Cu diet (*Aulerich et al., 1982*).

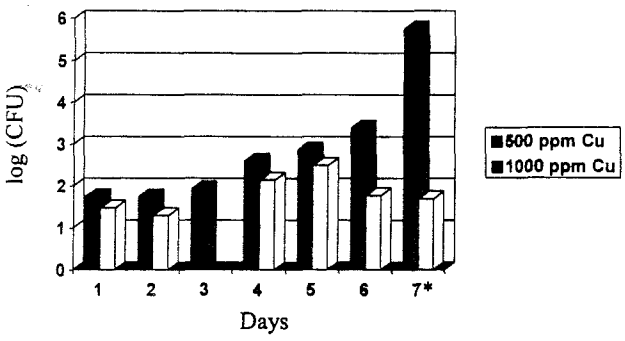
There were no differences among treatment groups in serum concentrations of the following elements: B, Ca, Cr, Fe, P, Zn, Na, or K. Cu and Mg levels were significantly greater in the 200 ppm Cu treatment diet when compared to the control (Table 2). While the Mg concentration was significantly greater in the 200 ppm Cu treatment diet, this concentration may not be biologically relevant since it is less than the high (32 ppm) for normal mink reported by Rotenberg and Jorgensen (1971). The elevated Cu levels were expected since the Cu intake was greater in the Cu treatment groups. Pastel mink kits fed 116 ppm Cu during the growth and molting period (July-Nov.) had a mean serum Cu concentration of 0.7±0.4 (S.D.) ppm (*Mejborn, 1989*) which is the same as the level detected in the serum of mink fed the control diet in the present study.

Table 2. Elemental concentrations[a] (ppm) in serum from mink kits fed one of three copper-containing diets

	Dietary treatment (ppm copper)		
Element	0 (Control)	100	200
B	<1.00	<1.00	<1.00
Ca	102.13 ± 1.595	100.82 ± 1.595	100.10 ± 1.595
Cr	<0.100	<0.100	<0.100
Cu	0.70 ± 0.080^{A}	0.83 ± 0.080^{AB}	1.07 ± 0.080^{B}
Fe	1.95 ± 0.301	1.97 ± 0.301	1.51 ± 0.301
K	270.17 ± 17.303	291.67 ± 17.303	307.50 ± 17.303
Mg	23.23 ± 0.787^{A}	25.43 ± 0.787^{AB}	26.58 ± 0.787^{B}
Na	3276.67 ± 29.509	3295.00 ± 29.509	3285 ± 29.509
P	88.62 ± 2.745	87.117 ± 2.745	94.15 ± 2.745
Zn	0.96 ± 0.079	1.06 ± 0.079	1.10 ± 0.079

[a] Means within a row not sharing a common superscript are significantly different ($p<0.05$)

The 1000 ppm Cu-treated eggs had consistently fewer CFU/ml eggs than the 500 ppm Cu-treated eggs (Figs. 3 and 4). The trend towards increasing bacteria counts from March thr gh July in both groups is probably associated with increa-sing ambient temperatures. Bacteriology and mycology results from the AHDL yielded: bacterial counts of 8.8. x 10^8 and 7.8 x 10^7 CFU/ml, for the 0 and 500 ppm Cu-treated eggs, respectively. The bacteria present in the 1000 ppm Cu-treated eggs were too few to count. There was no fungal growth in any of the groups. These results were similar to the bacterial counts obtained in our laboratory for the final week: 3.3 x 10^{10} and 3.7 x 10^9 CFU/ml for the 0 and 500 ppm Cu-treated eggs, respectively. The bacteria present in the 1000 ppm Cu-treated eggs were also too few to count. The predominant bacteria species isolated were Beta hemolytic and included *Streptococcus, Coliform,* and *Proteus* species.



* Significant difference between 500 and 1000 ppm Cu ($p<0.05$)

Fig. 3. Median bacterial colony forming units (CFU) in eggs containing 500 or 1000 ppm Cu. Eggs were cracked out on day 0 and held at room temperature for seven days.

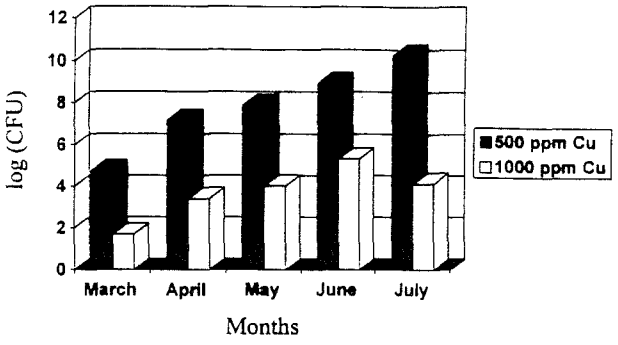


Fig. 4. Average bacterial colony forming units (CFU) in eggs containing 500 or 1000 ppm Cu after seven days at room tem-perature over the course of the reproduction trial.

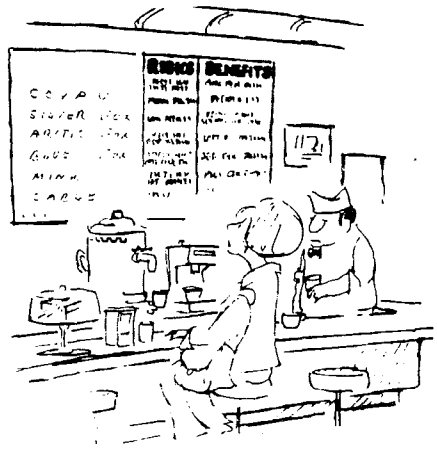
References

Aulerich, R.J. and R.K. Ringer. 1976. Feeding copper sulfate: Could it have benefits in nutrition of mink? U.S. Fur Rancher 56:4, 6, 9.

Aulerich, R.J., R.K. Ringer, M.R. Bleavins, and A. Napolitano. 1982. Effects of supplemental dietary copper on growth, reproductive performance and kit survival of standard dark mink and the acute toxicity of copper to mink. J. Anim. Sci. 55:337-343.

Braselton, W.E., G.L. Meerdink, H.D. Stowe, and S.R. Tonsger. 1981. Experience with multielement analysis in diagnostic clinical toxicology and nutrition. Proc. Ann. Meet. Amer. Assn. Vet. Lab. Diagn. 24:111-126.

Braude, R. 1965. Copper as a growth stimulant in pigs. In: Cuprum Pro. Vita (Transactions of a symposium). Copper Development Association, London, pp. 55.



Bush, C.R., J.C. Restum, S.J. Bursian, and R.J. Aulerich. 1995. Responses of growing mink to supplemental dietary copper and biotin. Scientifur 19:141-147.

Castell, A.G and J.P. Bowland. 1968. Supplemental copper for swine: Growth, digestibility, and carcass measurements. Can. J. Anim. Sci. 48:403-413.

