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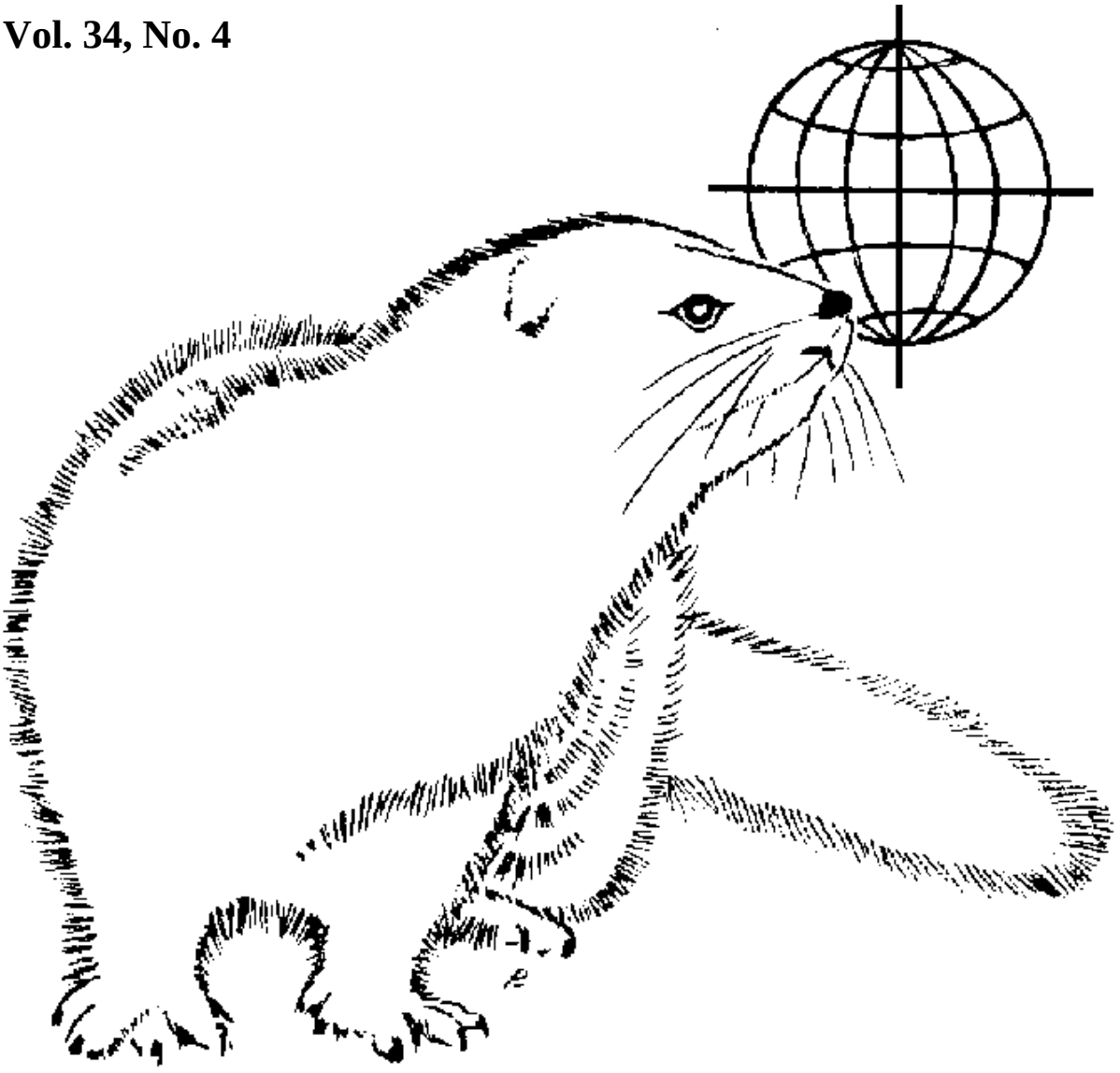

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Notes from the Editor

In this issue of Scientifur 34,4, abstracts are presented from studies in mink and foxes. Genetic variation in litter size and kit survival was studied in mink showing that it is possible to improve these traits by selection. In a study with foxes, loci associated with behaviour were mapped. In mink, the results from a study of digestive enzyme activity suggest that digestibility of fat is low in mink kits compared to adult mink. From the results of a study with several monogastric species including mink it was concludes that bacterial meal derived from natural gas fermentation may be a future protein source in animal feed. Another study supports vaccination against distemper virus in mink production.

