# SCIENTIFUR

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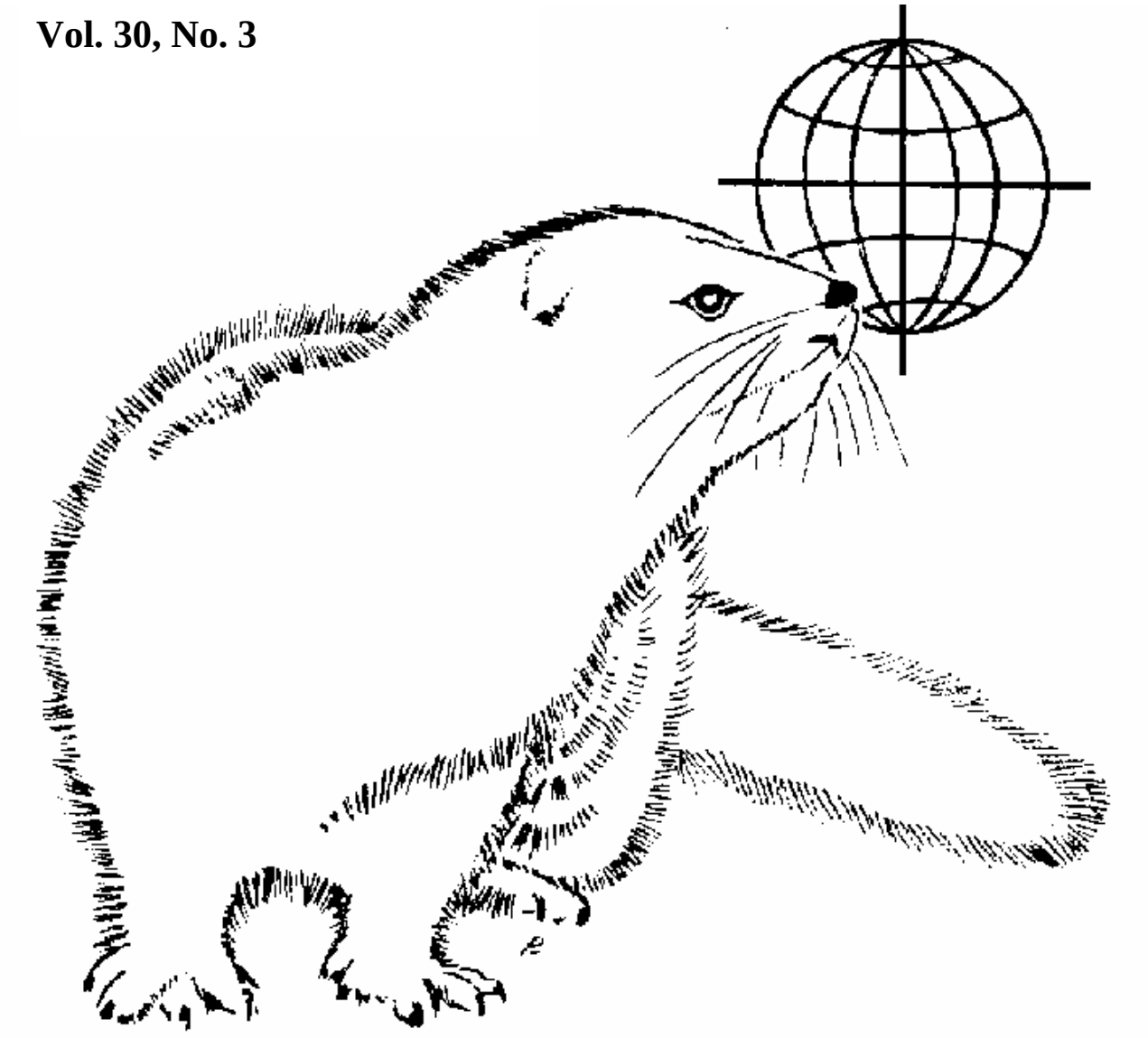

IFASA

**INTERNATIONAL FUR ANIMAL SCIENTIFIC ASSOCIATION**

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**Birthe M. Damgaard**
**SCIENTIFUR**
**P.O. Box 14**
**DK-8830 Tjele, Denmark**

**Tel: +45 89991512**
**Fax: +45 89991500**
**E-mail:** Scientifur@agrsci.dk

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**Steen H. Møller**
**IFASA**
**P.O. Box 14,**
**DK-8830 Tjele, Denmark**

**Tel: +45 89991346**
**Fax: +45 89991500**
**E-mail:** IFASA@agrsci.dk

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**Regional Scientifur Representatives**
USA: Dr. Jack Rose: E-mail: rosewill@isu.edu
Finland: Nita Koskinen: E-mail: nita.koskinen@mtt.fi
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**International Fur Animal Scientific Association (IFASA).** Board of directors:
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Dr. Tuula Dahlman. E-mail: tuula.dahlman@stkl-fpf.fi
Ing. Wim Verhagen. E-mail: info@nfe.nl
Dr. Marian Brzozowski. E-mail: brzozowskim@delta.sggw.waw.pl

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# Notes from the Group of Editors

This issue of Scientifur, Volume 30, No 3, contains a number of abstracts provided by some of our regional representatives. Included are also the abstracts of NJF Seminar No 392, held in Akureyri, Iceland, 22 – 25 August 2006.

Furthermore, the book *Mink Feeds and Feeding*, which is a practical feeding guide for the mink industry, is mentioned.

As always, we invite our readers to submit proceedings from congresses and seminars with relation to fur animal production. We also invite you to submit short communications, abstracts and letters on fur animal production, and in particular we ask you to send us articles for reviewing.

On behalf of the
Group of Editors

Birthe Damgaard

**Temperament, stereotypies and anticipatory behaviours as measures of welfare in mink**

*S.W. Hansen, L.L. Jeppesen*

A farm mink population of 290 1-year-old wild-coloured females was scanned for stereotyped behaviour in October 2003. At the same time the temperament of the individuals was established with a stick test. Some of the females performed no stereotypies in 54 scans and this fraction of the population, 73 individuals, included significantly more fearful animals (38.4%) as opposed to the stereotyping part of the population (22.6% fearful animals). Since fear observed under farming conditions directs to reduced welfare, the results suggest that stereotypy should not unconditionally be used as a measure of poor welfare. On this basis, it was interesting to see if the sensitivity to a reward as expressed by the level of anticipatory behaviour of high and low stereotyping mink would clarify the discrepancy between the two classical measures of welfare. Twenty-four of the most stereotyping animals and 24 of the non-stereotyping animals were selected and exposed to Pavlovian conditioning with both positive and negative rewards. Their behaviour during anticipation of the reward changed, however, they also showed a great variation and dependence on feeding time as well as stereotypy status. So, the results showed changes in anticipatory behaviour in mink in a Pavlovian set-up, however, possible relationships between fear and stereotypies, and stereotypies and anticipatory behaviour should be elucidated in future studies.