Drouliscos, N.J., J.P. Bowland, and J.I. Elliott. 1970. Influence of supplemental dietary copper on copper concentration of pig blood, selected tissues, and digestive tract contents. Can. J. Anim. Sci. 50:113-120.

Hawbaker, J.A., V.C. Speer, V.W. Hays, and D.V. Catron. 1961. Effect of copper sulfate and other chemotherapeutics in growing swine rations. J. Anim. Sci. 20:163-167.

Jay, J.M. 1986. Intrinsic and extrinsic parameters of food that affect microbial growth. Modern Food Microbiology (3rd ed.). VanNostrand Reinhold Co., NY. pp. 33-60.

King. J.O.L. 1972. The feeding of copper sulphate to growing fowls. Brit. Poult. Sci. 13:61-65.

King. J.O.L. 1975. The feeding of copper sulphate to growing rabbits. Brit. Vet. J. 131:70-75.

Mejborn, H. 1989. Effect of copper addition to mink feed during the growth and molting period on growth, skin production, and copper retention. Scientifur 13:229-234.

Poulsen, J.S.D. and G. Jorgensen. 1986a. Examination of mink (*Mustela vison*) fed a sulfuric acid preserved fish silage during lactation and growth period. 1. A clinical-chemical examination. Nord. Veterinaermed. 38:90-105.

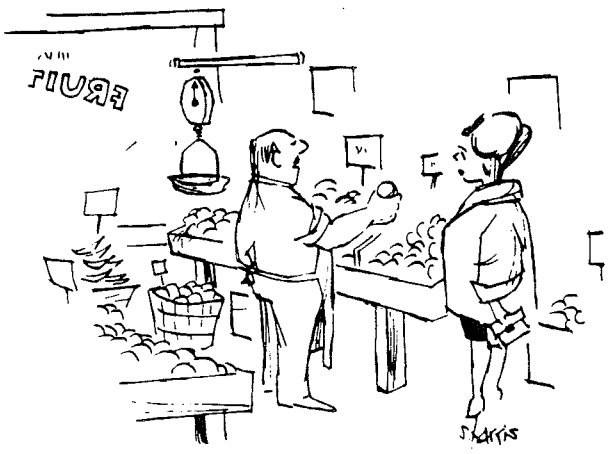
Poulsen, J.S.D. and G. Jorgensen. 1986b. Examination of mink (*Mustela vison*) fed a sulfuric acid preserved fish silage during lactation and growth. 2. Production and pathologic studies correlated to results of clinical-chemical studies. Nord. Veterinaermed. 38:106-111.

Rotenberg, S. and G. Jorgensen. 1971. Some haematological indices in mink. Nord. Vet.-Med. 23:361-366.

Urlings, H.A.P., G. de Jonge, P.G.H. Bijker, and J.G. Van Logtestijin. 1993. The feeding of raw, fermented poultry by-products: Using mink as a model. J. Anim. Sci. 71:2427-2431.

Van Lunen, T.A., D.M. Anderson, A.M. Laurent, I. Barclay, and J.W.G. Nicholson. 1991. The utilization of acid-preserving poultry offal by growing-finishing pigs. Can. J. Anim. Sci. 71:935-938.

Varel, V.H., I.M. Robinson, and W.G. Pond. 1987. Effect of dietary copper sulfate, Aureo SP250, or clinoptilolite on ureolytic bacteria found in the pig large intestine. Applied and Environmental Microbiology 53:2009-2012.



"Don't worry about insecticides. The radioactivity neutralizes them."

Assessment of the accuracy of quantitative urine collection in mink (*Mustela vison*) using osmotic pumps for continuous release of p-amino-hippuric acid and inulin

Søren Wamberg, Jan Elnif, A.-H. Tauson

A method is described to assess the accuracy of quantitative collection of urine in small experimental animals using implanted Alzet® osmotic pumps for continuous release of specific urinary markers. The nominal pumping rate (10.00±0.15 µl/h; mean±SEM) of 10 osmotic pumps was verified (9.96±0.12 µl/h) in a 10-day *in vitro* assay in isotonic saline at 39.0°C. Ten adult female mink (1100±34 g) had a 2-ml osmotic pump implanted intraperitoneally for 7 days while maintained in metabolic cages on a conventional mink diet. In 5 mink the pumps contained [^{3}H]-labelled *p*-aminohippuric acid (PAH) only. The remaining 5 animals received a pump containing [^{3}H]-PAH and [^{14}C]-labelled inulin. The experiment was well tolerated by all animals. In fed animals, the amount of urine collected per day was not influenced by the osmotic pumps, whereas 24 h of fasting (water allowed) caused a dramatic fall in urinary volume. In 4 consecutive 24-h collections of urine (n=10 animals) the recovery of [^{3}H]-PAH was 70.8±3.6% (range: 52.0-87.2%), and urinary plus faecal water (=total) recoverey of [^{3}H]--PAH averaged 77.0±3.7% (range: 60.3%-94.3%). For [^{14}C]-inulin (n=5 animals) the urinary and total recoveries were 68.4±2.2% and 77.2±2.4%, respectively. In urine the ^{14}C to ^{3}H counts-ratio was almost identical to that of the infusion solution, indicating that metabolic decomposition of the markers was negligible. The results indicate that the daily recovery of suitable urinary markers, released by implanted osmotic pumps, provides a reproducible and valid measure of the accuracy achieved in quantitative collection of urine in mink and probably also in other animals species. Hence, this technique may be useful in future studies on animal nutrition and/or drug disposition.

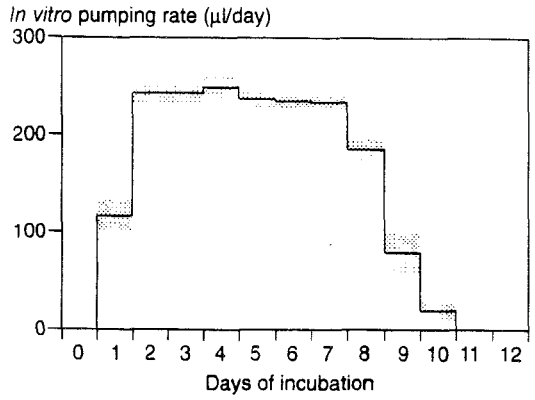


Fig. 1. Mean daily output (µl/24 h) by 10 Alzet® osmotic pumps (model 2ML1) measured *in vitro* in isotonic saline at 39.0±0.1°C. The shaded areas represent the 90% confidence intervals calculated for the ten osmotic pumps.

Laboratory Animals 30, pp. 267-272, 1996. 1 table, 2 figs., 18 refs. Auhtors' summary.

