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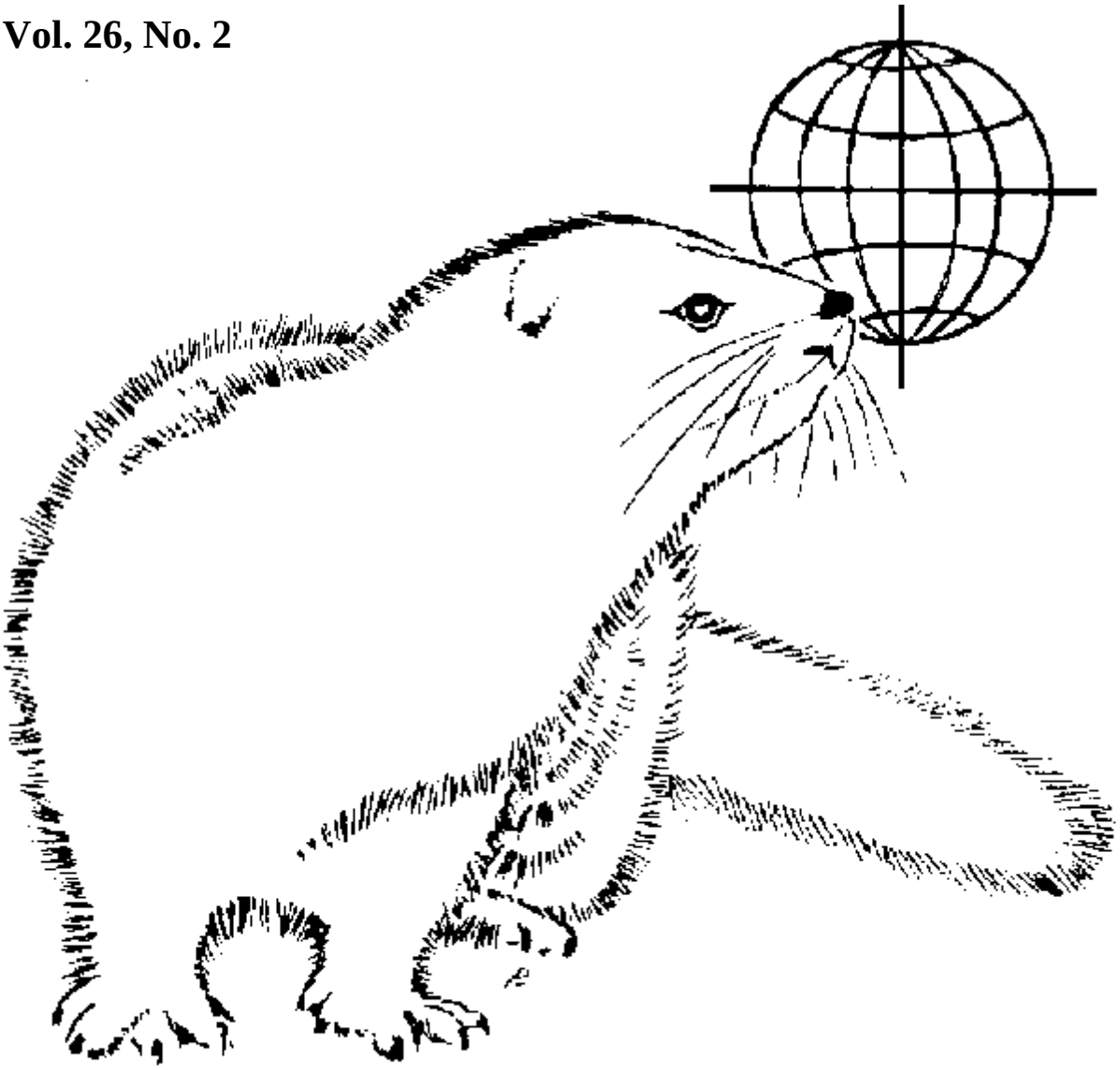

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INTERNATIONAL FUR ANIMAL SCIENTIFIC ASSOCIATION

SCIENTIFUR - scientific information in Fur Animal Production.

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Notes from the Group of Editors

This version of Scientifur is the second issue of volume 26. After being published electronically, the first two issues of this volume will soon appear in a paper version which will be sent to all our subscribers.

This issue contains primarily abstracts of oral presentations as well as posters presented at the Seminar No. 347 of the Nordic Association of Agricultural Scientists, Subsection for Fur Animals. Approximately 100 participants from Belgium, Canada, Denmark, Finland, Iceland, the Netherlands, Norway, Russia and Sweden participated in the seminar which took place in Vuokatti, Finland, 2 – 4 October 2002.

At the seminar, we took the opportunity to present a poster describing the objectives of Scientifur, and we were pleased to see that many of the participants in the seminar took an interest in our work.

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.

We expect to publish the last two issues of volume 26 within the next two – three months.

Merry Christmas and a Happy New Year to all our readers and contributors.

On behalf of the
Group of Editors

Birthe Damgaard

Wooden blocks and straw as environmental enrichments for juvenile blue foxes (*Alopex lagopus*)

H.T. Korhonen, L. Jauhiainen, P. Niemelä, R. Sauna-aho

Acta Ethol., 2002: 5, 29-37, 2 figs., 2 tables, 48 refs.

This study was designed to evaluate the enrichment value of a wooden block (30 cm long x 4 cm in diameter) and straw for growing farm-bred male blue foxes (*Alopex* lagopus). Comparisons were made between animals provided with these enrichments at 7 weeks and 15 weeks of age. Various behavioural, physiological, and haematological variables as well as fur and teeth characteristics were assessed. The foxes showed significantly higher motivation to interact with the block than wilth the straw. The novelty response to block manipulation was higher when the block was given to foces at 15 weeks than at 7 weeks of age. In straw groups no actual age effect was observed. Both the wooden block and the straw appeared to stimulate particularly the occurrence of play behaviour, which can be considered an indicator of good welfare. Significant differences were not found between the experimental groups in the novel object (ball) in-cage test. However, a slight tendency for increased explorative activity and shorter latency to object sniffing in the open field test were evident in the block animals. The wooden block was found effectively to prevent the accumulation of dental plaque and development of hypertrophia gingival. However, both the block and the straw markedly increased the incidence of hyperaemia in the mucous membrane of the stomach and intestine. This may explain the lower weight development in these groups than in the controls. Significant differences were not found between the experimental groups in blood screen (haemoglobin, white blood cells, red blood cells, haematocrit) or in the cortisol : creatinine ratio analysed from 24-h urine. The body-weight-related adrenal weight, however, tended to be lowest in the block animals. Furthermore, the presence of a wooden block in a cage significantly reduced the amount of oral stereotypies during the latter part of the growing season. Significant differences did not exist in economically important fur characteristics (quality, mass, cover). It is suggested that fur studies on alternative chewing objects should be conducted before introducing such environmental enrichments into farming practice.

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NJF RAPPORTER

Nutrition

Calcium and phosphorus nutrition of blue foxes

J. Valaja, I. Pölönen, T. Rekilä, N. Nenonen, T. Jalava

Four experiments were conducted to study the effects of dietary mineral level and Ca:P ratio on the performance, fur quality and bone mineralisation of growing blue foxes (Alopex lagopus). In the first experiment, the effects of dietary mineral level (50, 77 and 105 g/kg DM ash in low, medium and high mineral level, respectively) and Ca:P ratio (1.2 or 1.7) on mineral metabolism and bone mineralisation were studied with 24 male blue foxes (age 2.0-2.5 months). In the second experiment, the effects of dietary mineral level (53, 81 or 115 g/kg DM ash in low, medium or high mineral level, respectively) on growth performance and fur quality properties were studied with 150 growing male and female blue foxes from mid. September to pelting in December. In the third experiment, the effects of diet Ca:P ratio (1.5 or 2.5) and metabolisable energy content (ME) (17.3 MJ/kg DM or 19.2 MJ/kg DM ME in low and normal energy diets, respectively) on performance and bone mineralisation were studied with 40 growing male blue foxes from mid. July to October. In the fourth experiment, the effects of diet mineral level (61, 81 and 116 g/kg DM ash in low, medium or high mineral level, respectively) on growth performance and bone mineralisation were studied with 30 male blue foxes from mid July to end of September. All low ash experimental diets were composed of acified low ash slaughterhouse by-products, baltic herring, maize glutein, heat-treated barley, soybean meal, fat, minerals and vitamins. Ash content of the diets were increased with meat and bone meal and Ca:P ratio were adjusted with limestone and monocalciumphosphate. In the first experiment animals were housed individually in digestibility cages where separate collection of faeces and urine was possible. In other experiments the animals were kept in normal wire mesh cages, one animal per cage (exp. 3 and 4) or two animals per cage (exp. 2). All the animals were fed once daily and water was provided freely. At the termination of the experiment tibia bones of the legs were removed for bone breaking strength and mineral content determinations.