*Applied Animal Behaviour Science, 2006: 99, 172–182, 2 figs, 4 tables, 21 refs.*

**Activity of antioxidant enzymes in polarfox under the influence of starvation**

*V.A. Ilyukha, L.B. Uzenbaeva, B.M. Damgaard*

The authors studied the influence of short-time starvation and subsequent re-feeding on activity of superoxid dismutase and catalase in different organs and tissues of polar fox at the conditions of farm keeping. It was shown, that short-time starvation in polar fox influences on activity of superoxid dismutase and catalase, which return to initial level in tissues of most organs after rehabilitation feeding during 6 days. The character of changes in activities of these enzymes during adaptation to feed deprivation determines by metabolism features of tissues and organs and depends on physiological state of animals.

*Selskohozyaistvennaya biologiya, 2004: 4, 47-51, 2 tables, 14 refs.*

**A first estimate of the amino acid requirement for milk production in mink**

*R. Fink, A-H. Tauson, A. Chwalibog, N.E. Hansen*

The mink is a strict carnivore and conventional mink diets have very high protein content especially during the reproduction period. However, recent research has shown that lactating mink are able to regulate protein oxidation rate and that milk yield, during the first four weeks post partum, was improved and dam weight loss reduced, when protein supply was reduced below current recommendations (Fink et al. 2004). However, in meeting the actual amino acid requirement of lactating mink, the effect of reduced protein supply on chemical composition and amino acid profile of the milk needs to be investigated. The objective of the present experiment was to test the hypothesis that replacement of part of the dietary protein with readily available carbohydrates increases milk yield, without negative effect on amino acid output in milk, and thereby, by a factorial approach, be able to give an estimate of the amino acid requirement of the lactating mink.

*Proceedings from NJF – Seminar No. 377, 4 pp, 3 tables, 2 refs.*

**Non-alcoholic fatty liver – A bottleneck in the metabolism of blood sugar and body fat**

*K. Rouvinen-Watt*

Fatty liver (hepatic lipidosis) is a common pathological finding in mink, cats and other carnivore animals. Fat accumulation in the liver most often occurs due to metabolic (obesity, lack of adipose tissue, diabetes) or nutritional

(lack of appetite, sudden weight loss, emaciation) causes. The liver becomes enlarged, is yellow in color, has a fragile texture and its fat content can be very high. The liver enzyme (especially ALT) values can be multiple times higher compared to normal. The liver has a central role in the metabolism of blood sugar and body fat. Storing blood sugar as glycogen is one of the functions of the liver. It also synthesizes blood sugar and triglycerides which it either releases into circulation or stores. The blood sugar balance of an animal is determined by glucose uptake, glucose synthesis, storage, release from storage and its oxidation for energy. The main role of the liver in body fat metabolism is to uptake free fatty acids from blood circulation, and manufacture, store and release into circulation fats and lipoproteins. Insulin and glucagon have an important regulatory role in both lipid and glucose metabolism. In addition, the stress hormones may play a significant role in the development of fatty liver as they increase the mobilization of blood sugar and body fat from storage. Hepatic lipidosis is a common finding in type 2 diabetes and the associated metabolic syndrome and it is now regarded as the hepatic manifestation of insulin resistance. In peripheral insulin resistance glucose uptake by tissues is hindered due to defective insulin function resulting in intra-cellular energy deficit and abnormally high blood glucose levels. In hepatic insulin resistance the liver's ability to clear glucose from blood and store it as glycogen is impaired. Instead the liver releases glucose from storage and manufactures more glucose from amino acids via gluconeogenesis, which further increases the already elevated blood sugar levels. This is a vicious metabolic cycle which, if uncontrolled, quickly leads to severe damage to the liver and other organs and tissues (kidneys, nervous system) eventually resulting in death.

*Fatty Liver Seminar, MTT Agri-Food Research Finland, June 20, Kannus, Finland*
*Fatty Liver Syndrome in Fur-Bearing Animals – causes and metabolic consequences*

**Effects of prolactin on underhair follicle development in mink (*Mustela vison*) during the winter fur growth cycle**

*J. Hunt, J. Rose*

In mink, winter anagen is correlated with reduced serum prolactin (PRL) levels, suggesting that the hormone plays an inhibitory role during winter fur growth. We have further defined the role of PRL during winter anagen by answering the following questions: 1) Are the inhibitory effects of PRL on winter anagen mediated equally on all three hair follicle bundle types (G-type: underhairs plus one large guard hair, I-type: underhairs plus one intermediate size guard hair, and U-type: underhairs only)?, 2) Do skin PRL-R concentrations change during the transition from summer telogen to winter anagen?, and 39 Does PRL influence production of the skin PRL-R? Mink were treated with haloperidol (HAL) to increase PRL secretion and melatonin (MEL) to inhibit PRL secretion between 7 July and 22 October. Control mink entered winter anagen during mid-Sept and skin PRL-R levels were unchanged. In HAL-treated mink anagen was delayed in five mink while occurring early in one animal. Skin PRL-R levels increased on 18 Aug, and remained elevated in all HAL-treated mink ($P<0.05$). Exogenous MEL induced winter anagen 6 weeks early and skin PRL-R levels were higher than controls on 18 August and 9 September, ($P<0.05$) declining to values not different from controls on 22 October. Adrenalectomy (ADX initiated anagen six weeks earlier than controls and PRL-R levels were unchanged. Underhair density was lower in G-type than I or U-type bundles ($P<0.001$). Exogenous DOC and HAL, reduced underhair density in all three bundle types ($P<0.01$). Following ADX, underhair density increased in I and U-type bundles ($P<0.05$). Underhair density in all three bundle types following early induction of anagen with MEL was not different from mink exhibiting natural winter anagen. We conclude that PRL inhibits the onset of anagen in a subset of underhair follicles, and that reduced circulating PRL levels in the fall, results in greater hair density during the winter season.