Distribution of digestive enzyme activities along the intestine in blue fox, mink, ferret and rat

V.M. Oleinik

The activities of amylase, total proteases, monoglyceride lipase, glycel-leucine dipeptidase and sucrase were investigated in mucosa from five consecutive parts of the small intestine in blue fox, mink, ferret and rat. In comparison with rats, the activity gradient of carbohydrases and TPA in the mucosa of predatory animals was shifted in the distal direction. The distribution of dipeptidase and monoglyceride lipase along the intestine was similar in all animals: the first was exemplarily the same all along the gut, while the second slightly decreased in a distal direction.

Comp. Biochem. Physiol., Vol. 112A, pp. 55-58, 1995. 2 tables, 5 figs., 20 refs. Author's abstract.

Mechanism of carotenoid cleavage to retinoids

Norman I. Krinsky, Xiang-Dong Wang, Guangwen Tang, Robert M. Russell

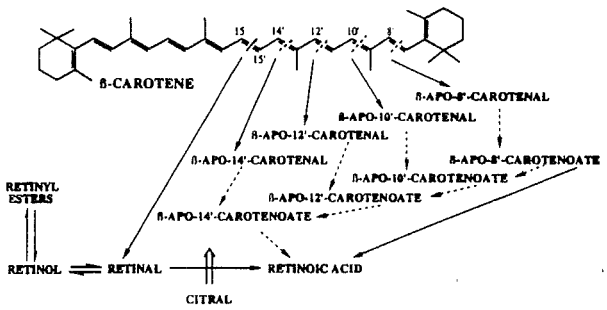


Fig. 1. The central and excentric cleavage mechanism for converting β-carotene to retinoids.

An excentric cleavage pathway exits for the conversion of β-carotene to β-apo-carotenoids and retinoic acid in intestinal homogenates of humans, ferrets, monkeys and rats.

The formation of retinoic acid occurs even in the presence of citral, an inhibitor of retinal oxidation. Furthermore, when β-carotene is perfused through the small intestine of ferrets, it is absorbed at a rate comparable to that of humans, and β-apo-carotenoids are found in the intestinal mucosa, along with polar retionoid products. Among the polar products in the perfused ferret small intestine is retinoic acid, which on GC/MS analysis, consists of a mixture of four cis-trans isomers. Thus, β-carotene can be converted to retinoic acid by an excentric cleavage process, and this process may be involved in the formation of cis-trans isomers of retinoic acid.

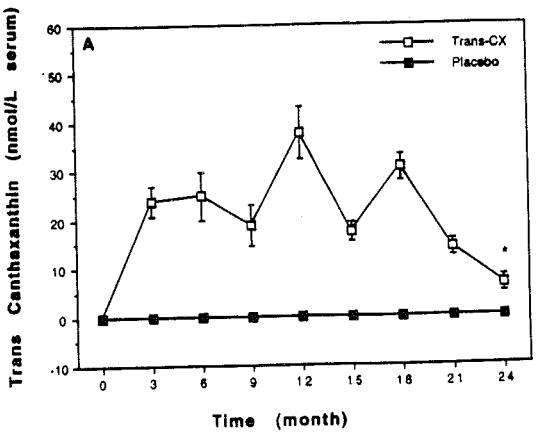
Annals of the New York Academy of Sciences, vol. 691, pp. 167-176, 1993. 1 table, 5 figs., 38 refs. Authors' conclusion.

Supplementing ferrets with canthaxanthin affects the tissue distributions of canthaxanthin, other carotenoids, vitamin A and vitamin E[1,2,3]

Guanwen Tang, Michael C. Blanco, James G. Fox, Robert M. Russell

To study the effects of canthaxanthin supplementation on the tissue distribution of canthaxanthin, other carotenoids, vitamin A and vitamin E, 26 spayed female ferrets (2 mo of age) were used. Ferrets were assigned to receive a commercial ferret diet and a gavage of canthaxanthin [50 mg/(kg body wt·d)] or a gavage of placebo beadlets (0 mg canthaxanthin) 5 d/wk).

Serum canthaxanthin concentrations in the canthaxanthin-fed group increased from 0 at baseline to 37.76 ±5.34 nmol/L *trans* and 77.10 ± 12.60 nmol/L *cis* canthaxanthin at 12 mo. Further accumulation of canthaxanthin did not occur with continuous dosing. After 2 y of receiving canthaxanthin beadlets by gavage, the ferrets did not show a detectable concentration of canthaxanthin in the eyes, nor did they have clinical signs of toxicity. Canthaxanthin concentrations were highest in liver, with high concentrations also seen in fat, lung and small intestine.



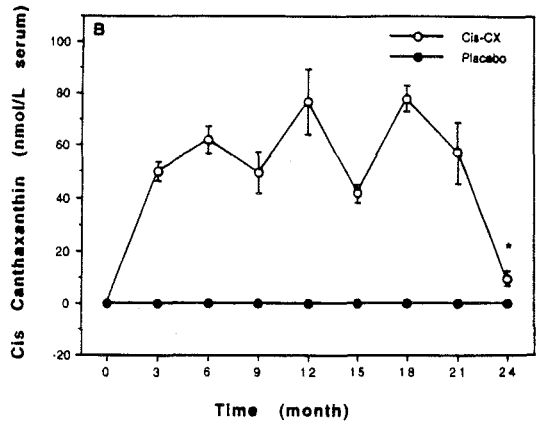


FIGURE 1 Serum canthaxanthin (CX) concentrations in ferrets receiving by gavage CX or placebo [50 mg/(kg body wt·d), 5 d/wk; *trans:cis* CX = 78:22] for 3, 6, 9, 12, 15, 18 and 24 mo (means ± SEM, nmol/L, $n = 7$). *Panel A, trans* CX, open squares for the CX-fed group and solid squares for placebo group; *Panel B, cis* CX, open circles for CX-fed group and solid circles for placebo group. The asterisk in *panel A* indicates that the value at 24 mo is significantly different from the values at 12 mo and 18 mo; the asterisk in *panel B* indicates that the value at 24 mo is significantly different from the values at 6, 12, 18 and 21 mo at $P < 0.01$ by one-factor ANOVA with repeated measures.

The sum of α and β-carotene concentrations detected in livers was significantly higher in the canthaxanthin-fed group than in the placebo-fed group, but not significantly higher when individual carotenes were compared. However, α-tocopherol concentrations in the livers and lungs and lutein/zeaxanthin in the fats of the ferrets fed canthaxanthin were significantly lower than in those fed the placebo. Retinoid concentrations in tissues of the ferrets fed canthaxanthin were not different from those of the placebo-fed group.

The effects of canthaxanthin supplementation on other antioxidants and vitamin A nutrients demonstrate either a synergistic or antagonistic relationship, depending on the specific tissue assayed.