Increase in dietary mineral content impaired Ca and P digestibility ($p<0.001$) (exp.1 and 2). Mineral content had no effect on daily P retention which indicates that dietary P level of the diets was above the requirement of growing foxes (exp. 1). Weight gain of the foxes increased with incremental diet ash content ($P<0.001$) (exp. 2 and 4). However, improvements in performance of foxes were due to differences in the diet ME contents and not due to diet minerals. Diet mineral content had no effects on the pelt quality of the foxes (exp.2). P excretion in faeces and urine was decreased by 73% as dietary mineral content was lowered from high to low ($p<0.001$) (exp. 1) and P content of faeces was lowered from 67 to 15 g/kg DM with dietary ash level ($p<0.001$) (exp. 2). High Ca:P ratio decreased the urinary P excretion ($p<0.001$) and increased P retention ($p<0.01$) (exp. 1). Higher Ca:P ratio also resulted in higher Ca and P content of the bones ($p<0.01$) (exp. 3). Low dietary mineral level had no negative effects on bone mineral content or breaking strength (exp. 1, 2 and 4). The results of these experiments strongly indicate that low mineral diets (ash content 50 g/kg DM and P content 6 g/kg DM) are above the P requirement of modern growing foxes. In addition, low ash and P diets clearly decreased the excretion of P. Higher Ca:P ratio (above 2.0) seemed to enchance P retention and bone mineralisation in foxes but the observation still needs verification.

Proceedings from NJF - Seminar No. 347. 6 pp, 4 tables, 3 refs. Authors' abstract

Soybean products in fur animal diets

A. Skrede, Ø. Ahlstrøm

Three different soybean meals, solvent extracted (not dehulled) soybean meal from Denofa AS (SBM), HP 300 from Hamlet Protein A/S (SHP), and the fullfat soybean product SOYAX-F from Shouten Products B.V. (SSP) were studied in feeding experiments with dark mink during the late growth and furring period. Each soybean product was fed at two levels (15 and 30 percent of total dietary protein) replacing fish meal protein. Each diet was fed to 32 kits, half males and half females. Appetite, growth performance, skin size and fur development were generally acceptable with all

diets. There were tendencies towards slightly reduced gain and final body weights in male mink fed increasing levels of SBM ($P>0.05$). Skin size and fur characteristics were not affected by replacing fish meal protein with SBM. The highest level of SHP reduced significantly the gain of male kits ($P<0.05$), while the gain of female kits was unaffected. There was no significant effect of replacing fish meal with SHP on skin size or fur characteristics. Feeding of SSP at 30% of total dietary protein (13% of diet) reduced significantly the gain of male kits ($P<0.05$), while there was no significant effect on the gain of female kits. Fur characteristics were not significantly affected by feeding increasing levels of SSP. Overall, substitution of fish meal protein with soybean products tended to increase guard hair length, especially in male mink.

Proceedings from NJF - Seminar No. 347. 9 pp, 8 tables, 10 refs. Authors' abstract.

Dehulled and naked oats in mink and blue fox diets

N. Nenonen, I. Pölönen, T. Rekilä, P. Siirilä, J. Valaja

Substitution of barley with oats is a viable alternative in fur animal feeds. Its fat content is high and it contains only small amounts of soluble β-glucanes. That means oats are not likely to cause problems with faeces, and cage neatness remains better because the husk percentage in oats is quite high and its energy value is fairly low, lower than in barley. However, the feeding value of oats can be improved by removing husks, which results in dehulled oats. Naked oats are a new strain of oats. The hull falls off from the groat already during threshing. Therefore the groat yield of naked oats cultivars is about the same as that of covered oats cultivars after dehulling. Naked oats have a very high percentage of fat (7%) compared to normal oats (5%). Dehulled oats have a fat content of 8-9%.

Naked and dehulled oats have been widely studied and used in diets for pigs, ducks, dogs and horses, but hardly ever in fur animal diets. Only raw barley and oats in mink and blue fox diets have been studied by Kiiskinen et al. (1978). The aim of this project was to study the effects of naked and dehulled oats in blue fox and mink feeds on digestibility, performance and fur quality. The results will be applied in optimising nutrition of fur animals and increasing utilization of cereals in fur animals.

Our results – both preliminary digestibility data, growth and fur characteristics – show that both dehulled and naked oats are suitable ingredients in mink and blue fox feed. Naked oats are a new crop and not yet widely cultivated in Finland. Recent studies have showed that some cultivars produce yields as high as common oats. However, naked oats can be quite sensitive to damage during seeding and harvesting. Hence, naked and dehulled oats will have a potential as a feed ingredient in fur bearing animal diets. Further research is required to optimise the composition of the diet containing naked and dehulled oats.

Proceedings from NJF - Seminar No. 347. 8 pp, 4 figs, 4 tables, 7 refs.

Apparent digestibility and storage stability of amino acids in feedstuffs prepared from end-of-cycle laying hens by formic acid preservation

M. White, K. Rouvinen-Watt, D. Boudreau, L. Longmire, M. Johnson

A 2×4 factorial design experiment was conducted to determine digestibility coefficients (DC) of dry matter (DM), crude protein (CP), crude fat (CF), gross energy (GE) and amino acids (AA), in raw ground (RGH) and acid ensiled end-of-cycle laying hens (AEH) by mink. The AEH was prepared with the addition of 1.5% (wt:wt) formic acid (85% concentration) and 0.3 % (wt:wt) sodium benzoate to the raw carcass mass prepared from end-of-cycle laying hens. Eight different mature standard type male mink per period were confined to metabolism cages during the digestibility trial, which consisted of four experimental periods comprised of a 4-d adjustment, followed by a 3-d collection. Based on the total collection method with graded levels (0, 15, 30 and 45%) of the test feedstuffs in the experimental diets, nutrient digestibility in the pure feedstuffs was determined using a linear regression technique. The apparent digestibility (AD) of DM, CP, CF and GE were RGH: 67.2, 75.7, 91.3 and 78.8% and AEH: 69.7, 71.8, 94.3 and 77.9%,

respectively. The AD of all the AAs was generally the same in both the RGH and AEH, with the exception of a significantly higher AD of; threonine, serine and glycine in the RGH and histidine, methionine and cystine in the AEH. A quality evaluation of the AEH was conducted in a completely randomized design with two replications to determine storage stability on four different sampling days over the 180 day storage period. Quality of the AEH was stable up to day 35, based on increases in pH and total volatile nitrogen (TVN) content and decreases in N and AA content. A microbial evaluation of the AEH indicated no significant findings of E. coli growth and total bacteria counts that were greatly reduced compared to that in the RGH. The formic acid sodium benzoate combination was an effective preservation method for the carcass mass prepared from end-of-cycle laying hens. These poultry byproduct feedstuffs would provide a good source of digestible nutrients for mink.

Proceedings from NJF - Seminar No. 347. 15 pp, 4 tables, 37 refs. Authors' abstract.

Short time conservation of slaughterhouse by-products

Ø. Ahlstrøm, O. Sylte Heggset, T. Granli, E. Kjos

Short-time conservation of slaugtherhouse by-products for fur animal feed has become of current interest in Norway to reduce the delivery of by-products to meat-and-bone meal production. The destruction plants have to charge the slaughterhouses for processing their by-products, as the meat-and-bone meal has to go for stock pending on cancellation of the ban of using it as feed for animal livestock or alternative utilization. A simple and cheap method for preservation is short-time conservation with acid at pH 5. At that pH microorganisms still will be able to grow and preservation will just be adequate for days depending on hygienic quality at the start point and the storage temperature. The relatively high pH would allow a high inclusion of the product in the feed without any risk of too low pH (<5) even if other acid conserved ingredients are used in the feed, for instance fish silage.

The preservative effects of four products based on formic acid were examined in the experiment. Formic acid (85 %), formic acid + ammonium diformate+propionic acid+ benzoic, potassium diformate+propionic acid and potassium diformate revealed satisfactory preservative effect on slaugtherhouse by-products (rumen) at pH 5 stored in room temperature
18-20 °C for three days and in a refrigerator (3-4 °C) for at least seven days.

Proceedings from NJF - Seminar No. 347. 6 pp, 4 tables, 2 refs. Authors' abstract.

Digestibility of nutrients by young mink (*Mustela vison*) kits and adults, a comparison

C. Hejlesen

The development of the mink kits (7-10 weeks of age) ability to digest nutrients in commercial feed was investigated by Elnif and Hansen (1987). Besides this, reports concerning the age dependant development before 1-12 weeks of age is scarce. The aim of the trials reported herein, was to examine the age (7-10 week) dependant development in digestibility of feed ingredients (Fish Offal, Swine Pulp and Meat and Bone Meal) having different adult levels of nutrient digestibilities.

It is concluded that the mink kits ability to digest protein and fat at 7 and 9 weeks of age is inferior to the level of adults.

The age dependant ability to digest protein seemed to be dependant of the adult level of digestibility. Data were too limited to be conclusive, but it suggested that the ability increased linear from week 7 to week 9 of age, when the adult level was high (85%). At a low level of adult digestibility (65%), the kits ability to digest protein was constant in this period.

The lower adult ability to digest fat from Meat and Bone meal compared to fat from Swine Pulp was reinforced at 7 weeks of age. From week 7 to 9 of age the ability increased linear, most radical for fat from Meat and Bone Meal. From the linearity the

adult level of fat digestibility was calculated to be reached at the age of about 11 weeks.

Proceedings from NJF - Seminar No. 347. 7 pp, 5 tables, 14 refs. Author's abstract.

Individual feeding of mink in May and June – an alternative way of feeding mink

M. Sønderup

If mink farming in Denmark is to remain attractive when skin prices are lower than today, it will continue to be necessary to rationalize farm labour. The limiting factor to the number of mink per person is the amount of work on the farm during the suckling period in May and June. A method of individual feeding of dams and litters is described and discussed.