*Hair Science and Technology, Proceedings of the 9th annual meeting of the European Hair Research Society held in Brussels, Belgium, June 2002,37-48.*

**The role of prolactin in regulating summer hair growth cycles in mink**

*S. Larson, J. Hunt, J. Rose*

Although onset of summer anagen in mink is correlated with elevated serum prolactin (PRL) concentrations, the effects of PRL on hair growth are controversial. Therefore, our objectives were to determine:

1) serum PRL levels in mink exhibiting natural and artificially-induced summer anagen and,
2) if the effects of PRL are mediated equally on the three hair follicle bundle types (G-type: underhairs plus one large guard hair, I-type: underhairs plus one intermediate sized quard hair and U-type: underhairs only). In mink exposed to an artificially long photoperiod (16L:8D), serum PRL levels increased 1 month before controls ($P<0.05$), but onset of anagen was the same in both groups. Mink treated with haloperidol (HAL) or HAL + melatonin (MEL), also displayed an early rise in serum PRL levels ($P<0.05$), but onset of anagen was similar to controls. Moreover, adrenalectomy (ADX) induced anagen 1 month early, but serum PRL levels were not different from controls. In MEL and 16L:8D +MEL-treated mink, serum PRL was non-detectible and none of the animals entered summer anagen. Underhair density was lower in G-type than in I or U-type bundles for all groups. HAL-treatment reduced hair density in I and U-type bundles ($P<0.05$). Interestingly, depilation over-rode the inhibitory effects of MEL on summer anagen and hair density was increased in all three bundle types ($P<0.05$). We conclude that PRL inhibits anagen in a subset of mink underhair follicles, reducing fur density, which contributes to thermoregulation during warm weather.

*Hair Science and Technology, Proceedings of the 9th annual meeting of the European Hair Research Society held in Brussels, Belgium, June 2002,49-62.*

*Reference is also made to:*

*http://www.isu.edu/%7Erosewill/SHANNONSPOSTER.html*

*(poster presented at the International Investigative Dermatology Meetings and the North American Hair Research Society Meetings).*

**Evaluation of the 'maximum price paid' as an index of motivational strength for farmed silver foxes (*Vulpes vulpes*)**

*A.L. Hovland, G. Mason, K.E. Bøe, G. Steinheim, M. Bakken*

To measure farmed foxes' motivations for full, naturalistic social contact, we constructed an apparatus where they could perform an operant to access stimuli, but then leave freely and thence determine their own bout lengths. Motivational measures based on demand curves can be invalid in such set-ups, and we therefore sought to validate the measure 'maximum price paid'. This was achieved by measuring six silver fox males' maximum operant responding for access or proximity to three resources differing in biological significance: food, vixens in oestrus and males. We predicted that if valid, maximum price paid would be highest for food and vixens. Maximum price were 970 _ 399 (S.E.) for food, 677 _ 173 (S.E.) for vixens and 389 _ 101 (S.E.) for other males ($P < 0.05$). In contrast, our complementary measures of motivation – price elasticity, expenditure and consumer surplus – did not differentiate between the resources, and ranked them in different orders (albeit not significantly). This was because the foxes rescheduled their behaviour with increasing costs, decreasing bout number while increasing bout length, to different extents with the three resources. Additional findings showed that all subjects 'overpaid', performing the operant response more than was required. This increased as the costs increased, perhaps due to increasing 'time outs' on the time-restricted schedule (DRH) as the task got harder. However, the overpayment was also highest when males were the resource, suggesting that operant responding was slowest and least efficient when working for less-valued resources. The resources present also affected how the foxes used the rest of the apparatus and influenced their behaviour; subjects staying more in the operant compartment when the resource was social (especially a female), but retreating to a distant compartment when it was food. While proximity to oestrous vixens elicited higher levels of tail wagging and only low levels of pacing, indicating a positive motivation, proximity to males elicited relatively high levels of pacing plus agonistic gaping, suggesting that the motives for seeking contact with males related to aggression. Thus, although our operant set-up reveals a drive to approach other males, the possible aggressive

motives suggest that this sort of social contact would not necessarily improve their welfare in a traditional housing system. Overall, these results help improve the design and interpretation of preference tests, and confirm maximum price paid as a useful motivational measure for farmed foxes.

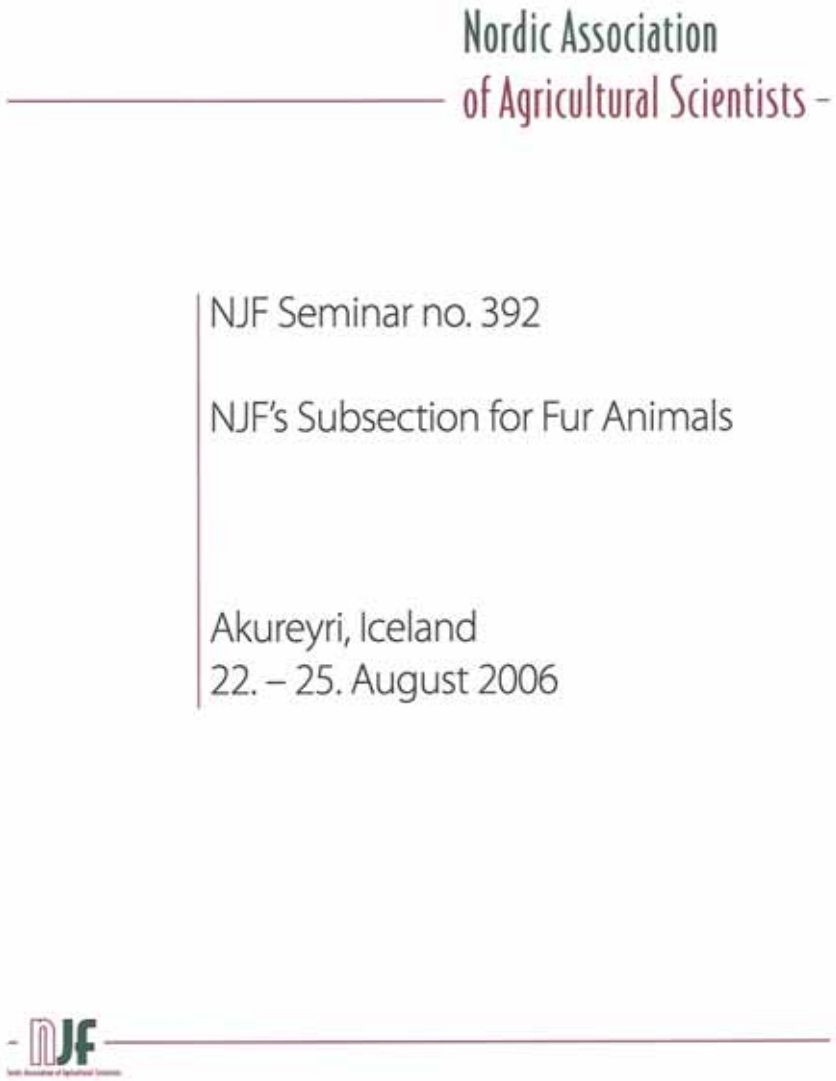
*Applied Animal Behaviour Science, 2006: 100, 258–279, 6 figs, 1 table, 57 refs.*

**A note on reward-related behaviour and emotional expressions in farmed silver foxes (*Vulpes vulpes*) – basis for a novel tool to study animal welfare**

*R.O. Moe, M. Bakken, S. Kittilsen, H. Kingsley-Smith, B.M. Spruijt*

The present study aimed to investigate the profile and quantitative aspects of reward-related behaviour and emotional expressions during anticipation of positive (predictable or various unpredictable) or negative (predictable) rewards in a Pavlovian trace conditioning paradigm in farmed silver foxes. When anticipating a positive reward, silver foxes were more active, performed more stereotypical behaviour, had more erected ears and spent more time in the front of the cage compared to anticipating aversive stimuli. Foxes were only to a minor degree able to discriminate the two different positive paradigms. In conclusion, studies related to anticipatory behaviour may be useful for the development of indicators of positive emotional states and, thus, positive welfare, in farmed silver foxes.