J. Nutr. 125, pp. 1945-1951, 1995. 4 tables, 1 fig., 24 refs. Authors' abstract.

Influence of supplementing the diet with feed of animal origin on some traits of raw nutria skin

Ryszard Cholewa, Krzysztof Miarka, Slawomir Nowicki

Investigations were carried out on 90 nutrias of standard variety divided into three groups, each containing 15 males and 15 females. The experimental animals were given additionally 6 g daily meat-bone meal in group I or fish meal in group II. The animals were slaughtered when 27 weeks old and the following skin and coat traits were measured: weight, thickness, width, length, coat height, SGM, and graded.

The skin weight was higher in the experimental groups fed with supplements of animal origin than in the group fed only a conventional diet. The coats in experimental animals were shorter and in males the skins were longer. The skin quality indices were mostly more advantageous in animals fed fish meal supplement than in those fed meat-bone meal.

Roczniki Akademii Rolniczej w Poznaniu - CCLXXII, pp. 15-21, 1995. In POLH, Su. ENGL. 2 tables, 12 refs. Authors' summary.

Influence of mineral-vitamin supplement on skin and coat quality in nutria

Ryszard Cholewa, Daniela Frontczak

Standard nutrias of both sexes were fed a standard feed with the mineral-vitamin supplement premix. In the first experimental group premix was added in an amount of 2 g daily per animal and in the second group 4 g daily. The animals were slaughtered when about 28 weeks old. In their dried skins the following traits were measured: skin weight (g), thickness (mm), and length on back and belly, height of guard hairs and underhair

(mm), SGM (mm) and they were also graded. It was found that the mineral-vitamin supplement influenced positively the weight of skin in the males and the quality class of nutria skin. However, there was a slight effect on differentiation of traits of coat structure.

Roczniki Akademii Rolniczej w Poznaniu - CCLXXII, pp. 3-7, 1995. In POLH, Su. ENGL. 1 table, 6 refs. Authors' summary.

Deficiency of vitamin B_1 (thiamine) and skin quality in mink

Tatiana Iljina, Galina Pietrowa, Ryszard Cholewa, Jelena Czerkaszyna

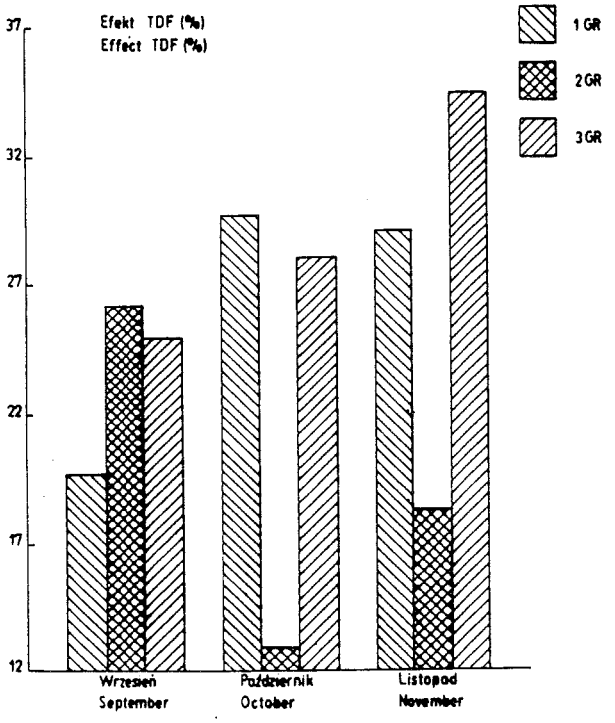


Fig. 1. Effect of "pirophosphoran" thiamine in mink with different vitamin B_1 (thiamine) levels.

On a fur animal farm in Karelia (North Russia) in the season of fur formation the experiment was carried out on avitaminosis B_1 induced by feeding. The aim was to determine the influence of different vitamin B_1 levels in feed on the activity of "transketolasis", size, effect of "pirophosphoran" thiamine and on the skin quality. There were three groups of animals, 30 females and 30 males in each. The first group was fed a diet containing 70 to 90% raw fish (herring), in the second group there was a supplement of 1 mg thiamine and 0.5 mg benfotiamine while in the third group only 1 mg thiamine per animal was given daily. The experiment showed that there was a possibility of mink survival due to the storage and mechanism of metabolite rearrangement. A diminished amount of vitamin B_1 was manifested only in the biochemical level in groups 1 and 3, but there was no visible effect on mink skin. It confirmed the usefulness of application of benfotiamine in prophylaxis of B_1 avitaminosis in mink.

Roczniki Akademii Rolniczej w Poznaniu - CCLXXII, pp. 77-82, 1995. In POLH, Su. ENGL. 1 table, 1 fig., 10 refs. Authors' summary.

Influence of milk substitute preparations on collected indices for slaughter analysis of coypu

Ryszard Cholewa, Slawomir Nowicki

Investigations were carried out on 210 standard nutrias divided into three groups fed differently. In each group there were 15 experimental males and 15 experimental females. The experimental animals were fed conventional diets supplemented with milk powder or serval or casein at a dose of 3 g daily per animal during the first three months and 6 g in the further rearing period. They were slaughtered when about 30 weeks old. From each group three representative animals were chosen. Their carcasses were divided into the cuts forepart, loin, rump, ham shoulder, heart, liver and kidney. In the meat the pH value, waterbinding capacity and thermal leaking were determined. The weights of the main cuts (forepart, loin and rump) and of the remaining body parts (ham

and plucks) were in most cases higher in the groups fed the milk substitute supplement than those in the animals fed only the conventional diet. The effect of this supplement was more marked in the males.

Roczniki Akademii Rolniczej w Poznaniu - CCLXXII, pp. 23-31, 1995. In POLH, Su. ENGL. 3 tables, 7 refs. Authors' summary.

Results of rearing young nutria kept with their dams fed different diets

Ryszard Cholewa

The author's aim was to determine the results of rearing nutria puppies with their dams which were fed diets containing 12% or 17% crude protein. The investigations were performed in the Institute of Small Animals in Celle (Germany) in the programme of Alexander von Humboldt grant.

The Greenland nutria puppies originated from two reproduction seasons. There were 124 animals (51 females and 66 males) in the first group and 118 animals (67 females and 51 males) in the second group. The animals were marked and weighed individually on the day of birth and at 6 weeks. Their dams were also weighed on the day of parturition.

The investigations concerned the connection between the number of puppies born in a litter, their live weight at birth, at the age of 6 weeks and the live weight of the dam after parturition. These diets as the only feed of nutria may be regarded as having an advantageous influence on rearing Greenland nutria puppies with their dams. The diet containing 12% crude protein gave clearly inferior effects on the results of rearing the progeny of primipara.

Roczniki Akademii Rolniczej w Poznaniu - CCLXI, pp. 59-65, 1994. In POLH, Su. ENGL. 2 tables, 4 refs. Author's summary.