The method, among other things, makes it possible to reduce the time spent per female per litter on feeding, to optimise feeding, to do a systematic health control, and to conduct a systematic, fænotypic selection for both kit growth and for dams having an optimal lactation period. The latter describes dams that are able to maintain a good condition, while at the same time taking good care of their offspring and maintaining lactation until the kits are able to eat on their own at around six weeks of age.

The feeding method has been practised on a practical farm for several years. The method requires a computer to control the feeding pump of the feeding machine. Because of focus on the advantages of the feeding method and its development, the method is discussed and used by more and more Danish farmers.

Proceedings from NJF - Seminar No. 347. 7 pp, 3 figs. Author's abstract.

Quality assurance in mink feed – Traditional microbiological quality control or HACCP

T. Mikael Lassén, E. Hedegaard

Feed quality is of great importance in mink production. Mink feed is produced from by-products from slaughterhouses and filleting factories. The quality of mink feed is highly dependent of the quality of the raw material. Quality of both raw materials and mink feed can be evaluated by microbiological analysis, however this method is both expensive and slow and do not provide any security. The HACCP (Hazard Analysis Critical Control Point) system is based on an evaluation of potential hazards in raw materials and mink feed. This provides a possibility to predict possible hazards and a way to avoid the hazards.

In this paper the differences in security between traditional microbiological quality control and quality assurance with HACCP-systems. The basic theory behind traditional microbiological control is described and some examples of microbiological control of mink feed and raw materials are shown. The basic principles for the HACCP system and the implementation into production of mink feed and production of raw materials are discussed.

Examples of critical control points in the production of mink feed and raw materials is shown together with examples of different ways of controlling critical limits and corrective actions.

Critical control points in mink feed production are hygiene time, temperature, pH, odour and appearance. These parameters are a part of the training programme for the personnel at feed kitchens.

It is concluded, that a fully working HACCP system is much more effective and less expensive than traditional microbiological control in assuring feed quality. However it is essential to keep the HACCP system under control, because a HACCP system, which is out of control do not provide any kind of security against potential hazards in mink feed. The HACCP system must continuously be evaluated and updated in order to be effective.

Proceedings from NJF - Seminar No. 347. 22 pp, 2 figs, 4 tables, 8 refs. Authors' abstract.

N-balance and production experiments with Bioprotein for growing mink

Ø. Ahlstrøm, A. Skrede

Production experiments with Bioprotein (4% and 8% of diet) as protein source for growing mink showed that Bioprotein may account for 40% of digestible protein in this period. The highest level of Bioprotein (8% of diet, 40% of digestible protein) reduced feed intake at the first part of the experiment and resulted in significantly lower body weight gain for males, but not for females. The lowest growth rate did not affect skin size. The highest level of Bioprotein reduced hair length significantly for both males and females. Other fur parameters were not affected by diet. An N-balance experiment with the respective diets confirmed that Bioprotein has an amino acid composition that can level that of fish meal.

Proceedings from NJF - Seminar No. 347. 5 pp, 4 tables, 2 refs. Authors' abstract.

Bioprotein meal, a new protein source for mink

A.L. Frydendahl Hellwing, A.-H. Tauson

A balance and respiration experiment with 16 male mink kits was performed in 5 periods from a kit age of approximately 9.5 weeks to approximately 23.5 weeks. The objective of the study was to evaluate the effects of an increasing amount of dietary bioprotein meal (BPM). The BPM contents in the 4 diets were 0% (Diet I), 20% (Diet II), 40% (Diet III) and 60% (Diet IV) of the digestible protein and it substituted fish meal. Animal live weights were not significantly affected by diet, but there was a tendency for lower live weights among animals fed diet IV. The intake of ME in relation to metabolic weight was decreased with increasing levels of BPM in the diet. This was mainly caused by a lowered digestibility of protein and energy when BPM was increased. The retention of nitrogen (RN) was not significantly ($P>0.05$) affected by diet but for diet IV the energy retention was negative and significantly lower ($P<0.05$ than for diets I, II and III. The utilisation of DN for retention was similar in all groups. Heat production was almost identical in all groups.

Proceedings from NJF - Seminar No. 347. 6 pp, 2 figs, 2 tables, 15 refs. Authors' abstract.

Ethology

Survival and growth of blue fox cubs from small and large litters

V. Ilukha, J. Mononen, T. Pyykönen, L. Nurminen, M. Harri

The effect of the litter size on the weight gain and survival of blue foxes from birth to pelting was studied by comparing cubs from 10 small (3-5 cubs at birth) and 10 large (10-15 cubs at birth) litters.

The cubs from the small litters were heavier at all times of the growing season, but the difference decreased from more than 25% at the age of a few days (in May) to less than 10% at pelting in October. Cub losses during the period from birth to pelting were 7% in the small litters and 15% in the large litters.

Although larger litter size at birth resulted in a higher percentage of cub losses and in a lower final body weight at pelting, it was clear that these disadvantages were compensated with the litter size: the ten large and small litters produced 97 and 38 cubs, respectively, for pelting.

Proceedings from NJF - Seminar No. 347. 5 pp, 1 table, 8 refs. Authors' abstract.

Operant methodology as a method to measure social priorities in farmed foxes

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

In farmed foxes group-housing experiments have demonstrated several negative welfare consequences. In view of the fact that sociality has a number of different functions (e.g. reproduction, protection, feeding) the social motivation of an animal may well vary according to its species age, sex, status, season, and individual behavioural characteristics. It is therefore important to validate the relevance of these factors to social motivation.

These findings could subsequently be used to identify the effects of group-housing on welfare in farmed foxes, and, potentially as a basis to construct functional social pairs or groups of animals.

Operant methodology and consumer demand approaches are frequently used in animal welfare research to value different environmental resources. There are however few studies using operant technology to quantify social priorities. A prerequisite for valid measures of resource value is allowing satisfactory "consumption" of the resource. In social experiments satisfying consumption involves physical interaction with another animal, a factor that poses some practical problems related to the test animals revisit to the operant compartment. In the construction of the operant apparatus for foxes this factor was in particular taken into account.

The aims of the study are, besides developing operant technology for measuring social priorities in farmed foxes, to document the social motivation of farmed foxes as a basis for flexible housing systems, and examine family dynamics in foxes, focusing on maternal and helping behaviour and their relationships with e.g. social status.

Proceedings from NJF - Seminar No. 347. 6 pp, 1 fig, 9 refs. Authors' abstract.

An operant apparatus for blue foxes: preliminary results

T. Koistinen, J. Mononen, T. Ryhänen, S. Hänninen

Operant conditioning is a potential method for measuring the strength of animals' motivation towards different environmental features. The method is based on an assumption that animals are willing to work more to get commodities that they need strongly than to get less important commodities. Fulfilling the needs that are the most important from the animals' point of view improve their welfare more efficiently than fulfilling less important needs (luxuries).

For some years we have been willing to apply the method for blue foxes without a laborious manual controlling of the test system. Therefore, we developed an automated apparatus consisting of a commercial control unit and four self-made operant chambers including the levers. The apparatus is modifiable according to the special features of the commodity studied. We tested the compatibility of the control unit and self-made device by generating demand functions for feed in seven blue foxes. We also performed a few trials with a sand floor as the reward.

All the foxes learned to press the lever with their forepaws. The mean slope of the demand curve for feed was 0.43 ± 0.083 (mean ± SD, n = 7). This slope for feed was steeper than expected according to previous experiments for feed. The factors that possibly affected the slope are discussed in the paper. The slope for the sand floor ranged from 0.34 to 0.61, which indicates that a sand floor may be an important need to foxes, and that the experiments are worth continuing.

The apparatus worked properly in the food and sand floor trials, and with minor modifications it can be used in the future to study the motivation towards various environmental commodities.

Proceedings from NJF - Seminar No. 347. 6 pp, 8 refs. Authors' abstract.

Breeding success of farmed silver foxes with top boxes

T. Pyykönen, J. Asikainen, M. Miettinen, J. Mononen, J. Sepponen, L. Ahola

A nest box is a crucial part of the housing environment and a few earlier studies have shown that nest box configuration may influence reproduction and also animal welfare. Our study concentrated on the possible advantages of a top box as a breeding box for silver foxes.

Silver fox vixens were provided with top boxes E group (154 primiparous, 70 multiparous) and with floor boxes C group (159 primiparous, 31 multiparous). As expected, the multiparous vixens reproduced markedly better than the primiparous vixens. In the primiparous vixens there were less barren females and more successful breeders with larger litters in the E group than in the C group. The reproductive performance (cubs per breeding female) was 0.7 cubs better in the top boxes than in

the floor boxes. In the multiparous vixens, all variables pointed to better reproduction in E than in C, but the differences were not statistically significant. The differences between E and C groups were minor in the multiparous vixens but pronounced in the primiparous vixens. Accordingly it seems that the top boxes are beneficial in particular to primiparous vixens.

Two-year field data, where top boxes were used as only breeding boxes for silver foxes, support the previous results. The reproductive performance was 2.7 cubs for the primiparous vixens and 3.1 cubs for the multiparous vixens. These values are good when compared to the national reproductive performance (2.82 cubs). There were no major differences between the multiparous and the primiparous vixens, which probably is a proof for the benefits of the top boxes especially to primiparous vixens.

The top box can be recommended as a breeding nest box for farmed silver foxes. It is both practical and economical, and it may improve the welfare of the foxes.