*Applied Animal Behaviour Science, 2006: 101, 362-368, 4 figs, 2 tables, 14 refs.*




**Social motivation in young silver fox vixens**

*A.L. Hovland, G.J. Mason, R.D. Kirkden, M. Bakken*

In order to examine the strength of social motivation in farmed silver foxes, the willingness to pay (the 'maximum price paid') for unrestricted access to a companion of same sex and age (N = 6) were measured in six young vixens. As a comparator resource the vixens' maximum price for food was also measured in a subsequent test. The vixens and the companions were housed continuously in an operant apparatus for foxes and the test subjects had to pay, by performing a pulling response, increasingly higher costs to access the companion. During the social test the vixens were video taped and their social behaviour was recorded to investigate potential motives for wanting contact. The vixens were willing to pay to make contact with a same-age vixen and the average maximum price for contact constituted 38.3 ± 8.3% of the price they paid for food. When the price to access the

companion was almost free the pair of vixens spent on average about 45% of the time together in the same cage per 24h. During the very first interactions the vixens would typically fight to establish the dominance relation. Overall, later meetings were peaceful with low levels of aggression. The vixens spent time grooming and sniffing each other, resting together and sporadically initiated play sessions. The study showed that the vixens were motivated for social contact and that this contact provides potential welfare benefits because of the presence of grooming and play and low levels of aggression.

*Proceedings from NJF – Seminar No. 392, 1 pp. Authors' abstract.*

**Access to occupational materials improves the welfare of farmed mink, whereas a doubling of the cage size has only minor effects in relation to mink welfare**

*S.W. Hansen*

The effects of cage enrichments and additional space were studied in 60 pairs of mink kits kept in standard cages (STD) and 67 pairs of mink kits kept in enriched cages (ENR). During the period from mid July to the end of September both groups had alternate access to one and two connected cages. From October, half of the mink in each group had permanent access to one cage and the other half permanent access to two cages. The enrichment of the cages consisted of extra resting places (tubes made of wire mesh and plastic) and occupational materials in terms of table tennis balls and ropes to pull and chew. The mink were observed during an experimental period of nine month, from late lactation until the beginning of the next mating season. The welfare was assessed by behavioural elements (use of nest box and enrichments, activity out in the cage, stereotypies and fur chewing) consumption of food and straw, bodyweight and level of faecal corticoid metabolites. The presence of enrichments resulted into less tail chewing, fewer stereotypies, and a reduced level of faecal corticoid metabolites. In addition, the presence of enrichments led to fewer social interactions and reduced the consumption of straw. Concerning the frequency of using different occupations, the mink did not use the table tennis balls, but the tubes and the pull ropes were used extensively as occupational material. Access to one or double cages had no effect on stereotypies, fur chewing and physiology linked to welfare, but the mink with access to double cages used the nest box less, had a lower consumption of straw and pull ropes than the mink with access to only one cage. However there were no indications of frustration when the mink were deprived from using double cages. We conclude that increased environmental complexity as achieved by the introduction of occupational materials improved the welfare of the mink, whereas a doubling of the cage size had no or only minor effects in relation to mink welfare.

*Proceedings from NJF – Seminar No. 392, 1 pp, 1 ref. Author's abstract.*

**Effects of cage enrichment on behaviour in female mink during winter**

*H.M.K. Lindberg, E. Aldén, L. Lidfors*

The aim of this study was to evaluate different enrichments in a standard cage system and the behavioural effects of these in mink during winter.

Mink was housed in long roofed standard sheds containing two parallel rows of standard cages with a nest box. The study was carried out at two farms in south of Sweden and included 150 juvenile female mink of the colour type "black-cross". All mink were housed and reared in family groups (mother together with kits) in standard mink cages. In December 75 juvenile females on each farm were randomly allocated, and individually housed, into new standard cages which contained one of the following treatments: wire net shelf (S) (L 10 cm x W 30 cm), plastic cylinder (C) ( diameter 11 cm x L 25 cm), plastic ball (B) ( diameter 8 cm) or all three combined (ALL). Standard cages without enrichments were used as control. Drinking water was provided ad libitum and food was provided once a day. Behavioural observations were made using one - zero sampling at 9.00 - 11.00h before feeding and at 14.00 - 16.00h after feeding. The observations were conducted in four periods consisted of 10 days (period one - three) and four days (period four). At farm 1 behavioural observations were conducted on the 3 - 12 January, 29 January -7 February, 21 February - 2 March and 27 - 30 March and at farm 2 on the 18 - 27 January,

9 - 18 February, 4 - 13 March and 1 - 4 April. Each animal were observed 18 times during one day, nine before feeding and nine after feeding. All observations were performed by the same observer from the path inside the nearby shedhouse to minimize the observer's effect on the animals. Weather conditions such as wind speed, light intensity, humidity and temperature as well as disturbances due to management at the two farms were recorded during each observation.

Data were partially analysed on separate farms due to farm having the largest effect in original tests. Differences can be explained by management activity (larger farm, people in motion, food production etc) at (F1). The females spent 4.2% (F1) respectively 3.9% (F2) interacting with enrichments, 28.8% (F1) respectively 20.9% (F2) performing active behaviours, 11.8% (F1) respectively 9.8% (F2) performing stereotyped behaviours and 55.2% (F1) respectively 65.4% (F2) performing inactive behaviours. There were significant effects of treatment on interactions with enrichments at both farms ($p<0.001$, Genmod procedure, SAS). The proportion of interactions between treatments at (F1) were 6,7% (C), 41,6% (S), 1,9% (B) and 49,8% (ALL) (ALL equals 75,8% (S), 19,7% (C), 4,4% (B)) and at (F2) 13% (C), 30,2% (S), 1,6% (B) and 55,1% (ALL)(79,3%, 15,5%, 5,1%). Interactions with enrichments decreased significantly over time at (F1) ($p<0.001$, Genmod, SAS). Stereotyped behaviours increased over time at (F1) ($p<0,0001$, Genmod, SAS). There was a significant positive correlation between activity and stereotyped behaviours (F1; $p<0.05$, $r_s=0.29$, F2; $p<0.001$, $r_s=0.64$, Spearman rank correlation. Our results indicate that providing female mink with a shelf, a cylinder, a ball or all enrichments combined in standard housing during winter were not efficient enough to decrease stereotyped behaviours when they had been raised in standard cages without enrichments.