The influence of differentiated feeding of raccoon dogs on reproduction indices

Manfred O. Lorek, Andrzej Gugolek

Feeding is the basic factor determining a high productivity expressed in reproduction indices. Investigations were carried out on 36 females and 18 males in the first reproductive season. The animals were divided into three equal groups and fed with diets of differentiated feed composition - the differences were in the proportion of feed of animal origin and that of plant origin and in the energetic value. The analysis of the reproductive use of females included the following selected indices: the time of first mating, number of barren females, females after kittening, females rearing the litter, and number of heads in the litter. In the case of males, the time of starting sexual activity and the number of females covered were determined. The best results were obtained in the groups of animals fed the diet in which the content of plant feeds was from 50 to 55% and the amount of metabolic energy from carbohydrates was from 34 to 39%.

Acta Acad. Agricult. Tech. Olst. Zootechnica, No. 40, pp. 153-158, 1994. 2 tables, 7 refs. In POLH, Su. ENGL. Authors' summary.

Digestibility of feed components and nitrogen retention by polar foxes fed a ration with a fatty concentrate additive

M.O. Lorek, S. Florek, A. Gugolek, I. Rusiecka

The research objective was to determine digestibility of fodder components and nitrogen retention by polar foxes fed a ration with a fatty concentrate additive. 15 polar foxes at the age of 4 months, randomly separated into 3 groups, were the experi-

mental material. Group 1 animals were fed a standard feed without a fatty additive and they constituted a control group. In the feeding ration for group II 50% of grain feeds were replaced by the concentrate and in group II - 100%. The differences observed as regards some standards under study in favour of the control group animals suggest the need to balance a ration for polar foxes with respect to the share of protein, fat and carbohydrate energy while applying the fatty concentrate composed of wheat bran (70%) and animal fat - technical (30%) stabilised by BHT in the amount of 0.02%.

Acta Acad. Agric. Tech. Ols., Zootechnica No. 39, pp. 71-81, 1994. 4 tables, 15 refs. In POLH, Su. ENGL, RUSS. Authors' abstract.

Mink feeding in late growth with fish offal as the only source of protein

O.N. di Marco, A. Maldonado

The effect of feeding hake offal as the only source of protein in mink was studied. For that 30 wild mink males and 30 females were assigned to 3 diets, 10 males and 10 females per diet, and fed for the last two months of the growing period in conventional cages. Diets were (fish:cereal): D1 87:12, D2 77:22 and T (control) 55:18 plus 25% slaughter offal and 2% oil and fat. Live weight was recorded, digestibility estimated and diet quality measured. Finally, weight of carcass, fur, undercoat fat, viscera and liver weight were taken; and fur quality evaluated. Acceptability and digestibility of dry matter was higher in the control diet (T), however, live weight, carcass, liver, fat and fur weight, and fur quality were not affected by diet. It was concluded that fish offal as the only source of protein in mink diet performed well in the last two months of growth.

Rev. Arg. Prod. Anim., Vol. 11, No. 3, pp. 259-266, 1991. 4 tables, 15 figs., 14 refs. In SPAN, Su. ENGL. Authors' summary.

A study of the possibility of substituting steamed ground barley by fat concentrate in the rations for polar foxes

Manfred O. Lorek, Andrzej Gugolek, Bozena Gawarecka

The investigation concerned 60 young polar foxes aged 8 to 22 weeks. The animals were divided at random into two equal groups: the control group (I) and the experimental group (II). Feeding was the experimental factor. Group I was fed with a standard ration, whereas in the rations for group II steamed ground barley was substituted by fat concentrate, i.e. extruded ground barley greased with animal fat.

A favourable influence of concentrate on the body weight gain, external traits, quality of skin and lower feed consumption per body weight gain were obtained.

Acta Acad. Agricult. Tech. Olst. Zootechnica, No. 41, pp. 47-56, 1994. 6 tables, 12 refs. In POLH, Su. ENGL. Authors' summary.

Subchronic oral toxicity study of diisopropyl methylphosphonate in mink

Thomas J. Bucci, William Wustenberg, Victor Perman, Douglas J. Weiss, Jack C. Dacre, Irwin P. Baumel, Robert M. Parker

Diisopropyl methylphosphonate (DIMP), produced during manufacture of the chemical agent GB (Sarin), is a groundwater contaminant at Rocky Mountain Arsenal, Colorado DIMP was fed for 90 days to dark brown "Ranch Wild" mink housed under controlled indoor conditions. One-year-old mink, 10 of each sex, were fed 0, 50, 450, 2700, 5400, or 8000 ppm in standard ranch diet. Actual DIMP consumption was 0, 8, 73, 400, 827, and 1136 mg/kg body wt/day, respectively. Two additional groups of 10 served as "pair-fed" controls. Body weight and food intake were recorded weekly. Complete blood count and 15 chemical

analyses were measured at weeks 0, 3, 7, and 13. Necropsy and microscopic examination were performed on all mink. No clinical morbidity or deaths occurred. Both sexes fed 8000 ppm ate approximately 20% less and weighed approximately 20% less tan the controls; 5400 ppm females had a 10% weight decrement. Plasma cholinesterase (ChE) decreased in the top three dose groups starting at week 3. AT 13 weeks, decrements were approximately 50% but returned to normal after 1 week without DIMP. Erythrocyte ChE was not reduced. Heinz bodies occurred in 10-15% of RBCs in 50% of 8000 ppm mink at 13 weeks, and 0.1-2.0% of RBCs in 25% at 2700 ppm. There were mild decreases in RBC count, hematocrit, and hemoglobin, and increases in reticulocyte count, at the 5400 and 8000 ppm doses. All recovered within 3 weeks after DIMP was withdrawn. The 8000 ppm group had marginal splenic hematopoiesis, histologically. No other treatment-related changes were noted. The 450 ppm dose was a clear no-effect level (approximately 73 mg DIMP/kg body wt/day). Compared to reports of similar studies of DIMP in rats and dogs, these mink displayed no unique species susceptibility.

Fundamental and Applied Toxicology 22, pp. 220-230, 1994. 10 tables, 2 figs., 20 res. Authors' summary.

Effects of dietary exposure to fumonisins from *Fusarium moniliforme* culture material (M-1325) on the reproductive performance of female mink

D.C. Powell, S.J. Bursian, C.R. Bush, J.A. Render, G.E. Rottinghaus, R.J. Aulerich

Adult female mink (*Mustela vison*) were fed diets that contained *Fusarium moniliforme* culture material that provided low- or high-dose dietary concentrations of 86 or 200 ppm fumonisin B_1, 22 or 42 ppm funonisin B_2, and 7 or 12 ppm funonisin B_3, respectively, from approximately two weeks prior to breeding through gestation and lactation. Breeding performance of the females was not affected by consumption of the funonisin diets. However, 58% of the mated females fed the high-dose diet (254 ppm total funonisins) whelped compared to 100% of those fed the control and low-dose diets (115 ppm fumonisins). There was a statistically significant, dose-dependent decrease in kit (young mink) body weights at birth and a notable, but non-significant, decrease in litter size. The percentage of stillborn kits was directly proportional to the concentration of fumonisins in the dams' diets. Fumonisin concentrations in milk collected from those fed the high-dose diets were approximately 0.7% of the dietary fumonisin concentrations. Lactational exposure to fumonisins did not significantly decrease kit survival from birth through three weeks of age. Hepatic cell vacuolation was present in 25% of the control and 80% of the high-dose adults. No treatment-related gross or histologic lesions were observed in the kit mink. Numerous differences in hematologic and serum chemical parameters were noted between the control and fumonisin-exposed mink.