Proceedings from NJF - Seminar No. 347. 8 pp, 4 tables, 6 refs. Authors' abstract.

On group size and space allocation in cage-housed silver foxes

L. Ahola, J. Mononen, M. Miskala, T. Pyykönen, M. Mohaibes, T. Rekilä

Silver fox cubs were housed either singly, in pairs or in quartets with either 0.6 or 1.2 m2 per fox in cage conditions. Several physiological, behavioural and production-related parameters were measured in order to assess the welfare effects of different social and spatial conditions in these cubs. The results revealed that a possibility for social behaviour is important for the welfare of young silver fox cubs. In the absence of cage mates, the singly housed cubs sought their social stimulus from the humans and performed more locomotor stereotypies than the cubs housed in pairs or in quartets. With the advance of autumn, the quartet-housed cubs stayed more and more apart from each other. This indicates that the natural dispersion behaviour of the wild red fox underlies even in farmed silver foxes. Space allocation as such had only minor effects on the physiology and behaviour of the cubs. However, the effect of smaller space allocation was revealed as a decreased fur quality and as increased biting injuries in female cubs.

Proceedings from NJF - Seminar No. 347. 6 pp, 12 refs. Authors' abstract.

Group housing of raccoon dogs (*Nyctereutes procyonoides*)

S. Hänninen, J. Mononen, T. Pyykönen, L. Ahola, M. Mohaibes, L. Nurminen

Social enrichment may be important for the welfare of the animals in a physically restricted environment, and group housing in so-called 'shared housing systems' can be an efficient and economical way to diversify also the physical environment. On the other hand group housing may lead to aggressive acts that impair animals' welfare. Aggression might be assumed to become a problem in particular if groups are kept together beyond the natural dispersion time of the species in question. In the wild, raccoon dogs disperse in August and September, but earlier studies show that on farms they could be housed as groups until pelting in December. In the present study, we investigated the effects of group housing on the production and welfare of raccoon dog cubs.

The experimental cubs were housed as litter groups (three males and three females) in a row-cage system from weaning to pelting. Traditional pair housing in male-female sibling pairs was used as a control treatment. There were 48 cubs in both groups. Effects of the housing system on the growth (body mass and organ masses), fur properties (skin length, scare score, fur quality, skin price) and stress (adrenal size and ACTH test) were assessed.

The growth of the animals was not affected by the group housing. Group housing led to slightly worse fur quality as compared to the traditional pair housing, although this difference was probably due to the physical environment rather than the social conditions. However, the group housed raccoon dogs were possibly more stressed than the pair housed animals. The results indicate that housing raccoon dogs as large litter groups from weaning to pelting did not lead to major problems, but certain

provisions in regard to the production of high quality furs and animal welfare must be made.

Proceedings from NJF - Seminar No. 347. 8 pp, 1 table, 12 refs. Authors' abstract.

Wooden block and straw as enrichment tools for foxes

H.T. Korhonen, L. Jauhiainen, P. Niemelä, R. Sauna-aho

Farmed foxes are raised in wire-mesh floor cages that provide few stimuli to motivate the animals to explore and interact with their physical environment. It may be assumed that such environmentally impoverished conditions are a potential cause of behavioural disturbances and distress. According to recent European animal welfare recommendations (European Convention 1999) the housing environment of farmed foxes should be enriched with suitably stimulating devices. Opportunities for species-specific behaviour are particularly emphasized. This study was designed to evaluate the enrichment value of a wooden block (30 cm long x 4 cm in diameter) and straw for growing farm-bred male blue foxes (Alopex lagopus). Comparisons were made between animals provided with these enrichments at 7 wk and 15 wk of age. Various behavioural, physiological and haematological variables as well as fur and teeth characteristics were assessed. The foxes showed significantly higher motivation to interact with the block than with the straw. The novelty response to block manipulation was higher when the block was given to foxes at 15 wk than at 7 wk of age. In straw groups no actual age effect was observed. Both the wooden block and the straw appeared to stimulate particularly the occurrence of play behaviour, which can be considered an indicator of good welfare. Significant differences were not found between the experimental groups in the novel object (ball) in-cage test. However, a slight tendency for increased explorative activity and shorter latency to object sniffing in the open field test were evident in the block animals. The wooden block was found to effectively prevent the accumulation of dental plaque and development of hypertrophia gingiva. However, both the block and the straw markedly increased the incidence of hyperaemia in the mucous membrane of the stomach and intestine. This may explain the lower weight development in these groups than in the controls. Significant differences were not found between the experimental groups in blood screen (haemoglobin, white blood cells, red blood cells, haematocrit) or in the cortisol:creatinine ratio analyzed from 24-h urine. The body weight-related adrenal weight, however, tended to be lowest in the block animals. Furthermore, the presence of a wooden block in a cage significantly reduced the amount of oral stereotypies during the latter part of the growing season. Significant differences did not exist in economically important fur characteristics (quality, mass, cover).

Proceedings from NJF - Seminar No. 347. 7 pp, 1 table, 7 refs. Authors' abstract.

Physiology

The development of homeothermy in the mink

S. Harjunpää, K. Rouvinen-Watt

Mink (Mustela vison) kits are born early in the spring and are physiologically immature. One of the major causes of newborn mortality is hypothermia. The objectives of this study were to observe the development of thermoregulation in mink kits and their ability to maintain their body temperature during the postnatal period (1 to 50 days of age) by measuring body weight, and rectal and body surface temperatures. The rectal temperature of the mother and the kits were measured in the nest and the kits were measured for body cooling and warming. Based on body weight, and the rectal and ambient temperature measurements during exposure to cold (4ºC) and warm (40ºC), a homeothermy index (HI) and cooling and warming rates of the kit were calculated. The results indicate that the first three weeks of the kit's life are the most critical. The body temperature of the kits reached the adult level (~39°C) in 50 days. No significant differences in the body temperatures were found after 36 days of age even though the kits' body temperatures were still 2 degrees lower than that of the dam's. At the age of 1 day the HI was 65%, whereas the kits were able to maintain homeothermy by 22 days of age (HI 90%). The body cooling rate was 0.9°Cmin-1 on day 1, but only 0.35°Cmin-1 at 22 days of age. The body

warming rate was lower: day 1, 0.85°Cmin-1 and 0.22°Cmin-1 at 22 days of age. All measured and calculated thermophysiological variables were significantly influenced by body weight and age of the kit.

Proceedings from NJF - Seminar No. 347. 11 pp, 6 figs, 19 refs. Authors' abstract.

Genetics and breeding

Requirements for selecting sound overall performance in animals

A. Mäki-Tanila

The basic elements in animal breeding programme are the formulation of selection objectives and the establishment of recording schemes. There is a special need for obtaining sufficient amount of information for assessing how the selection for economically important traits is affecting the overall performance of animals. In long-term, we may see undesirable changes in fitness traits, such as leg abnormalities, impaired fertility or health. These could be minimised by devoting selection and appropriate management to them. Therefore the main challenge for breeders is to implement a sufficiently sophisticated data collection and selection scheme. Another long-term risk is an increase of average kinship amongst animals, which may lead to enrichment of harmful genes. Preventive measures are the avoidance of matings between close relatives and the use of sophisticated tools to maintain a balanced representation of ancestral lines over generations. The molecular genetic tools may be used to locate and eradicate genetic defects and also to monitor the transmittance of genetically simple features, such as loci mediating the colour variation, between a gene bank stock and production animals.

Proceedings from NJF - Seminar No. 347. 3 pp, 6 refs. Author's abstract.

Selection response for confident behaviour in silver foxes (*Vulpes vulpes*) and correlated responses in the production traits

N.V. Nordrum, U. Tutein Brenøe, K. Rune Johannessen, M. Bakken

Several studies with silver foxes have revealed stress and fear reactions in contact with humans. A selection experiment comparing two different breeding objectives for silver foxes was recently carried out in Norway. The objectives were to estimate selection response in confident behaviour towards humans; to quantify genetic and environmental sources of variation in confidence; and to estimate correlations between confident behaviour and production traits.

An improved relationship between animal and human constitutes a possibility to increase welfare of fur animals. Selection for more confident silver foxes resulted in improvement of confident behaviour. The heritability of confidence was moderate. The study indicated generally small phenotypic and genetic correlations between confidence and the production traits. Probably due to a less intensive selection, smaller selection responses were expressed for the production traits in the line selected for increased confidence. Thus, including behaviour in the selection criteria may delay the overall progress. However, based on the genetic correlations revealed, there seemed to be a possibility to breed for improved behaviour without considerable loss of profit in the production.

Proceedings from NJF - Seminar No. 347. 11 pp, 2 figs, 5 tables, 25 refs.