*Proceedings from NJF – Seminar No. 392, 2 pp. Authors' abstract.*

**Is there a relationship between selection for time of birth and mating willingness?**

*M. Fredberg, P. Berg, B.K. Hansen*

The aim of this study is to investigate how selection for late time of birth affects females' mating willingness in relation till first mating and re-mating. In this experiment two lines of mink were divergently selected for time of birth. Flushing and mating were started about one week later in the line selected for late time of birth. In this study females' willingness to mate is dependent of the number of failed mating attempts. Willingness to mate was analysed by using a threshold model. Females' willingness to mate was higher but the re-mating percentage was lower in the line selected for late time of birth compared to the line selected for early time of birth. The increased willingness to mate in the line selected for late time of birth can be a result of both the postponed time of mating and the selection. Willingness to mate increased when the date of the first mating attempt was postponed. Furthermore there was no difference between selection lines in the number of barren females.

*Proceedings from NJF – Seminar No. 392, 6 pp, 2 figs, 3 tables, 14 refs. Authors' abstract.*

**Selection on *ad libitum* and restricted feeding in mink**

*V.H. Nielsen, S.H. Møller, B.K. Hansen, P. Berg*

The effect on November weight of selection for high November weight on *ad libitum* (AL) and restricted feeding (RF) and of selection for high feed efficiency on *ad libitum* feeding (FE) was studied in mink. The estimated responses in the AL-, RF-, and FE-line were 322 g, 432 g, and 81 g. Thus, November weight was increased in all cases.

*Proceedings from NJF – Seminar No. 392, 7 pp, 3 figs, 1 table, 4 refs. Authors' abstract.*

**Feed efficiency in the third growing season of *ad libitum* or restricted feeding**

*S.H. Møller, V.H. Nielsen, B.K. Hansen*

Most farmed mink in Denmark are fed close to the average *ad libitum* intake during the growth period, based on feed leftovers at farm, shed, or row level. Variation in voluntary feed intake between male + female pairs is ignored apart from the distribution of feed leftovers to cages without feed left over from the day before. Individual feeding systems have made true *ad libitum* feeding of mink possible. Voluntary feed intake, weight gain, and feed efficiency was studied in male + female pairs of brown mink kits during 15 weeks from 12 weeks of age in July to 26 weeks of age in November in 2003, 2004, and 2005. A large variation in voluntary feed intake, weight gain, and feed efficiency was found between male + female pairs of kits. It is concluded that individual *ad libitum* feeding increases the feed consumption, weight gain, and feed efficiency compared to the usual farm feeding practice. Selection for high body weight under both individual *ad libitum* feeding and moderate restricted feeding increases the feed efficiency by the same magnitude, mainly by increasing the weight gain or reducing the feed consumption, respectively. The feed efficiency was 26 % better in the *ad libitum* and restricted feeding lines compared to the farm fed line in the third growth season. Selection for feed efficiency under individual *ad libitum* feeding increased the feed efficiency 19 % compared to the Farm Fed control line by an increasing weight gain combined with a reduced feed consumption.

*Proceedings from NJF – Seminar No. 392, 5 pp, 1 table, 4 refs. Authors' abstract.*

**Modelling feed conversion efficiency in mink**

*P. Berg, B.K. Hansen*

Feed is the largest single cost in mink production. However, efficiency of utilization of feed cannot be easily recorded in mink production, as animals are normally kept in pairs.

The objective of the paper is to present a model for feed conversion rate when feed is measured for pairs of animals and weights are measured individually. These models are used to estimate variance components for feed conversion rate from a selection experiment. Variance components indicate a large potential for genetic improvement of feed conversion rate. Before implementation in breeding schemes this model should be validated for its predictive ability.

*Proceedings from NJF – Seminar No. 392, 4 pp, 1 fig, 2 tables, 3 refs. Authors' abstract.*

**Prediction of breeding values for feed conversion rate – validating models**

*B.K. Hansen, P. Berg*

It is possible to estimate a breeding value for feed conversion rate for mink using feed allowance recordings for pairs of animals. Four models to predict breeding values for individual feed conversion rate are tested. The material in these analyses includes 4278 animals from which 1798 pairs are used. The animals are from the selection project 'Large Animals – large challenges- selection for large animals without negative consequences' and are of the brown colour type from the period 2003 to 2005. Based on the test results in this paper the best model to predict the breeding value is to weight the cage feed conversion rate with the relative weight gain of each animal.

*Proceedings from NJF – Seminar No. 392, 6 pp, 4 figs, 4 refs. Authors' abstract.*

**Effect of dietary sulphur containing amino acids on urine pH in adult**

*Ø. Ahlstrøm*

The study was carried out to reveal the effect of sulphur containing amino acids (SAA) on urine pH in adult mink (n=6). High urine pH (>6.5) is a factor that promote urinary tract disease (struvite) in mink and other carnivores. The four diets comprising the experiment were the basal diet, basal diet + 0.2 % DL Met, basal diet + 0.4 % DL Met and basal diet + 0.4 % DL-Met and 0.2 % L-cystine (2 x cysteine). The analysed contents of SAA (g/kg DM) in the

four diets were 14.19, 17.88, 21.98 and 27.31, respectively. The study revealed that increasing level of dietary SAA reduced urine pH significantly. The urine pH at 6 h and 12 h after feeding was: 7.00, 6.88, 6.68, 6.17 and 6.68, 6.49, 6.23 and 5.98, respectively. Base excess (BE) values were high for all diets, 733, 682, 626, and 538 mmol/kg DM, respectively. Urine pH was significantly related to BE values of the diet. The SAA are important in fur animal nutrition. The pH reducing effect of dietary SAA on urine revealed in the present study should contribute to more focus on the importance of adequate dietary level and digestibility of SAA in diets for fur animals.

*Proceedings from NJF – Seminar No. 392, 6 pp, 2 tables, 9 refs. Author's abstract.*

**The occurrence of fatty livers and the influence of feeding, feed composition and quality on fatty liver syndrome on fur animals**

*N. Koskinen, T.M. Lassén*

Fatty Liver Syndrome (FLS) or *Hepatic Lipidosis* is a disease condition resulting in abnormal accumulation of fat in the liver cells of fur animals. Liver cells, which are called hepatocytes, go trough thousands of complex biochemical reactions every second in order to perform these myriad functions. Since the liver is involved with almost all biochemical processes it is no wonder that there are many different reasons that will affect it.