Arch. Environ. Contam. Toxicol. 31, pp. 286-292, 1996. 2 tables, 36 refs. Authors' abstract.

Oil and fat hydrolysis with lipase from *Aspergillus* sp.

X. Fu, X. Zhu, K. Gao, J. Duan

Hydrolysis of olive oil, soybean oil, mink fat, lard, palm oil, coconut oil, and a hydrogenated, hardened oil with lipase from an *Aspergillus* sp. has been studied. The lipase had high specific activity (60,000 U/g) and did not show any positional specificity. The lipase proved to be a more effective catalyst than Lipolase from A, *oryzae*, with an optimal activity at 37°C and pH 6.5-7.0. It was activated by Ca^{2+} but inactivated by organic solvents such as isopropanol and propanone. All substrates examined could be

hydrolysed to corresponding fatty acids with this enzyme at concentrations of 5-30 U/meq with yields of 90-99% in 2-24 h. The degree of hydrolysis was almost logarithmically linear with reaction time and occurred in two stages. The lipase was stable and could be repeatedly recycled for hydrolysis.

JAOCS, Vol. 72, No. 5, pp. 527-531, 1995. 4 tables, 3 figs., 14 refs. Authors' abstract.

The influence of fat concentrate addition in the mink feed ration on chosen utility indices

Andrzej Gugolek, Manfred O. Lorek, Bozena Gawarecka

The investigation on the influence of an addition to the fat concentrate ratio on chosen mink utility indices was carried out in two stages within the years 1990-1991. The first stage of the research concerned feeding young mink of the standard variety from weaning to the time of growth end and formation of winter fur. To this end, animals chosen at random were divided into two groups of 20 heads, with the same number of males and females. The animals in group I (control group) were fed a standard ration whereas in the feed ration for group II (experimental group) steamed ground barley was substituted by fat concentrate. The other components of the ration were in the same proportion as in the control group. Body weight gains and conformation features were analysed. 8 females from each group were chosen at random for the second stage of the research, and fertility indices in the first year of reproduction were analysed. The results obtained proved the possibility of substituting steamed ground barley by fat concentrate, and showed no negative influence on the utility indices investigated.

Acta Acad. Agricult. Tech. Olst. Zootechnica, No. 41, pp. 58-65, 1994. 4 tables, 15 refs. In POLH, Su. ENGL. Authors' summary.

Escherichia Coli and virus isolated from *"sticky kits"*

M. Jørgensen, F. Scheutz, B. Strandbygaard

A total of 121 Escherichia coli strains isolated from 3-week-old mink kits were serotyped and examined for virulence factors. 56 strains were isolated from healthy kits while 65 were from "sticky kits". Among these, 34 different serotypes were detected.

No difference in serotypes or the presence of virulence factors could be detected between healthy and diseased kits. By electron microscopy of faecal samples corona-, rota-, and calicivirus were demonstrated among healthy as well as diseased kits.

Acta vet. Scand. 37, pp. 163-169, 1996. 2 tables, 1 fig., 23 refs. Authors' summary.

Fatty liver in chinchilla (*Chincilla velligera*) bucks

B. Egri, J.Egri, B. Hajnovics

From February 1991 to February 1992 50 chinchilla bucks were examined, after pelting, for the presence of fatty liver. Macroscopical and light microscopical changes in the liver were observed in 47 animals. In 24 cases the histological changes were physiological (steatosis). In the remaining 23 cases histopathological changes were found.

Only two of the pelts of the 17 animals which had serious histopathological findings were fully mature. The other pelts were either immature or were over mature. Further investigations of this condition are recommended.

Tierärztl. Unschau 49, pp. 42-27, 1994. 1 table, 5 figs., 7 refs. In GERM, Su. ENGL. Authors' abstract.

Yersiniosis - a serious disease of chinchillas in our country (Slovakia)

Z. Vasilová

In 1991-1993 within the laboratory diagnosis the *Yersinia enterocolitica* was diagnosed 172-times (44%) from the total number of 389 dead chinchillas examined. This high frequency confirms that this microbe is one among the serious pathogens of morbidity and mortality of chinchillas.

According to anamnestic data in a clinical picture apathy and gastrointestinal disorders with sudden death dominated. Catarrhal enteritis, spleen tumor, pulmonary hyperemia and acute pneumonia were found pathologically - anatomically in the acute course. In chronic disease there were hemorrhagic enteritis and colitis as well as necrotic lienitis and hepatitis.

Selective media gave a good account of frequency and differentiation (CIN according to Shiemann, fy. Merck). This microbe was sensitive to CHL, STM, NEO, OTC and FUR; and resistent against ERY, AML10, OB5.

Slovensky Veterinarsky Casopis 19, 3, pp. 129-130, 1994. 3 refs. In SLOV, Su. ENGL. Author's summary.

Figurate erythema resembling erythema annulare centrifugum in a ferret with adrenocortical adenocarcinoma-associated alopecia

D.W. Scott, W.J. Gould, S.M. Cayatte, H.J. Lawrence, W.H. Miller Jr.

Bilaterally symmetric alopecia and vulvar enlargement is reported in a 3-year-old, spayed female ferret. The condition was ultimately shown to be associated with an adrenocortical adenocarcinoma and elevated serum estradiol concentrations. In addition, the ferret had a figurate erythema over the

dorsolateral lumbosacral region and tail that was clinically and histopathologically similar to erythema annulare centrifugum in humans.

The figurate erythema was successfully treated with a commercial omega-3/omega-6 fatty acid-containing product.

Fig. 1. Striking, mostly parallel bands of erythema and scaling over the dorsolateral rump and tail. Also note marked truncal alopecia.

Veterinary Dermatology, 5, 3, pp. 111-115, 1994. 3 figs., 13 refs. Authors' abstract.

Analysis of antigenicity of mink aleutian disease virus (ADV) proteins using monoclonal antibodies

Wu Wei, Nie Jinzhen, M.E. Bloom

McAb Y9, Y19, Y13, Y21 and b4 against ADV-G can neutralise ADV-G treated with others. Reaction of McAb Y9 with the products of seven DNA clones of ADV-G confirmed that the gene fragment coding an ADV-G neutralizaiton epitope is located between the 2750-3439 genomic sequence. We found that the combining protein epitopes of CIEP antigen is located in the 32k and 25k proteins. This provided the theoretical basis for a subunit vaccine.