Genetic parameters and responses in confidence, aggressiveness and ease of handling in silver foxes selected for confident behaviour

H. Kenttämies, M. Nikkilä, M. Miettinen, J. Asikainen

In 1995 to 1999, a selection experiment for confident behaviour in silver foxes was arranged at Siikasalmi Research Station Fur Farm of the University of Joensuu. The experiment was a part of a Nordic project "Selection for more confident foxes". The animals for the study were obtained

from the Research Station and in addition from 6 private farms. The foundation stock consisted of 306 animals from which 269 males and females were yearlings. Data in the present study were restricted to comprise only cubs of one-year-old females and males including altogether 891 cubs. Confidence of cubs was tested each year, aggressiveness in 1998 and 1999, and ease of handling in 1997 to 1999. A moderate estimate of heritability was obtained for confidence (CB) (h2 = 0.30±0.06) while very low estimates were obtained for aggressiveness (AG) (h2 = 0.01±0.06) and for ease of handling (EH) (h2 = 0.06±0.07). In addition, the moderate to low litter effects caused moderate repeatabilities (r = 0.2 to 0.42). Negative genetic correlation appeared between CB and AG (rg = -0.34±1.66) while a positive one existed between CB and EH (rg = 0.19±0.37). However, standard errors of both estimates were high thus decreasing the accuracy of the estimates. During 3 years of selection, a cumulative response of 0.12 points compared to control was achieved in CB. Indirect genetic changes in AG and EH tended to be low. A slight cumulative decrease in AG occurred in both lines (ΔG = -0.02 points). A positive cumulative response in EH was found in the selection line (ΔG = 0.03 points) while nearly no change occurred in the control line. It is evident that genetic selection for confidence also results in an improvement in EH.

Proceedings from NJF - Seminar No. 347. 9 pp, 3 figs, 5 tables, 10 refs. Authors' abstract.

Both direct and indirect genetic effects influence behavioural response in mink

P. Berg, B.K. Hansen, S.W. Hansen, J. Malmkvist

Despite evidence that animal behaviour is genetically controlled, the possibility of improving animal welfare by selection is not generally considered an option. It is hypothesised that both direct and indirect genetic effects of conspecifics affect confident and fearful behavioural responses in mink, tested by analysing a 12-year selection experiment for confident and fearful reaction towards humans. A total of 23397 observations for reaction towards humans and 9063 Trapezov hand test scores are analysed for direct and indirect genetic effects. Both direct and indirect genetic effects, i.e. effects of the genotype of the dam and the cage mate, can be modelled and affects these behavioural responses. Direct genetic effects account for 21% to 29% and indirect effects of dam and cage mate each accounts for 2% to 12% of the variation. With indirect genetic effects not only the genotype but also the environment can evolve.

Proceedings from NJF - Seminar No. 347. 5 pp, 2 tables, 11 refs. Authors' abstract.

Favourable genetic correlation between maternal traits and dam weight changes during lactation exists in mink

B.K. Hansen, P. Berg

Mink kits are born physiologically immature and are completely dependent of the dam during the first weeks of the suckling period. The objective of this study was to estimate the (co) variance for early growth of mink kits, for weight changes of the dam during lactation. Records of 9612 kits and 1296 yearling dams were included. The genetic variance of traits and the genetic correlations between traits were estimated using REML under an Animal Model. Heritability estimates for additive direct and additive maternal effects on early growth were h2d≈ 0.10 and h2m≈0.27, respectively and h2d≈0.36 for dam weight changes from 1 to 4 weeks post partum. A genetic correlation between maternal effect on kit body weight and dam weight changes from 1 to 4 weeks post partum at rmd=0.39 was found.

Proceedings from NJF - Seminar No. 347. 5 pp, 1 table, 12 refs. Authors' abstract.

Semen quality in blue fox (*Alopex lagopus*)

P. Pylkkö, V. Ruponen, E. Uunila, R. Sauna-aho, P. Siirilä, T. Rekilä

Artificial insemination was first introduced to blue fox (Alopex lagopus) farming practices in 1983 in Finland. Presently intrauterine method is most widely used and most of blue fox bitches are inseminated. However, now fur farmers have been alarmed since the mean litter size per one

inseminated female seems to be decreasing whereas the mean litter size of mink and raccoon dog is increasing. Impaired fertility in male dogs has been shown to correlate to semen quality requirements such as sperm motility and morphology (Dahlbom 1999). The quality of semen in Finnish blue foxes is not well illustrated. The aim of this study was to analyze the quality and to gain basic knowledge of semen in Finnish blue fox. Therefore, motility in sperm rich fraction and morphology of spermatozoa was analyzed.

Semen samples were collected from a group of 104 blue foxes from 36 fur farms from western part of Finland. Sample collecting period was carried out 19.3.-16.4.2002. Blue fox males were born in 1999, 2000 and 2001. The semen was collected from males as their first ejaculate in spring 2002 by hand manipulation. Sperm rich fraction of ejaculate was analyzed. The fresh sperm was evaluated immediately after manipulation under a light microscope for total motility and progressive motility. Motility was evaluated as a percentage from total count of spermatozoa. Semen smear samples for morphological analyzes were spread over an objective slide (in three parallels), the slides were kept on +37°C warm plate, air dried and stored for Giemsa staining.

Morphological features of spermatozoa were analyzed under bright field microscope and a phase-contrast field at 1000x magnification. Morphology of a group of 100 spermatozoa was analyzed from each male, in three parallels. Sperm was categorized by morphology to normal and abnormal sperm and thereafter to severe and minor abnormalities of sperm.

In our study the total and progressive motility was over 80% in males born in 1999 and 2000. However, males born in 2001 expressed total sperm motility of 80% and 72% for progressive sperm motility. These percentages of total and progressive sperm motility exceed quality requirements set for fertile dogs (Larsen 1980). In morphology there was no significant difference in correlation to the year of birth. Normal morphology was detected in 72 to 80% of spermatozoa. Severe morphological defects were found in <1% of spermatozoa. Oettle (1993) suggested that the proportion of morphologically normal spermatozoa should be over 60% in fertile dogs.

It can be concluded by the parameters analyzed in our study that the quality of blue fox semen is good enough for fertilization. Further studies in the complex problem of decreasing litter size of blue fox are still needed.

Proceedings from NJF - Seminar No. 347. 2 pp, 3 refs. Authors' abstract.

Statistical modelling

Group size, statistical power and inference in fur animal science

S.H. Møller, P. Berg

Given the size and cost of the individual fur animal and the number of animals on an average (experimental) farm, group size in many experiments is fairly large compared to that of other production animal species. For many types of experiments and response variables measured, the statistical power is sufficient to make inference on the data and to draw conclusions on relevant effects. It seems, however, that this has lead many researchers to believe that group size is always sufficient and that consideration on the size of experimental groups in a given experiment is not needed. For a number of parameters often taken as response variables the relation between group size and statistical power in simple two-group experiments are calculated. For many parameters such as body weight and skin length only 25 animals per group are needed to demonstrate the presence or absence of relevant effects, and many resources may therefore be spared if optimal experimental group sizes are used. For other parameters such as litter size, more than 900 litters per group are needed and resources may be used inefficiently if smaller groups are used. The number of animals used has, therefore, profound effects on the power of a given experiment to test the hypothesis posed.

Proceedings from NJF - Seminar No. 347. 5 pp, 2 tables, 5 refs. Authors' abstract.

Modelling covariance structures for repeated measures data – a case of welfare in blue foxes

L. Jauhiainen, H.T. Korhonen

The most important stage of repeated-measures data analysis is modeling the appropriate covariance structure for repeated measurements. Therefore, good analysis requires extend effort to assess the type of covariance structure.

In the present study four separate behavioural experiments were carried out at the Fur Farming Research Station in Kannus. Many behavioural and physiological variables were measured several times for each fox during the study. Typically, the set of observations on a single fox tends to be correlated. Eight different covariance structures for repeated measures were fitted for each variable separately. Structures were compared using Akaike's information criterion and likelihood ratio test when possible. Compound symmetry covariance structure proved useful in most behavioural variables, and heterogeneous compound symmetry covariance structure was also found useful. The widely used first-order autoregressive model was the most poorly performing and unstructured covariance structure the best performing of all structures for the most of physiological variables. It is not possible to formulate exact rules for the best-fitting structures to use on each occasion. Thus, the researcher must fit several models and compare the results using suitable statistical tests or information criteria. This task needs extended effort, but it is the only way to justify all conclusions drawn from the data.

Non-linear transformation is commonly used to handle heterogeneous random variation. Heterogeneity was handled directly through the use of heterogeneous covariance structures, and transformation was not needed in 79% (= 19/24) of all variables studied showing heterogeneous residual variation. Modelling an appropriate covariance structure proved essential to ensuring that inferences about means are valid.

Proceedings from NJF - Seminar No. 347. 9 pp, 4 tables, 12 refs. Authors' abstract.

Pathology and diseases

Molecular characterisation of mink astrovirus

C. Mittelholzer, L. Englund, H.H. Dietz, K.O. Hedlund, L. Svensson

Pre-weaning diarrhoea is a well known problem in mink farming in Europe causing morbidity that varies between farms, regions and season. Different causalities for the disease have been proposed but most recently, we have identified a novel astrovirus as an important risk factor [1]. Here we report the results from the molecular characterization of this mink astrovirus (MiAstV). The polyadenylated positive-stranded RNA genome was sequenced and found to contain 6610 nts organized into three open reading frames and two short untranslated regions. Sequence analysis indicate that MiAstV has all features typical for the members of the Astroviridae. Phylogenetic analyses revealed that MiAstV is only distantly related to established astroviruses, showing less than 67% homology on the nucleotide level with sheep astrovirus. Nevertheless, viruses from geographically distinct Swedish and Danish farms showed much less diversity. This suggests either the rapid spread of a virus that has evolved a long time ago within the mink population or the recent introduction of an ancient virus into a new host species.

Proceedings from NJF - Seminar No. 347. 4 pp, 3 refs. Authors' abstract.