The NJF Autumn Meeting within Fur Animal Research was held in Oslo, Norway 29th September to 1st October 2010. Abstracts from this NJF Seminar No. 440 are published in this issue of Scientifur. Reports are presented from studies within nutrition and management, genetics, and etology.

Vivi Hunnicke Nielsen
Editor Scientifur

Genetic variation in litter size and kit survival of mink (*Neovison vison*)

B.K. Hansen, G. Su, P. Berg

The aims of this study are to estimate variance components of litter size and kit survival rate and estimate genetic correlations of litter size and kit survival rate with dam's juvenile body weight and pregnancy length. Variance components for litter size and kit survival were analysed using an AI-REML approach, based on data from 1940 litters of the black colour type mink from 1996 to 2001. The models included (i) additive genetic effect of dam; (ii) dam and sire genetic effects; (iii) additive genetic effect of dam in relation to litter size and dam and sire genetic effects in relation to survival rate; (iv) additive genetic effect of dam to estimate the correlations of litter size or kit survival with dam juvenile body weight and pregnancy length on yearling dams (1357 litters). The dam heritabilities were of litter size (0.02-0.08) and survival rate (0.05-0.10). The permanent effects of dam were important for litter size (0.15-0.19) but not for survival rate. A positive dam genetic correlation between litter size and survival rate was found at 1 week postpartum (0.42), and a positive sire genetic correlation between number of weaned kits and survival rate at the age of 6 month (0.72). Litter size and survival rate were genetically antagonistically related to dam's juvenile body weight (-0.34 to -0.53). These results indicate the following: (i) it is possible to improve litter size and kit survival by selection, (ii) effective improvement of kit survival rate in the suckling period requires selection for maternal effect on kit survival and kit's own capacity to survive and later in the growth period for kit's own ability to survive and (iii) antagonistic genetic correlation of dam juvenile body weight with litter size and survival rate should be taken into consideration in mink breeding programs.

J. Anim. Breed. Genet, 2010:127(6),442-51.

Mapping Loci for Fox Domestication: Deconstruction/Reconstruction of a Behavioral Phenotype

A.V. Kukekova, L.N. Trut, K. Chase, A.V. Kharlamova, J.L. Johnson, S.V. Temnykh, I.N. Oskina, R.G. Gulevich, A.V. Vladimirova, S. Klebanov, D.V. Shepeleva, S.G. Shikhevich, G.M. Acland, K.G. Lark

During the second part of the twentieth century, Belyaev selected tame and aggressive foxes (Vulpes vulpes), in an effort known as the "farm-fox experiment", to recapitulate the process of animal domestication. Using these tame and aggressive foxes as founders of segregant backcross and intercross populations we have employed interval mapping to identify a locus for tame behavior on fox chromosome VVU12. This locus is orthologous to, and therefore validates, a genomic region recently implicated in canine domestication. The tame versus aggressive behavioral phenotype was characterized as the first principal component (PC) of a PC matrix made up of many distinct behavioral traits (e.g. wags tail; comes to the front of the cage; allows head to be touched; holds observer's hand with its mouth; etc.). Mean values of this PC for F1, backcross and intercross populations defined a linear gradient of heritable behavior ranging from tame to aggressive. The second PC did not follow such a gradient, but also mapped to VVU12, and distinguished between active and passive behaviors. These data suggest that (1) there are at least two VVU12 loci associated with behavior; (2) expression of these loci is dependent on interactions with other parts of the genome (the genome context) and therefore varies from one crossbred population to another depending on the individual parents that participated in the cross.