In a fatty liver, the liver cells and the spaces in the liver are filled with so much fat that the liver becomes enlarged and heavier. The liver has a yellow greasy appearance. Several factors contribute to FLS and some of these are: damage from toxins, protein malnutrition (especially methionine and cysteine), excess dietary carbohydrates, excess and the wrong kind of dietary fats, choline and biotin, folic acid, vitamin E and B12 deficiency, lack of exercise, excess calories, and obesity, thyroid dysfunction, steroid administration (from hormone injections) and stress - the stress hormone cortisol stimulates appetite, which leads to overeating.

The liver is the organ that orchestrates the metabolism of fats, carbohydrates, and protein. It does this in conjunction with the circulatory system, the lymphatic system and the endocrine (hormone) system. A healthy liver is critical to proper protein, carbohydrate, and fat metabolism. All animals require protein, which consists of amino acids. While some amino acids are synthesized by the animal, the essential ones cannot be synthesized at rate rapid enough rate to permit normal growth and health. These must be provided in the feed, otherwise the animal may develop a condition of FLS. With the aid of the hormones insulin and glucagon, the liver maintains a normal blood glucose level. Glucose is stored in hepatocytes as glycogen, and it is used as a reservoir during times, when carbohydrate intake is low (fasting or starvation). Excess of glucose or in cases of diabetes, glucose is converted and stored as fat, resulting in a greater risk of developing FLS. The liver also regulates fats (fatty acids) in the blood stream. It does this by converting excess amounts of carbohydrates and proteins into fatty acids. Excess fatty acid accumulation in the hepatocytes results in FLS.

Detoxification is an important liver function. It is a complex process that occurs in the endoplasmic reticulum of the hepatocyte. Another example of this detoxification process occurs with the compound ammonia. Poor feed quality as a result of oxidized fat, high content of biogenic amines, bacterial- or myco-toxins or some pesticides also increases the cases of FLS in fur animals.

Most animals that develop FLS are somewhat obese at the onset of the disease and stress is thought to be the main catalyst to bring on this condition, which begins with the animal stopping eating, even for just a day or two. This is the presentation of the cornerstone of FLS, which is Anorexia. The fat, or lipid cells, in the animal then are mobilized in the liver, which is unable to utilize them. The mechanism for the inability of the liver to brake down the fat cells is not fully understood, but it is mainly caused by a deficiency in certain amino acids and vitamins, which has to be provided in the feed. In Finland a higher frequency of blue foxes diagnosed with FLS is found in April and May and

just before pelting in October. Both situations are associated with low feed intake due to animals stopping eating or animals being fed in a restrictive way in order to gain a suitable body condition in order to maintain a normal reproduction.

*Proceedings from NJF – Seminar No. 392, 14 pp, 3 figs, 1 table, 32 refs. Authors' abstract.*

### Basis for benchmarking of mink production

*H.H. Møller*

In 2004 a question of common economic key figures in Danish mink production was raised. The purpose of the common figures was a better benchmarking between mink farms using the annual accounts. A cooperation between Kopenhagen Fur and Danish Agricultural Advisory Service (DAAS) was established to calculate these figures.

First we had to form a general view of the case to see solutions that were already available. In DAAS, we have a common annual accounting management system called Ø90 which is used by approximately 42,000 Danish farms. From other questionnaires we know that approx. 50% of the 1,700 Danish mink breeders use Ø90. The Ø90 annual accounts are made by local centres within DAAS, and the results from many of these annual accounts are sent to a common data base at the National Centre. This system based on common annual accounts and a national data base is a solid base for benchmarking. Another valuable solution is the automatic data transmission of invoices from companies dealing with farmers. Automatic data transmission means, that an invoice from e.g. Kopenhagen Fur is sent electronic and accounted directly to the Ø90 system.

At the beginning of the project the automatic data transmission was established between Kopenhagen Fur and Ø90. Besides the technical solution of common interfaces between two existing systems, it was necessary to make a common chart of accounts used in Ø90. This common chart ensures that both amount and price are placed equally for all farmers in the annual accounts, when buying and selling certain goods.

The final step in this project is the implementation of a common chart of accounts at the local centres who present the annual accounts for the mink farmers. To make the national data base perfect, it provides additional information on the number of skins and breeding females in status, together with other information. Already within 2006 it will be possible to state the first key figures of the 2005 annual accounts in order to benchmark your own mink production. Until now, the following key figures are:

- Gross margin per skin or female
- Average price of skin
- Feed expenses per skin
- Number of skin produced per female

*Proceedings from NJF – Seminar No. 392, 4 pp, 4 refs. Author's abstract.*

## Posters

### Adipic acid and benzoic acid for mink in the growing period

*T.N. Clausen, P. Sandbøl, C. Hejlesen*

To test the effect of adipic acid and benzoic acid on urinary pH and acid base balance of the animals, tree groups of 55 black male siblings were used. The test feed was given from mid July to pelting. One group (CON) had control feed, one group (ADP) had control feed with the addition of 0.34 % adipic acid, and the last group (BEN) had control feed with 0.1 % benzoic acid.

0.34 % adipic acid and 0.1 % benzoic acid in the feed to mink kits in the growing period had no effect on the blood acid-base balance of the animals at pelting. Adipic acid increased skin length, and reduced urinary pH compared to the control group. Benzoic acid only reduced urinary pH slightly and not continuously.

*Proceedings from NJF – Seminar No. 392, 3 pp, 2 figs, 2 tables, 3 refs. Authors' abstract.*

**Fasting of male mink after mating and its influence on liver fat content and blood ketone bodies**

*T.N. Clausen, P. Sandbøl*

Liver fat content at pelting is dependent on the feed we use (Clausen & Sandbøl, 2005; Damgaard et al., 1994; 1998a; 1998b), and how long before investigation the mink is fasted (Clausen, 1992; Clausen & Sandbøl, 2005; Bjørnvad et al., 2004; Mustonen et al., 2005). To investigate the effect of fasting breeding males, on liver fat content, we used 98 brown mink. The males were body scored before and after mating. After mating they were fasted for 0 to 72 hours before they were euthanized. The animals were weighed, blood samples were taken to measure ketone bodies, and liver samples were taken to determine relative liver weight and liver fat percent.

Fasting up to 72 hours of male mink with normal body score, gave a reduction in relative liver weight within the first 48 hours. There was no change in liver fat percent after fasting, but fat male mink, had the highest fat content in the liver. The blood content of ketone bodies increased after 24 hours of fasting, due to an increase in fat catabolism.