New hypothesis for pathogenesis of nursing sickness in mink

K. Rouvinen-Watt

Nursing sickness, the largest single cause of mortality in adult female mink, is an example of a metabolic disorder, which develops when the demands for lactation require extensive mobilization of body energy reserves. The condition is characterized by progressive weight loss, emaciation and dehydration with high concentrations of glucose and insulin in the blood. Mortality due to nursing sickness is on an average 14-15% and morbidity around 8%, but the incidence is known to vary from year to year. Stress has been shown to trigger the

onset of the disease and old females and females with large litters are most often affected. Increasing demand for gluconeogenesis from amino acids due to heavy milk production may be a predisposing factor. Glucose metabolism is inextricably linked to that of protein and fats. In obesity, the ability of adipose tissue to buffer the daily influx of nutrients is overwhelmed interfering with insulin-mediated glucose disposal and leading to insulin resistance. Insulin resistance may also be a result of oxidative stress due to a high protein diet. It is suggested that the underlying cause of mink nursing sickness is acquired insulin resistance with two contributing key elements: obesity and high protein oxidation rate. It is recommended that mink breeder females be kept in moderate body condition during fall and winter to avoid fattening. Lowering of dietary protein reduces (oxidative) stress and improves water balance in the nursing females and may therefore prevent the development and help in the management of nursing sickness. It is also surmised that other, thus far unexplained, metabolic disorders seen in male and female mink may be related to acquired insulin resistance.

Proceedings from NJF - Seminar No. 347. 11 pp, 44 refs. Author's abstract.

The practical establishment of a Veterinary Health Advisory System in Danish fur farms

I. Christiansen

In Denmark we have a health advisory contract for pig producers and for beef and milk producers. These are made by law to give the farmers the opportunity to treat their own animals with different antibiotics in exchange for their paying a veterinarian to consult them every month.

In Danish fur farming the farmers are not limited by law against treating their own animals. If a veterinarian has diagnosed the disease and handed out or prescribed the medicine they are free to treat their own animals.

The health advisory contracts are in view of public health made to reduce the use of antibiotics and in the view of the public opinion they are made to insure the health and welfare of the animals.

In The Danish Agricultural Advisory Center we have tried to make a veterinary health advisory system to be used in the fur farms that would be attractive to the fur farmers for other reasons than the use or abuse of antibiotics.

We have tried to implement the information already available in the " farm panel " in our health advisory system to make it work on more reliable data and on data easily picked up in a more systematic way and easily calculated and compared to other farmers receiving feed from the same feed kitchen.

A " farmpanel " is a group of breeders who register information from their farm ex weight development of the mink, breeding results and kittens mortality rate in our databases connected with the feed kitchens. These results can be calculated and compared to other feed kitchens to optimize the ingredients in the feed.

Our veterinary health advisory system is based on three farm visits pro year.

The first visit is a production-planning meeting in which the results from last production period are evaluated and the strategy for the next production is discussed and planned. Especially the assembling of data from the next production period is planned.

The second visit is a vaccination-visit. The health of the animals is evaluated and vaccines are delivered or prescribed. Short evaluation of previous period is made.

The third visit is based on evaluation of data collected in the production period. It is now possible to illustrate and to compare the calculated material from the previous period with other farmers. Also evaluation of type and relevance of data is made at this visit. Proposals for changes in the next year are discussed.

Naturally all three visits on the farm includes advising of the breeder in all veterinarian aspects such as: Vaccination strategy, cleaning and disinfections strategy, strategy of flee and fly control, strategy of protection against infections hazards, animals welfare, diseases handling and treatment, medicine handling and documentation, and documentation of treatment.

All of these procedures will be presented to the breeder in writing as a Systematic Operation Programme that will be updated as new scientific results, management procedures, experiences or legislations changes our knowledge.

We think that we by introducing this systematic veterinary health advisory system will be able to insure and increase the earnings and the pleasure by working with fur animals. And we hope this advisory system in time will give the participating breeders a possibility to document that fur animal farming is as respectable a profession as any profession.

Proceedings from NJF - Seminar No. 347. 2 pp. Author's abstract.

Economy and technology

Production economics at The National Department of Fur Animal Production

T. Damsbo Nielsen

The agricultural advising in Denmark is privileged in having an extremely good data foundation in the field of farm accounting and management within most production branches. This results in very good statistical materials from the farm accounts and the variations between them. Within fur animal production we have not got similar statements of accounts for the total economy fitted for production advising and comparison. Among other things, this is mainly due to the fact that the production foundation has not been sufficiently examined in connection with reporting to the database on the fur animal production accounts.

It is important that accounting figures and management ratios are not used to standardise people. Instead we are to use the results and their variations to motivate people and in some respects show them what is possible.
I think that the individual breeder's future is a matter partly of being skilful and partly of acknowledging his own and his farm's strengths and weaknesses. In this way we can prioritise and assess how to establish an optimal production on the farm in question.

Management ratios from accounting results and production results as well as the coherence between them are important instruments in starting up economic advising.

At the National Department of Fur Animal Production we are, among other things, engaged in:

1) Farm check, comparison and development of management ratios
2) Development visits: What is the next move?
3) Start up advising and investment advising
4) Budgets

Proceedings from NJF - Seminar No. 347. 3 pp.

New structural solutions for fox breeding halls in Finland

T. Kivinen, T. Rekilä

Fur producers use traditional sheds for foxes in Finland. Hall solutions are very rare. The reason for this situation is not clear. Simple shadow sheds have been easy to manage. On the other hand local or regional traditions have guided general opinion. Even if it still is feasible for further fur production there are some environmental issues - such as rainwater mixing with manure – which are regarded as a slowly growing threat for ground waters. MTT has developed a new hall concept for fox breeding. A first sample hall will be built for MTT´s Fur Farming Research Station at Kannus. Primarily the hall is a simple uninsulated wooden building much like modern machine halls in Finland today. Its main purpose is to stop ground water pollution and at the same time make manure handling as easy as possible. The solution is a 8 row cage system with fully covered asphalt floor area. The hall is 15.8 m wide and 79 m long, 1290 m2 in total area. The height at the ridge is 7 m. The total number of cages is 464. The hall is divided into two sections, the one with machine controlled ventilation and the other with natural, gravity based air flow. This is for the research purposes to investigate real rates of ammonia emissions, temperature control etc. in Finnish weather conditions.

Proceedings from NJF - Seminar No. 347. 4 pp, 4 figs. Authors' abstract.

Environmental characteristics of sand, coal granules, barley straw and peat as bedding material underneath the blue fox cages – a laboratory study

T. Rekilä, P. Pylkkö

Increased knowledge of effects of nitrogen and phosphorus on the water system eutrophication and ground water quality has tightened environmental requirements for fur farming. Traditional shed housing became general in the 1930's. This type of housing creates a risk for water pollution when manure is leached by rain.

Varis (1994) stated that for one fox skin 10-20 g phosphorus and 300-350 g nitrogen is emitted, similarly the emission for one mink skin is 10-15 g and 60-220 g, respectively. Phosphorus and nitrogen emission of fur farming is in average 1% of total emission caused by man, and regionally can rise up to 10% (Repo et al. 1999).

Before the year 2005 fur farmers are demanded by Finnish Environmental authority to decrease the phosphorus and nitrogen emission down to 55% from the level of the year 1993. Assumed phosphorus and nitrogen emission in the year 1993 is 45 ton phosphorus and 430 ton nitrogen. Thus for the year 2005 the target emission level is 20 ton phosphorus and 190 ton nitrogen.

Environmental authority has guided farmers to build solid base or to use sand course and peat under cages. Rekilä (2001) reviewed the phosphorus and nitrogen emission studies at fur farms. The scientific value of these studies is lowered due to their realization. The studies were carried out as field trials in a traditional shed house conditions. Therefore the effect of a rain and evaporation have been impossible evaluate (Rekilä 2001). Aim of our study was to measure phosphorous and nitrogen emission of sand, coal granules, barley straw and peat in constant temperature and humidity.

Proceedings from NJF - Seminar No. 347. 5 pp, 1 fig, 1 table, 3 refs. Authors' abstract.

Posters

Sodium chloride in the feed in the nursing period

T.N. Clausen, B.M. Damgaard

Different dietary amounts of Sodium Chloride (NaCl) were investigated in seven groups of wildtype mink females and kits in the lactation period 2001. There were 15 females with litters and 5 farren females in each group. The control diet (K) had a natural Sodium Chloride content of 0.17 g per 1000 kcal. The experimental diets S15 - S30 - S45 - S60 - S75 and S90 were added Sodium Chloride to a final content of 0.25 - 0.34 - 0.42 - 0.50 - 0.60 and 0.70 g per 100 kcal.

Judged from the concentration of Sodium in the urine of mink kits, it seems that mink kits cannot concentrate urine to a final content of more than 250 mmol Sodium per 1 urine (plus negative ions). This is achieved when the Sodium Chloride content in the feed is more than 0.50 g per 100n kcal. Further addition of salt will increase the water need for the kits. The aldosterone level in plasma of mink females at day 42 was at a normal level of <200 pg per ml when the Sodium Chloride content of the feed was 0.50 g per 100 kcal or above. Earlier investigations showed normal plasma aldosterone level when the feed content was 0.42 g Sodium Chloride per 100 kcal. The plasma Sodium content in females at day 42 was at a normal level when the dietary Sodium Chloride content was 0.42 g per 100 kcal. From this investigation 0.42 – 0.50 g Sodium Chloride per 100 kcal seems to support normal performance of both females and kits during the lactation period.