Behav. Genet. 2010: [Epub ahead of print]
doi: 10.1007/s10519-010-9418-1

Changes in digestive enzyme activity, intestine morphology, mucin characteristics, and tocopherol status in mink kits (*Mustela neovison*) during the weaning period

M.S. Hedemann, T.N. Clausen, S.K. Jensen

Weaning of livestock mammals is often associated with digestive problems related to profound changes in the physiology of the gastrointestinal tract. Knowledge on the changes occurring in the gastrointestinal tract of mink kits during the weaning period is scarce. Such knowledge is important in order to understand the increased occurrence of gastrointestinal disorders around the time of weaning and the reduced growth rates often

observed. The present study was undertaken to investigate the developmental changes in the gastrointestinal tract of mink kits during the period 34-59 days of age. Twenty-four mink kits from 8 litters were included in the experiment. The dams and their litters were kept under standard farm conditions. The dams and the kits were fed a diet consisting of 48.1 % protein, 40.7 % fat, and 11.1 % carbohydrate of ME. The mink kits were weaned at 42 days of age. At 34, 47, and 59 days of age one male mink kit from each litter was euthanized, a blood sample was taken and samples were collected from the digestive tract (pancreas and intestinal tissue at 25 % and 75 % of the small intestinal length) and the liver (tissue and bile). The total activity of the pancreatic enzymes amylase, trypsin, chymotrypsin, lipase, and carboxyl ester hydrolase (CEH) per gram metabolic weight increased during the experimental period. When the activities were compared to the levels observed in adult mink in other studies it was found that amylase and CEH are fully developed at the age of 8 weeks whereas the activities of trypsin and chymotrypsin were 2-3 times higher in adult mink. The activity of lipase is 20-35 times lower in mink kits than in adult mink and hence the digestibility of fat is anticipated to be low in mink kits. The vitamin E concentration in plasma was stable from 34 to 59 days of age, while the concentration decreased in the liver. The stereochemical composition of α-tocopherol showed a steep decrease in the concentration of the biologically most active natural isomer in both plasma and liver through the whole weaning period, while the biologically less active 2S isomers showed a clear increase. This indicated that some α-tocopherol acetate was hydrolysed and made available for absorption but the vitamin E status observed prior to weaning was not maintained. The villus height increased in the proximal part of the small intestine and decreased in the distal part whereas the crypt depth was doubled in both the proximal and distal part of the small intestine. This is probably a sign of a high proliferative activity in the crypts reflecting the rapid growth of the small intestine during the experimental period. The intestinal lining is covered by a protective mucus layer, and the backbone of this mucus layer is mucin secreted by the goblet cells found in the intestinal lining. The mucin staining area on the villi was markedly reduced during the experimental period but no change in the mucin staining area in the crypts was observed. A reduction in the mucin staining area may correlate to a decrease in the thickness of the mucus layer which may render mink kits more susceptible to infections during the weaning period.

In conclusion, the present study demonstrates that the enzymatic capacity is not reduced during the weaning period but the low activity of lipase in mink kits compared to the activity found in adult mink implies that the digestibility of fat is low in mink kits, however, this warrants further investigation. The reduced mucin staining area and the lower vitamin E status suggests that the mink kits may be more susceptible to infections during the immediate postweaning period.

Published in Animal, 2010,
doi: 10.1017/S1751731110001990

Evaluation of methane-utilising bacteria products as feed ingredients for monogastric animals

M. Øverland, A.H. Tauson, K. Shearer, A. Skrede

Bacterial proteins represent a potential future nutrient source for monogastric animal production because they can be grown rapidly on substrates with minimum dependence on soil, water, and climate conditions. This review summarises the current knowledge on methane-utilising bacteria as feed ingredients for animals. We present results from earlier work and recent findings concerning bacterial protein, including the production process, chemical composition, effects on nutrient digestibility, metabolism, and growth performance in several monogastric species, including pigs, broiler chickens, mink (Mustela vison), fox (Alopex lagopus), Atlantic salmon (Salmo salar), rainbow trout (Oncorhynchus mykiss), and Atlantic halibut (Hippoglossus hippoglossus). It is concluded that bacterial meal (BM) derived from natural gas fermentation, utilising a bacteria culture containing mainly the methanotroph Methylococcus capsulatus (Bath), is a promising source of protein based on criteria such as amino acid composition, digestibility, and animal performance and health. Future research challenges include modified downstream processing to produce value-added products, and improved understanding of factors contributing to nutrient availability and animal performance.