Chinese Journal of Virology 9, 3, pp. 236-240, 1993. 3 tables, 4 figs., 6 refs. In CHIN, Su. ENGL. Authors' summary.

The nature of the scrapie agent. Biological characteristics of scrapie in different scrapie strain-host combinations

Richard I. Carp, Xuemin Ye, Richard J. Kascsak, Richard Rubenstein

There are the esential points raised in this presentation:

1) Scrapie strains exist and they play an important role in agent-host interactions.
2) Scrapie strain differences have been observed in several species and in tissue culture systems, have been shown to involve a number of clinical parameters and are manifested in different organs and in different host functions including behavioural, metabolic and immunological.
3) The concept is put forward that the information that specifies these strain differences cannot be contained within the host-coded PrP molecule and that there must be a nucleic acid which serves as the informational molecule in scrapie.

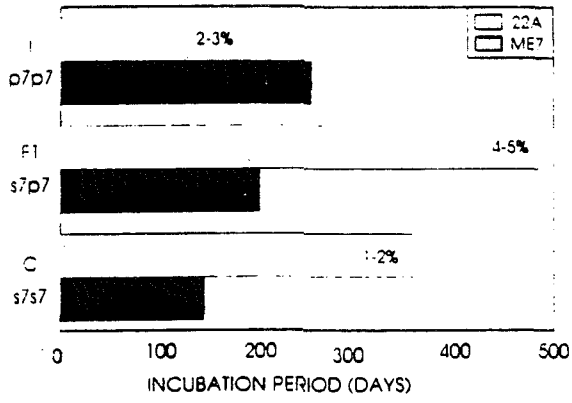


Fig. 1. Scrapie incubation periods (sinc gene effect). Incubation periods of the 22A and ME7scrapie strains in mice with the p7p7, s7p7 and s7s7 Sinc genotypes. The number values at the end of each column indicates the S.E. as a percentage of total incubation period.

Annals of the New York Academy of Sciences, Vol. 724, pp. 221-234, 1994. 7 tables, 2 figs., 56 refs. Authors' conclusion.

Clinical approach and preventive surgery in the domestic ferret (*Mustela putorius furo*)

Vittorio Capello

Recently the domestic ferret (*Mustela putorius furo*), is becoming a companion animal also in Italy. In this review the author outlines zoological, anatomical and physiological features, and gives quick references about common diseases with special emphasis focusing on distemper, heartworm disease and both diagnosis and therapy of estrogen-induced bone marrow aplasia. In addition the author describes the basis of anesthesiology and the preventive surgery techniques: orchiectomy, ovariectomy and anal sacculectomy; based on references and personal experiences.

Veterinaria (Cremona) 9, 1, pp. 7-12, 15-20, 1995. 1 table, 12 figs., 27 refs. In ITAL, Su. ENGL. Author's summary.

Experimental evaluation of mink and *apodemus speciosus* in the *Echinococcus multilocularis* life-cycle in Hokkaido, Japan

Hong-Kean Ooi, Chieko Inaba, Masao Kamiya

The epizootiological status of mink (*Mustela vison*) as definitive hosts and *Apodemus speciosus* as intermediate hosts in the transmission of *Echinococcus multilocularis* in Hokkaido, Japan, were evaluated by orally inoculating mink with protoscoleces, and *A. speciosus* with eggs of the cestode, respectively. No tapeworms were recovered from the alimentary tract of the mink, and no hydatid cysts were recovered from the viscera of the egg-inoculated *A. speciosus*. We conclude that mink and *A. speciosus* cannot serve as definitive hosts and intermediate hosts of *E. multilocularis*, respectively, in Hokkaido.

Journal of Wildlife Diseases, Vol. 28, 3, pp. 472-473, 1992. Authors' abstract.

Isolation of Polish strains of blue fox parvovirus (BFPV)

Beata Mizak

In 1993 Polish strains of blue fox parvovirus (BFPV) were isolated from farms with reproductive failures, where mean litter size was 2.7. Comparative studies with other parvoviruses of carnivores revealed that BFPV reacted more like mink enteritis virus (MEV) and feline panleukopenia virus (FPV) than like canine parvovirus (CPV) showing a clear optimum pH reaction at 5.9. FPV and BFPV grew well in feline kidney cells (NLFK) and moderately in feline lung cells (FC). This was confirmed by fluorescence technique. Cross reactivity indicated a serological relationship between virus used in the studies, but newly isolated strains of blue fox parvovirus seemed to be more closely related to MEV and FPV than to CPV.

Bull. vet. Inst. Pulawy 38, pp. 98-104, 1994. 4 tables, 16 refs. Author's summary.

Infestation by helminths of dwindling population of European mink (*Mustela lutreola L.*) in Belarusi

E.I. Buchkova, V.E. Sidorovich

The results of helminthologic examinations of European mink from the dwindling population are presented in the paper. Helminthological investigations of the 41 mink showed that a total of 38 animals were infested by parasitic worms (93.7%). A total of 17 species of parasitic worms were recorded from the European mink. Capillaria putorii (35.3%), C. mucronata (29.4%), Skrjabingylus nasicola (24.9%) are most numerous among nematoda, Euparyphium melis (40.0%) - among trematoda, Spirometra erinacei, larvae (90.0%) - among cestoda.

Analysis of our data as well as those published already, show that the general level of

helminth incidence is significantly higher in the declining populations (t=2.2; P=0.02). However, the rising levels of helminth infestation in the European mink reported here can be connected with the stressful conditions caused by American mink. The competitive ability of the acclimatized is based on its higher reproductive rate (achieved through reproductive regulation), greater ecological plasticity and superior strength and aggression.

Only abstract received. Authors' summary.

Veterinary-sanitary means on fur animals farms

E. Pärnase

The main purpose for applying veterinary-sanitary means is to avoid and eliminate infectious diseases. Only well-timed and regular applications can give the proper results.

A closed system is essential on a fur animal farm. Feed quality must be considered. The state veterinary surgeon ensures that sanitary rules are followed.

Veterinary Medicine '94, pp. 218-220, 1994. In ET, Su. ENGL. Author's summary.