Proceedings from NJF - Seminar No. 347. 9 pp, 6 figs, 6 tables, 10 refs. Authors' abstract.

Impact of feed supplements on diet palatability by mink

K. Rouvinen-Watt, M. White, N. Clarke, M. Cormier

The objective of this research was to investigate the effects of feed supplements (palatability enhancers and sweeteners) no feed intake by mink. The research investigated the following palatability enhancers: Experiment 1; liver powder (LP 2%), liver-whey powder (LWP 1.5%), kelp (KLP 2%), salt (SLT 0.5%), and molasses (MLS 2%); and sweeteners: Experiment 2; dextrose (DEX 1%), fructose (FRU 1%), stevia (STE 0.05%, aspartame (ASP 0.03%), and xylose (XYL 1%). In experiment 1, in two separate studies, twelve female and twelve male mink were individually housed in metabolism cages for 18 days during which the mink were fed a standard diet supplemented with the studied palatability enhancers. Each mink was fed one of the five supplements for three consecutive days and all mink received all the test diets during the study. In experiment 2, six juvenile male and six juvenile female mink were individually housed in metabolism cages, and each mink was given each of the sweeteners for a period of 7 days during a 42-day trial. Measured parameters included feed dry matter intake, water intake, fecal dry matter excretion, fecal water output and urine excretion. In experiment 1, no improvement in diet acceptance or consumption was observed in the female or male mink due to the dietary supplementation with LP, LWP, KLP, SLT or MLS. The LWP was shown to reduce feed intake in the male mink, whereas the KLP supplement increased faecal dry matter output in the female mink as well as faecal water excretion in both males and females. Water intake was elevated in both sexes due to the SLT supplement. In the females this also increased urine excretion. Diet change was shown to increase feed intake of the females, whereas the males ate less of any new diet when it was first introduced. In experiment 2, significant individual taste preferences were observed among all test mink as well as between the males and females. In the male mink, DEX ASP, and XYL were shown to reduce feed dry matter intake, whereas FRU, STE and ASP lowered feed water intake. No difference in intake was observed in the female mink due to the addition of sweeteners. Regardless of the type of sweetener, feed intake was observed to be elevated in the male mink three days after the introduction of each new diet. Feces and fecal water excretion was lower in the males when fed ASP. In addition, STE and XYL reduced fecal water excretion, whereas FRU reduced urine volume in the male mink. In the females, FRU and ASP lowered feces excretion, while DEX, FRU and ASP all reduced fecal water and urine excretion. XYL was shown to increase urine volume in the female mink. Non of the studied sweeteners increased feed or water intake by the mink. It is recommended that changes in diet composition be implemented gradually to avoid negative impact on feed intake of the mink.

Proceedings from NJF - Seminar No. 347. 12 pp, 6 tables, 19 refs. Authors' abstract.

The use of cheese waste in mink diets

M. White, K. Rouvinen-Watt

The use of block (BC) and scrap (SC) wheeze waste was evaluated for nutritional value, nutrient digestibility and inclusion in growing-furring diets for mink. A 2x4 factorial design experiment was conducted to determine apparent digestibility coefficients (AD) of dry matter (DM), crude protein (CP), crude fat (CF, gross energy (GE) and carbohydrate (CHO) in the BC and SC by mink. Thirty-six mature standard black genotype male mink were confined to metabolism cages during the digestibility trial, which consisted of three experimental periods comprised of a 4-d adjustment, followed by a 3-d collection. Based on the total collection method with graded levels (15, 30, 45 and 80%) of the test feedstuffs in the experimental diets, nutrient digestibility in the pure feedstuffs was determined using a linear regression technique. The apparent digestibility (AD) of DM, CP, CF, GE and CHO were BC: 75.1%, 81.2%, 93.5%, 81.4% and 44.6% and SC: 63.0%, 87.0%, 85.2%, 58.4% and 35.9%, respectively. The growing-furring experiment was conducted with a total of 100 mink of the standard black genotype to determine the effects of the BC and SC on animal health and performance. There were five dietary groups with 10 males and 10 females in each group. The cheese based diets were formulated by replacing half (15%) or all of the herring (30%) in the control diet (ME 19.7 MJ kg^{-1} DM, Me% distribution ratio CP:CF:CHO 31:53:16) by block or scrap cheese. The final body weights of the mink did not differ among the test groups and were: CTRL (n=17) %

2094∀11g, &1202∀8g; BC15 (n=20) % 2325∀9g, &1298∀8g; BC30 (n=20) % 2190∀9g, &1158∀8g; SC15 (n=20) % 2257∀9g, &1312∀9g; and SC30 (n=18) % 2246∀9g, &1245∀9g. Fur quality, based on live animal grading and pelt evaluation, showed no significant difference due to diet. Waste block and scrap scheese at 15 and 30% inclusion in growing-furring diets for mink were found to support normal growth and fur development in the mink with no observed detrimental effects on animal health or performance.

Proceedings from NJF - Seminar No. 347. 10 pp, 4 tables, 14 refs. Authors' abstract.

Evaluation of extruded barley and brewer's barley in mink diets

M. White, D. Pelkey, K. Rouvinen-Watt

The use of extruded barley (EB) and spent brewer's barley (BB) was evaluated for nutritional value, nutrient digestibility and inclusion in growing-furring diets for mink, in comparison to extruded wheat (EW). A 3x2 factorial design experiment was conducted to determine apparent digestibility coefficients (AD) of dry matter (DM), crude protein (CP), crude fat (CF), gross energy (GE), carbohydrate (CHO), starch (ST) and acid detergent fiber (ADF) in the EB, BB and EW at high (H) and low (L9 levels of incorporation in a CHO free basal diet (control, CTRL). Twenty-four mature standard black genotype male mink were confined to metabolism cages during the digestibility trial, which consisted of three experimental periods comprised of a 4-d adjustment, followed by a 3-d collection. Based on the total collection method with low and high levels of the test feedstuffs (24% and 45% of DM from the CHO source, respectively) the AD of CHO in the experimental diets was EWL: 74.9%, EWH: 64.0%, EBL: 62.5%, EBH: 58.2%, BBL: 34.3%, BBH: 23.1%. The growing-furring experiment was conducted with a total of 100 mink of the standard black genotype to determine the effects of the EB and BB on animal health and performance. There were five dietary groups with 10 males and 10 females in each group. The test CHO diets were formulated by replacing half of the DM (5.1%) or all of DM from the EW (10.1%) in the control diet (ME 19.1 MJ kg^{-1}DM, ME % distribution ratio CP:CF:CHO 30:54:16). The final body weights of the mink among the test groups were: CTRL (n=17) % 2129±89g, &1220±82g; EBL (n=20) % 2025±81g, &1293±81g; EBH (n=20) % 2227±85g, &1143±83g; BBL (n=20) % 2126±86g, &1153±81g; BBH (n=18) % 1810±81g, &1111±87g. The mink fed the BBH diet had a reduced overall weight gain and consumed more ME than mink in all other dietary treatments. Fur quality was evaluated with a live animal grade and the male mink fed the BBH diet were found to be smaller in body size, with 80% of the mink falling into the size grade 2 and 20% of the animals in grade 1. The male mink in the BBH group had smaller body weights (BW) (P=0.004), pelt lengths (P=0.09 and pelt weights (P=0.01) at pelting compared to the mink in the CTRL, EBH and BBL groups, but not in the EBL group. The EB diets had no negative effect on the measured parameters whereas the BB diets reduced growth, pelt size and BW. BB is not considered suitable as an alternative carbohydrate source for mink.

Proceedings from NJF - Seminar No. 347. 13 pp, 4 tables, 30 refs. Authors' abstract.

Low dietary energy concentration to mink females. Effects on behaviour and performance

B.M. Damgaard, S.W. Hansen

The effects of traditional and alternative feeding strategies on mink females' body weight and behaviour were investigated in female kits from August 2000 to June the following year. The investigation included 180 females divided into three groups. From October 16 to February 18 one group (group ADL) as fed conventional wet mink diet ad libitum, another group (group SUB) was fed ad libitum as group ADL, but was offered a substantial diet from December 22 to February 18. The third group (group RE) was fed a conventional diet restrictively. The females were weighed approximately every second week and behavioural observations were made using focal sampling before and after feeding from December to March. Restrictive feeding stimulated stereotypic activity. The weight of stereotypic females was lower than the weight of non-stereotypic females from September 20. Changing the level of energy in the

feed may be a useful parameter for regulating the weight loss in mink without at the same time stimulating stereotypic behaviour.

Proceedings from NJF - Seminar No. 347. 4 pp, 4 refs. Authors' abstract.

SCIENTIFUR – Scientific information in fur animal production

B.M. Damgaard, O. Lohi, E. Fritze

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Proceedings from NJF - Seminar No. 347. 3 pp. Authors' abstract.