Arch. Anim. Nutr. 2010:64(3),171-89

Evaluation of the immune response after vaccination against distemper at a mink (Mustela vison) farm in Argentina

A.M. Jar, L.G. Ramayo, A. Stempler, L.H. Goldman, S.L. Mundo

Distemper virus causes a disease affecting minks with respiratory, gastrointestinal, neurological and skin symptoms and showing high morbidity and mortality, mainly among puppies. It is controlled through immunization, using vaccines that are supplied for mink use. The aim of this work was to determine the seroneutralization titer against the distemper virus at a mink farm in Argentina. The antibody kinetics obtained after vaccination in 27 adult animals, as well as the duration of colostrum-transferred antibodies in 10 puppies were determined. All vaccinated adult minks showed protective titers up to at least 3 months after vaccination, and 37.5% significantly reduced their antibody levels, 12 months after vaccination. Only 20% of the puppies showed protective levels of colostrum-transferred antibodies at the age of 7 weeks, while non-detectable levels of antibodies were found when puppies reached 11 weeks old. Vaccination performed in these puppies at the age of 13 weeks, elicited protective seroneutralization titers. These results show that vaccination induces a satisfactory humoral immune response in our environment, and support the convenience of vaccinating dams annually before the beginning of the breeding season. The vaccination plan in puppies is also discussed.

Rev. Argent. Microbiol. 2010: 42(3),189-92

Nordic Association of Agricultural Scientists

NJF - Seminar no. 440

Fur Animal Research

Autumn Meeting - Oslo, Norway

29 September – 1 October 2010

Nordic Association of Agricultural Scientists

NJF Subsection for Fur Animals

Dietary preferences in mink offered increasing levels of oat hulls – a comparison between palatability trials, operant conditioning method and eating time trials

M. Schulin-Zeuthen

Series of three palatability trials, a trial using operant conditioning method and an eating time trial were conducted to measure preferences in mink for the same diets: control, diets with 3, 6, 9 or 11.3 % oat hull meal or 11.3 % barley hull meal. Results from all three methods showed that the dietary preferences increase in mink when the inclusion of dietary fibre decreases the first time they were presented to the diets. After an adaptation period, results from the palatability trial were unchanged but in contrast to the eating time trials, where the results showed that an adaptation to the diet took place

NJF Seminar No. 440, Oslo, Norway, September-October 2010, 11 pp. Authors' abstract

Higher body weight of mink kits in nests with screen

B.K. Hansen, V.H. Lund, M. Sønderup, H. Bækgaard, T. Clausen

Nest box design affect early growth of mink kits. In this farm trial 9 farms including 5130 females with 34303 kits were involved. Size of nest box was reduced using an inner screen in the nest. As nest material were used *Easy Stroe* or traditional cutted straw. Nest with and without screen were compared, and *Easy Stroe* was compared with traditional cutted straw. The Number of living kits from 2 to 5 days of age and the number of kits alive at 3 to 4 weeks of age were recorded. Litters of 5-9 kits between 6 to 24 days of age were weighed females and males separately. Nests with screen showed no difference in litter size compared to nests without screen. However, kits born in a nest with screen were heavier in week two after birth than kits born without screen. This applied especially female kits. The farm trial confirms the effect of dam age on litter size and kit growth. Adult dams give birth to larger litters and kits are heavier. Litter size has a negative effect on body weight, kits born in large litters are smaller.

NJF Seminar No. 440, Oslo, Norway, September-October 2010, 8 pp. Authors' abstract

Digestibility and nutrient content values of Norwegian fur animal feeds in comparison with declared values

Ø. Ahlstrøm, G. Sanson, E. Kjos, A. Skrede

The study determined digestibility of main nutrients and metabolizable energy (ME) content and ME distribution of feed from six Norwegian fur animal feed kitchens. The feed was produced in May 2010 and the results were compared with declared values. Digestibility values were close to predicted values calculated by the computer program on the basis of single ingredient digestibility and the dietary inclusion level. Discrepancy between declared values and determined values concerning content of digestible protein, fat and carbohydrates and metabolizable energy content were mainly caused by slightly higher or lower content of protein, fat or carbohydrates than expected. Generally, all six feeds were in line with recommendations given by the Norwegian Fur Breeders' Association and declared nutrient content values were in most cases acceptable compared with actual nutrient content values.