*Proceedings from NJF – Seminar No. 392, 4 pp, 1 fig, 2 tables, 15 refs. Authors' abstract.*

**Protein supply did not affect intestinal morphology and enzyme activity in 7 weeks old mink kits**

*R. Fink, J. Elnif, A.-H. Tauson*

Mink kits start to eat solid feed in addition to milk about 4 weeks post partum. For management reasons the kits are fed the same diet as the dams. Mink kits thereby experience a dramatic dietary change, and the frequency of gastrointestinal disorders and loss of kits is high during this period (Rattenborg et al. 1999). The authors have previously shown that the optimal protein supply for milk production not is optimal as weaning diet for mink kits (Fink et al., 2005). The objective of this study was to investigate the effects of protein supply on intestinal morphology and enzyme activity, in order to test the hypothesis that mink kits have a higher protein requirement than the lactating dam.

*Proceedings from NJF – Seminar No. 392, 4 pp, 2 tables, 3 refs. Authors' abstract.*

**Taste enhancers in an amino acid diet to mink**

*K. Hvam, C. Hejlesen, P. Sandbøl*

It is optimal and often necessary to use a so-called 'synthetic' diet when the nutrient requirements of mink are investigated. Obviously it is also important that the energy intake matches the animal's requirement for maintenance. However, in the small scale experiment we have conducted so far using 'synthetic' diets the energy intake has varied and been low. An experiment was therefore conducted to investigate if addition of a taste enhancer to an amino acid diet could increase the energy intake.
The three taste enhancers used (Fish Sauce, Soya Sauce and Sweet Soya Sauce) increased the energy intake at all 3 inclusion levels. For Soya Sauce and Sweet Soya Sauce at the highest inclusion level the increase wasn't statistically different from the control group (diet without taste enhancer). For the other 7 groups (combination of taste enhancer and inclusion level) the ingestion of feed end thereby metabolizable energy matches the requirement for maintenance of the male mink used in the experiment.

*Proceedings from NJF – Seminar No. 392, 4 pp, 4 tables, 5 refs. Authors' abstract.*

**The first genetic map for the American mink; mapping of coat colour genes**

*R. Anistoroaei, O. Serov, A. Farid, K. Christensen*

Denmark alone produces more than 30% of mink fur of the world market and this is an important reason to be the first country involved in gene mapping of this specie. Despite the economic importance of mink production in Northern Europe and North America, mink genomics research is lagging far behind other livestock species therefore, a genetic map for Mustela vison was the first priority. This map will serve as a basis for further

refinement as well as identification of genes that modulate monogenic traits, or for the identification of chromosomal regions which contain genes having a major effect on economically important traits (QTL). In order to achieve such goals, two main approaches have been adopted: development of new polymorphic markers (microsatellites) and linkage analysis in the mink families by genotyping these microsatellite markers.

Microsatellites are highly polymorphic (Tautz et al., 1999), abundant, and near randomly distributed in eukaryotic genomes (Tautz et al., 1989 & Weber et al., 1989) and the maps of microsatellites have provided a valuable resource for identification of genes associated with traits of interest. Microsatellite markers are ideal tools for the development of a genetic linkage maps as evidenced by the steadily growing number of genetic maps based on them.

Development of new microsatellites was achieved by standard cloning and sequencing procedures. Mink genomic DNA was cleaved into small size fragments (300 to 1300 bp) by complete digestion with Sau3A1 or NlaIII enzymes and subsequently ligated into BamH1 and SphI digested, deposphorylated pGEM7Z vectors (Promega) and transformed into XL_Blue MRF strain of E. coli (Stratagene).

Insert sequences of randomly selected clones were obtained by universal primers and microsatellite sequences were detected by bioinformatics tools. (Anistoroaei et al., 2006).

Genotyping of the 167 informative polymorphic microsatellites was performed in a reference population consisting of five sires, 13 dams and 92 F1 progeny obtained from crosses between minks with different color types.

Forward primers were flourescently labeled and the fragment analysis was performed using an ABI Prism 3100 automated DNA sequencer (Applied Biosystems) equipped with GeneScan and Genotyper software.

Eighty five of these markers were assigned to 17 linkage groups using Crimap software. Physical mapping of the at least one microsatellite per group was also performed using a panel of mink-hamster hybrid somatic cell lines, showing consistent results with the linkage map. The linkage groups were assigned to all chromosomes except chromosomes 9, 11 and X.

The 17 linkage groups cover a total length of 690 cM with an average intragroup intermarker distance of 8 cM. Assuming coverage of 16cM (2x8cM) for each of the 60 unlinked markers, the total length spanned by all the markers would be around 1650cM (690 + 960). Our estimates over the total length of the American mink is 2750 cM and is resulting from the interpretation of the outcome from the last markers ran in the linkage analysis.

This map is the first genetic map of the American mink and thus a major step towards the development of a high quality genetic map for this species. Analysis of mink pedigrees supports that most of the color patterns inheritability is autosomal recessive. The mink genetic map will have a great and most immediate impact in facilitating the mapping of these genes and the subsequent development of assisted breeding. Even without identifying the underlying genetic expression, analysis with markers closely liked to a specific trait will allow breeders to identify the carriers as well as to adopting breeding plans. QTL's have continued to be reported on all chromosomes for many traits in many animal production species, therefore QTL studies can now be planed for such traits as size, growth, fur quality, litter size and coat colour.

In our study, by introducing in the study families segregating in different colour patterns, so far, two colour genes have been mapped in this map. The "silver" gene was genetically mapped on chromosome 3 in mink. The physical localization of BAC RP81-203J24 (containing the "dilution" gene from dog) on q arm of mink chromosome 3 performed by hybridization in situ (utilizing) as well as by the comparative studies between these 2 species (Hameister et al., 1997) in mink strongly supports the assumption that "silver" colour gene in mink is in fact what it has been described in dog as "dilution" gene.

In the future, developing resources in our laboratories will be utilized to expand the mink map. Additional microsatellite markers under development will complete the genetic map for this species. As well, a large-insert BAC library which is under development will be utilized in anchoring the genetic map to the physical one as well as for

isolating markers from the underrepresented or unrepresented chromosomes.