A practical guide to ferret care

by

Deborah Jeans

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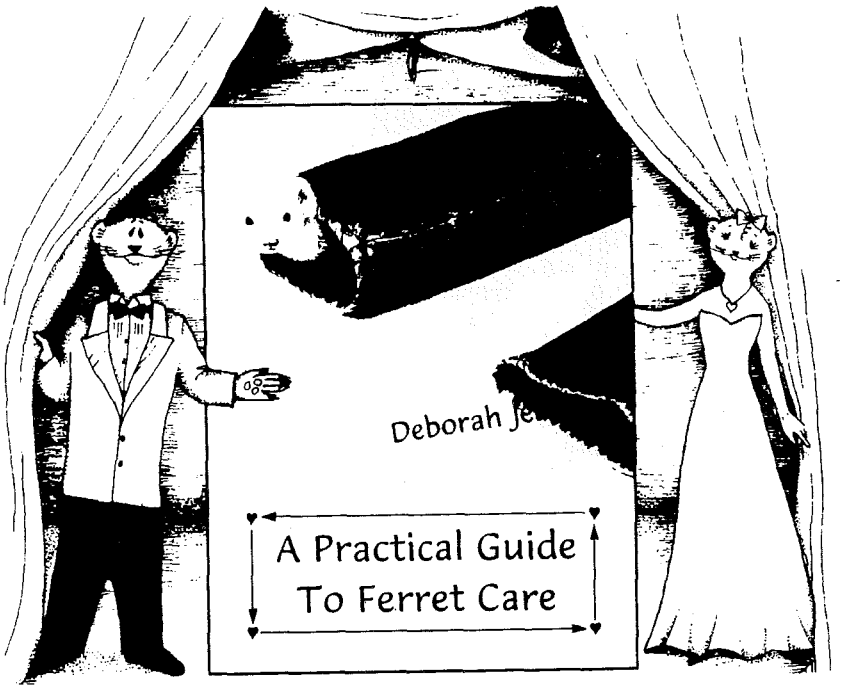

Highlights of "A Practical Guide To Ferret Ca

SECOND EDITION

Thanks to author Deborah Jeans the public has no reasons and no excuses to be ignorant about this f pet. Here are some of the interesting facts and information to be learned from her research and exper

♥ Ferrets are high-maintenance pets. The primary caretaker must be a responsible adult.

♥ Don't buy a pet to teach a child responsibility, buy a pet for a responsible child.

♥ Ferrets are not rodents. The small mammals are the only domesticated members of the weasel family.

♥ Ferrets as domesticated animals can be documented to at least 425 B.C. in a literary work by Greek playwright Aristophanes. They were a favorite of Queen Victoria of England.

♥ These domesticated pet engineers ferreted through the nooks and crannies underneath St. Paul's Cathedral to lay TV cables in preparation for the world viewing of the wedding of Prince Charles and Princess Diana.

♥ There are at least 7 million domesticated ferrets in North American households.
Domesticated ferrets must be spayed or neutered to prevent them from adding to the numbers of unwanted and homeless ferrets in need of shelter and rescue.

♥ The ferret's musky odor is caused by scent and oil glands in the skin. Spaying or neutering virtually takes care of that problem.

♥ Ferrets enjoy leaping about in a spirited style, which has become known as the " Weasel War Dance."

♥ Ferrets sleep 15 - 20 hours a day, but when they are awake they are both curious and highly active. They want and deserve lots of human attention.

♥ As of July 1996 ferrets still are illegal in California and Hawaii. Other jurisdictions also may have restrictions regarding ferret ownership.

♥ A ferret's housing needs include a large, sturdy wire cage that has plenty of floor space. A washable piece of carpet is ideal for the cage floor as ferret paws are not designed for wire floors.

♥ Pelleted products made from paper or pla are the best litter. Do not use cedar or pine because they may cause respiratory problem

♥ Ferrets need a diet high in quality animal They need to eat frequently and probably wi consume several small meals a day due to the rapid metabolism.

♥ Ferrets, like cats and dogs, have been know seriously injure babies and children through scratches and bites.Parental supervision is the preventative against such incidents.

♥ Instinctively, ferrets will nip, but flicking hitting a ferret is neither an appropriate nor response. When a ferret nips, try grasping it scruff of the neck and calmly remove it. Look eyes and say "No" loudly and quickly divert the attention elsewhere, such as to playing with a

♥ Do not declaw ferret paws. Ferrets need the for climbing, grasping onto objects, traction they walk, digging and scratching and for rem particles of food that sometimes get caught in roof of their mouth.

♥ Domesticated ferrets are indoor pets, but ca exercised outdoors. Ferrets can be harnessed a trained to walk outside. However, don't walk yo ferret on paved surfaces during hot weather.

♥ Ferrets will not enjoy a day at the beach. Sa salt water can cause gastrointestinal problems, hot sand will burn the ferret's delicate paws.

♥ Many of the ferret's health needs are unique possible, choose a veterinarian experienced in fe medicine.

♥ Cancer is the most common disease of ferrets North America, but it can be brought under cor for an extended period or even cured if it is dete in time.

♥ If your experience with your ferret does not w out, don't abandon the little animal. Take it to a shelter or find a caring home for it.

Ferrets in the veterinary practice of small animals

by

Ulf Dieter Wenzel

VET special

Frettchen in der Kleintierpraxis

Ulf Dieter Wenzel

23 Abbildungen
5 Tabellen

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Colour measurement applied to understanding of visual grading of colour shades in mink pelts

Palle Vistisen Rasmussen

Corrections in Zeszyty Naukowe 29 (Vol. 29) pp 111-115

Page	Line	Is	Should be
111	13 from above	(= 1mm)	(= $1mm^2$)
111	22 from above	L*a*b	L*a*b*
111	9 from below		
Is:	$Yi = \mu + b1*x1i + b2*x1i + b3*x2i + b4*x3i + ei$		
Should be:	$Y_i = \mu + b1 \cdot x1_i + b2 \cdot x1_i^2 + b3 \cdot x2_i + b4 \cdot x3_i + e_i$		
111	7 from below	Yi	Y_i
111	5 from below	x1i	$x1_i$
111	4 from below	x2i	$x2_i$
111	3 from below	x3i	$x3_i$
111	2 from below	ei	e_i
112	8 from below	- 0.017L*	- $0.017L^{*2}$
112	7 from below	(r^2=0.63; F=0.02)	(r^2=0.63; P=0.02)
112	6 from below	- 0.017L*	- $0.017L^{*2}$
112	5 from below	(r^2=0.58; F=0.005)	(r^2=0.58; P=0.005)
112	4 from below .	- 0.014L*	- $0.014L^{*2}$
112	3 from below		
Is:	(r^2=0.40; F=0.07) (non - snificant)		
Should be:	(r^2=0.40; P=0.07) (non - significant)		
113	1 from above	- 0.018L*	- $0.018L^{*2}$
113	2 from above	(r^2=0.58; F=0.005)	(r^2=0.58; P=0.005)
113	16 from above	588.00 nm	(588.00 nm
113	17 from above	586.70	586.70 nm
115	1 and 2 from below		
Is:	1.51L - 0.018L. (r^2=0.31; F=0.036).		
Should be:	1.51L* - $0.018L^{*2}$.(r^2=0.31; P=0.036).		

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