NJF Seminar No. 440, Oslo, Norway, September-October 2010, 4 pp. Authors' abstract

Effect of foetal life nutrition on the expression of some enzymes regulating the fat metabolism in mink

C.F. Matthiesen, M.A. Aguinaga, A-H. Tauson

The nutrition during gestation has high impact on the metabolism of the offspring. Studies in mink have shown that that the expression of some hepatic enzymes regulating the gluconeogenesis and glycolysis are affected in foetuses and kits from mothers exposed to protein restriction during pregnancy. The objectives of this study were to investigate if the expression of enzymes regulating

the fat metabolism were affected in foetuses and adult female mink of mothers fed either a low level of protein (LP ~ 14, 51 and 35 % of metabolizable energy (ME) from protein, fat and carbohydrates) or an adequate level of protein (AP ~ 29, 56 and 15 % of ME from protein, fat and carbohydrates) during late gestation. A pilot study with six F_0-generation, three LP and three AP fed dams, and six F_1-generation female mink born by mothers fed either AP or LP diet during gestation but adequately fed themselves from weaning onwards, was performed. The females were euthanized and liver samples from both F_0 and F_1-generation dams and six F_1-generation foetuses where snap frozen in liquid nitrogen and stored at -80 Cº. The expression of mRNA of the genes of interest was determined by q-PCR. The chosen genes were acetyl coenzyme A carboxylase (ACC) catalyzing a committing step in the fatty acid synthesis and fatty acid synthase (FAS) catalyzing the synthesis of saturated long-chain fatty acids. Both enzymes are thereby of importance for de novo lipogenesis. The enzyme carnitine palmitoyl transferase 1 (CPT-1) is responsible for the transfer of long chain fatty acids into the mitochondria and thereby rate limiting for fatty acid oxidation.

The results indicate that protein restriction during fetal life might decrease the expression of FAS in the fetal liver of the F_1-generation ($P=0.04$), whereas there was a tendency towards higher expression of FAS in the adult liver of the F_1-generation females which had been exposed to foetal life protein restriction ($P=0.09$), similar to findings in weanling rats. There was no difference in the expression of ACC in the liver tissue between controls and treated ones. The expression of CTP1 was significantly ($P<0.01$) lower among female F_1-generation adults exposed to foetal life protein restriction compared to controls. Further investigations are needed to clarify the consequences of these changes for the fat metabolism

NJF Seminar No. 440, Oslo, Norway, September-October 2010, 8 pp. Authors' abstract

Energy metabolism of breeding blue foxes, *Alopex lagopus*

N. Koskinen, A-H. Tauson

The main objective of this project was to establish baseline data on the energy requirement of breeding blue foxes by measuring feed intake, energy expenditure, and protein and fat retention. The data will be used to develop practical farming feeding recommendations for young future breeding blue fox vixens, in order to avoid excessive fat retention during the autumn, and then severe weight reduction during the winter.

At the beginning of the experiment mean live weights were significantly different (9.5-11.4 kg), as intended. Animal live weight reflected strongly the energy supply. After blue foxes had been artificially inseminated there were no differences in the live weight, as intended. In the periods before the gestation differences were found between groups in ME and RE. HE was similar in all groups. Nitrogen retention was lowest during the measuring period in February in group 1.

Feeding recommendations for the breeding and production blue fox females have been assigned according to the results. Recent data suggest that blue fox vixens being selected for breeding purposes during the summer, and then rearing them on a restricted feeding regimen, has resulted in improved reproductive results when compared to vixens reared on *ad libitum* feeding (Koskinen et al., 2008). Future investigations will focus on the reproductive performance in vixens raised on different levels of energy supply.

NJF Seminar No. 440, Oslo, Norway, September-October 2010, 3 pp. Authors' abstract

Evidence for genetic variation in bite marks in group housed mink

P. Berg, S.H. Møller

There is evidence from several species (e.g. poultry) that selection can contribute to reduced aggression in groups, and selection thus could be one way of reducing aggression in group housed mink. On this background, a selection experiment was started,

aiming at reducing the number of bite marks on the skin side. This study describes variation in bite marks in the first generation. The study includes evaluation of bite marks on a total of 640 mink in group housing and 289 of their full sibs in standard cages (two animals). In group housing the females are generally more bitten than males, though the most bitten male has on average more bite marks than the least bitten female. A higher correlation between number of bite marks are observed between animals of the same sex (the two males and the two females) than between sexes in group housing. This indicates that bite marks to a large extent is due to fights within sexes. A large variation between full sibs/cages was found in the number of bite marks. Preliminary analyses indicate that genetic differences are an important factor contributing to the number of bite marks. It is argued, that this could be due to both direct and associate effects (effects of group mates).