Drying and cooling rates in adult mink following simulated diving

H.T. Korhonen, P. Niemelä

In fur animals, one of the adaptations for survival in a cold climate is to renew their hair cover seasonally by moulting old hairs and growing new ones. This furring process changes thermoregulatory properties of the animal's body in response to changes in ambient temperature. In mink the fur is renewed twice annually, with hair shedding in spring for summer coat and in autumn for winter coat. The lower critical temperature of winter-coated mink may be as high as about +20ºC, however, lower temperatures are also well tolerated. If provided access to a well-insulated nestbox, farmed mink can withstand ambient air temperatures far below 0ºC. This holds true only for a dry-coated animal, however. One would expect that wet fur coat particularly at very cold temperatures may compromise heat balance. To what extent wet fur after swimming and diving actually affects thermoregulation in farmed mink has not yet been clarified, however, and thus requires further study. The aim of the present study was to evaluate water absorbing capacity and the drying and cooling rates of fur in farmbred male mink (*Mustela vision*) following 10 sec of stimulated diving. Comparisons were made between adult animals with summer and winter fur. The water loss from swimming pool following diving in summer amounted to 146±14g and 152±9g in dry and wet mink, respectively (not significant: $p>0.05$). No significant differences between summer and winter were found for dry mink. In wet-coated mink, on the other hand, water loss from the swimming pool was significantly greater ($p<0.05$) in summer than in winter. The wet fur dried rather slowly, and was significantly ($p<0.05$) affected by season so that half of the 100 g water absorbed by fur evaporated within 20 min during winter (at -2ºC) whereas in summer (at +18ºC) it took 60 min. Slower drying rate in summer could be beneficial as it allows long-term body cooling in warm environment. Cooling constants of winter-coated dry mink (0.01955 ± 0.00183 min^{-1}) were not significantly different ($p>0.05$) from those of wet mink ($0.02091\pm0.00144 min^{-1}$) indicating that energy costs of wet fur after diving are not critical for survival of the mink during winter.

Proceedings from NJF - Seminar No. 347. 6 pp, 1 table, 18 refs. Authors' abstract.

Temperament affects pre-mating behaviour and reproductive performance in female mink (*Mustela vison*)

H.T. Korhonen, T. Rekilä, L. Jauhiainen, L. Kokkonen

The present study sought to evaluate the relationship between temperament, pre-mating behaviour and reproductive performance in farmed female mink (Mustela vison). Temperament was measured by using a stick test and pre-mating behaviour by a walking test. The experimental animals comprised 100 confident and 100 fearful scanblack female mink. In each temperament group, 58% of female mink were primiparous and 42% multiparous. The length and timing of mating periods and the length of the gestation period were similar in all groups. Pooled data showed that the length of the gestation period correlated negatively with litter size ($r=0.17$, $p=0.03$). The whelping proportions for confident and fearful primiparous female mink were 81% and

74% (p=0.37), respectively, and for multiparous vixens 83% and 81% (p=0.78), respectively. A significant correlation between kit losses and litter size was found only in primiparous and multiparous confident females (r=0.35, p=0.02; r=0.32, p=0.07). Postnatal kit mortality was higher in primiparous confident than fearful females. Pre-mating body weights were significantly higher (p<0.001) in primiparous than in multiparous females. Significant correlations between pre-mating body weight and reproductive success were not found. During walking tests, fearful animals, irrespective of age, remained inside the nestbox more frequently than did confident ones. Stationary behaviour outside the cage (lying, sitting, standing etc.) was more common in confident than in fearful animals (p<0.001). Significant differences in locomotor activity or stereotypies were not found between the groups. In multiparous fearful females, the whelping result declined significantly with the increasing incidence of stereotypies (r=0.37, p=0.04). In primiparous fearful female mink, the relationship was the reverse (r=0.37; p=0.01). We conclude that the significant temperament dichotomy (confident vs fearful) found in farmed mink stock has a marked effect on the reproductive performance of this species.

Proceedings from NJF - Seminar No. 347. 7 pp, 28 refs. Authors' abstract.

Milk production in mink (*Mustela vison*) – effect of protein supply

R. Fink, A.-H. Tauson

Milk from the dam is the only source of nutrients for mink kits during their first 24-26 days of life, and therefore milk production of the dam is strongly determining for kit performance. Selective breeding programmes have resulted in profoundly increased litter sizes, which place higher energetic demands on the lactating dam. Since protein metabolism is an energetically expensive process, adverse effects of surplus protein intake include a reduced energetic efficiency, and thereby perhaps adverse effects on milk production.

In an experiment, reduced protein supply increased the milk production and thereby the kits' weight gain during the first 4 weeks of lactation. Thus, though the protein used was of a high quality, and the feed's amino acids profile has to be further elucidated, the results show that there is a considerable potential to reduce the protein and increase the carbohydrate supply to lactating dams with positive effects on animal performance.

Proceedings from NJF - Seminar No. 347. 1 pp, 2 figs.

Cub adoption as a potential method to increase survival in neglected silver fox cubs

A.L. Hovland

Loss of cubs due to incomplete maternal behaviour (maternal infanticide) is a common phenomenon in farmed silver fox vixens. Because infanticide has both animal welfare and economic implications alternative efforts to increase cub survival should be approved of. In pigs and rheas crossfostering is demonstrated to enhance survival of piglets and chicks. Due to the fexible reproductive biology in *Vulpes vulpes* adoption and crossfostering might be an alternative method to prevent cub loss due to maternal infanticide. This preliminary experiment completed as a case study was aimed to document whether adoption of maltreated cubs would occur in farmed silver foxes, and demonstrated five incidents of successful adoption. The relevance of adoption and crossfostering in farmed silver foxes is discussed.

Proceedings from NJF - Seminar No. 347. 5 pp, 2 tables, 11 refs. Author's abstract.

Correlated responses in litter results, body size, fur quality and colour clarity in blue foxes (*Alopex lagopus*) selected for confident behaviour

H. Kenttämies, K. Smeds

Correlated responses in Finnish blue foxes selected for 3 generations (SL) or not selected (C) for confident behaviour (CB) gained 0.34 cubs and 0.33, 0.05 and 0.22 points, respectively, in litter result (LR), graded body size (BS), fur quality (FQ) and colour clarity (CC) within the SL line and 0.10 cubs, 0.80, 0.83 and 0.50 points, respectively within

the C line. Data comprised 3317 cubs with CB, BS, FQ, and CC and 660 mated females of which 545 with CB tested as a cub. CB denoted the mean of 4 successive tests with a scale from 1 to 2 points. LR denoted the number of cubs at two weeks per mated female. BS, FQ and CC were graded using an ascending scale from 1 to 5 points. (Co)variances for breeding values were estimated with REML and multitrait animal models using VCE4 and Pest programs.

Proceedings from NJF - Seminar No. 347. 5 pp, 1 fig, 1 table, 13 refs. Authors' abstract.

Effects of social and physical housing environment on the welfare in silver foxes (*Vulpes vulpes*)

Doctoral dissertation

By

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Farmed silver foxes (*Vulpes vulpes*) are usually weaned and separated from their mothers at the age of seven-eight weeks. After this the cubs are first kept in larger sibling groups but subsequently they are raised either in pairs or singly in cages measuring 115 cm long x 105 cm wide x 70 cm high. The current housing circumstances do not necessarily fulfil foxes' species-specific needs for social and locomotor behaviour and, thus, the foxes' welfare may not be optimal.

In the present study, the effects of different social and physical housing environments on behavioural and physiological as well as on production-related

welfare indices were evaluated. The effects of the social environment were assessed by either changing group composition (including or excluding the mother) or group size (one, two, four or five siblings within a group). Spatial requirements were studied by changing the quality (seminatural enclosures or wire-mesh cages) and the quantity (space per individual fox varying between 0.6-28 m^2) of the living area. Furthermore, the impact of different housing environments on human-animal relations was defined. In clarifying the effects of these two factors under farm conditions, the knowledge of the behaviour and adaptations of the wild red fox (the silver fox is a colour mutation of the red fox) were applied.

The cubs that were weaned directly into single living performed more stereotyped behaviour in early winter than the cubs that were housed either in pairs or in quartets. Although it seems that for young farmed foxes social contact does act as an environmental enrichment and can improve their welfare, the situation is somewhat different at the time of natural dispersal. When the mother of the cubs was included into the group the welfare of her cubs, and especially her male cubs, was disrupted due to the prevention of their inherent tendency to disperse from their mother's living area. Overall, even between the siblings, aggressive encounters increased and the individuals within each group tended to avoid each other with the advance of autumn. Though it possibly provided the foxes with some sense of control of their living environment, available space had only minimal effects on the foxes. The need of foxes to adopt territorial behaviour may have been eliminated in farm conditions where there is plentiful and stable food supplies. However, constructions enriching the living areas (e.g. platforms, separating walls in cage systems) are important for foxes, providing them with opportunities to avoid group members and to survey their surroundings. The quantity of space further affects the expression of human-animals relations. In large enclosures, foxes are desocialised from human and may eventually become feral. Both social and physical environments affect the quality of furs of foxes. A soil floor as such impairs the fur quality. Keeping silver foxes in groups leads to increased social tension and aggressiveness with the consequence of an increased incidence of bite wounds and poorer fur quality, especially in group-housed females. Decreasing the space allocation in cage conditions also decreases the fur quality.

In conclusion, the welfare of farmed silver foxes can be promoted by altering their social conditions according to their developmental stage. Furthermore, quality rather than quantity of the living area is the crucial factor for the welfare of farmed silver foxes.

Universal Decimal Classification: 591.6, 636.93, 636.083.6

CAB Thesaurus: animal behaviour; animal housing; animal physiology; animal welfare; fur farming; fur quality; social environment; stocking density; *Vulpes vulpes*

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