*Proceedings from NJF – Seminar No. 392, 2 pp, 5 refs. Authors' abstract.*

**Early selection of young breeding blue foxes (*Alopex lagopus*) improves breeding result**

*N. Koskinen, P. Pylkkö, T. Rekilä*

Decreasing litter size of blue fox (*Alopex lagopus*) females in the past few years has alarmed Finnish fur farmers. On an one hand increasing weight of blue fox females has been suspected to be an important factor affecting the litter size/ female and on the other hand a season of a selection of female breeders may have an effect as well. A field study was carried out in years 2003-2006. A number of blue fox females, 136 (year 2003), 107 (year 2004) and 105 (year 2005), were studied at a private fur farm. Aims of the present study were: to determine if the season, when blue fox females are selected for breeding, has an effect on the litter size and to clarify connection of body weight of artificially inseminated blue fox female and the litter size. Young blue fox females were selected for breeding in summer (after weaning) or in autumn (before pelting). The females selected in summer were fed on a restricted breeder's diet. Females selected in autumn were fed on an unrestricted diet during growing-furring season, and then were fed on a restricted diet after selection for breeding. The females were weighed at the time of artificial insemination. Breeding result (litter size/female) was calculated when vixens were six weeks old. The season for choosing the first year's blue fox breeders was important. The selection in summer improved the breeding result. The weight of blue fox female at the time of artificial insemination had an effect to the litter size. Therefore, also feeding history and dieting had remarkable effect on breeding result.

*Proceedings from NJF – Seminar No. 392, 5 pp, 4 figs, 1 table. Authors' abstract.*

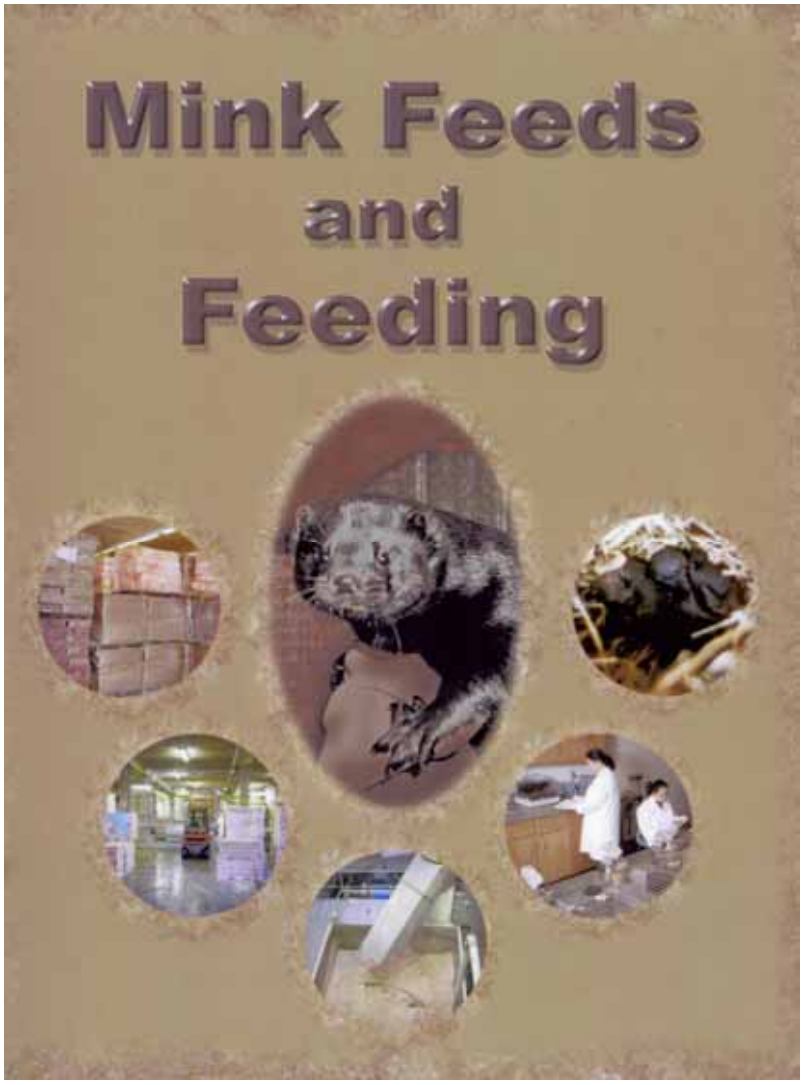
# Mink Feeds and Feeding

**by**

**Kirsti Rouvinen-Watt, Margot B. White,**

**and**

**Rosaria Campbell**




Ontario Ministry of Agriculture and Food,
through the Agricultural Research Institute of Ontario,
and the Nova Scotia Agricultural College

*Mink Feeds and Feeding* is a practical feeding guide written to aid the mink industry in feed ingredient identification and evaluation, ration balancing, and the assessment of nutritional and hygienic quality. The guide is intended to be applied in focus, and to provide producers with the tools and skills required in the planning, realization, and evaluation of their ranch feeding program.

To ensure a comprehensive coverage of current information on mink feeds and feeding, the guide is presented in seven sections. Section 1 to 3 introduce

key concepts in basic nutrition, feed and water analysis, and evaluating feedstuff quality. Section 4 details the nutritional and hygienic characteristics of a variety of feed ingredients, and Section 5 covers the handling, storage, and processing options that help ensure both feeds and ingredients are of the highest nutritional and hygienic quality. Section 6 covers nutrient requirements and feeding programs throughout the production cycle, and Section 7 provides basic tools for evaluating ingredient and diet quality, and for troubleshooting the feeding program.

The printable CD version of this guide contains expanded information on each topic, a complete list of the references used in the preparation of the guide, and a number of additional appendices on topics of practical interest.

To supplement the information provided in the guide the *Mink Feed Ingredient Database* provides information on nutrient composition and digestibility for a variety of mink feed ingredients. When used properly the database is a powerful tool that allows the comparison of ingredients on the basis of their nutritional content, digestibility, and cost. It is intended to serve as a numerical tool for evaluating the feeding value of feed ingredients, and also allows you to input data on new or opportunity feedstuffs as they become available. The complete database version is available on the CD, and a condensed tabular version is included as an Appendix to the printed guide.

*Mink Feeds and Feeding* is the result of a great deal of collaboration and cooperation from a number of experts in the fields of mink nutrition and production. The authors are deeply indebted to the members of the advisory board and to the external reviewers for their review and fine-tuning of this guide. Their time and expertise was instrumental in ensuring that the information presented is the most current available.

Rouvinen-Watt, K., White, M.B. & Campbell, R., 2005. Mink Feeds and Feeding, Applied Feeding Guide and Mink Feed Ingredient Database. CD-ROM version. ISBN 1-55174-324-8. Ontario Ministry of Agriculture and Food, through the Agricultural Research Institute of Ontario, and the Nova Scotia Agricultural College. 286 p.

Rouvinen-Watt, K., White, M.B. & Campbell, R., 2005. Mink Feeds and Feeding. ISBN 1-55174-323-X. Ontario Ministry of Agriculture and Food, through the Agricultural Research Institute of Ontario, and the Nova Scotia Agricultural College. 182 p.

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