NJF Seminar No. 440, Oslo, Norway, September-October 2010, 7 pp. Authors' abstract

Mapping of QTLs for fur quality traits in mink

V.H. Nielsen, R. Anistoroaei, B. Guldbrandtsen, K. Christensen, M. Fredholm

A 3-generation population (F_2-design) was established to map quantitative trait loci (QTLs) for fur quality traits in mink. In the parental generation, Nordic wild mink were crossed with American short nap mink. All mink were genotyped with 10 and 8 microsatellite markers on chromosomes 2 and 6, respectively. Recordings of fur quality traits were done by Kopenhagen Fur. QTL-analyses were performed using GridQTL. On chromosome 2, the analyses revealed QTLs for guard hair thickness and hair length, pelt quality and size of the pelt. On chromosome 6, QTLs were detected for type, guard hair and pelt quality. Identification of QTLs for fur quality traits makes it possible to improve fur quality traits quickly and efficiently by DNA-based selection.

NJF Seminar No. 440, Oslo, Norway, September-October 2010, 6 pp. Authors' abstract

Guidelines for optimization of dose-response experiments

P. Berg

Several experiments aim at finding the optimal dose of a factor, e.g. amino acid levels in feed. A trade-off in experimental design is a choice between the number of experimental groups and the size of experimental groups, as the total number of animals available is often the limiting factor and the main determinant of costs. Based on theory of experimental design and stochastic computer simulations guidelines for optimising dose-response experimental designs are presented assuming that the total number of animals is the limiting factor. In general the optimal design depends on the (unknown) optimum to be found, and thus provides a challenge in design of dose-response experiments.

NJF Seminar No. 440, Oslo, Norway, September-October 2010, 1 pp. Authors' abstract

Selection on number of active (mammary) nipples looks effective

Number of nipples show big variation and affects kit survival

J. de Rond, F.C. Kleyn van Willigen

Research Farm Edelveen and the Animal Health Service have looked into the effect of the number of developed and active (mammary) nipples in relation to kit survival between kit's birth and 21 days of age.

In May 2009, all female mink with a litter at Edelveen were controlled on the number of active nipples. Based on number of active nipples of the mother (4 or 5, 6, 8 and 9), minks were selected for breeding and combinations were carried out. After whelping 1334 kits in all litters were checked on number of nipple dots (place where a mammary nipple may develop). The number of nipple dots at kits varies from 6 to 11 dots per kit. This variation can occur within one litter. The average number of nipple dots differ significant between the combinations when the mother in 2009 had 6 active nipples (7,3 nipple dots), 8 active nipples (7,6 nipple dots) or 9 active nipples (8,0 nipple dots). The kits in combination 4/5X4/5 active nipples (7,3 nipple dots) don't differ with the kits in the combination where the mother had 6 active nipples.

The correlation between number of active nipples and kit losses is also clear in 2010. On each litter size the kit losses between whelping and 21 days are significant higher when the number of active nipples is too low compared to number of kits. There is no correlation between number of active nipples and fertility. The correlation between the number of nipples in 2009 and in 2010 is clear. The litter size in 2010 dictates the small differences. The average number of nipples in 2010 is 80-90% of the number in 2009 + or – 1 nipple. The number of nipples at the daughters is correlated to the number of the mother.

The year 2011 must show how much dots develop into an active mammary nipple. This trial shows the big variation in active nipples and the smaller variation in nipple dots as well as the correlation between the number of active nipples and kit losses. Selection on number of active nipples looks effective and helps the female mink in nursing their kits.

NJF Seminar No. 440, Oslo, Norway, September-October 2010, 6 pp. Authors' abstract

Killing farmed mink with CO and CO_2

H.T. Korhonen

In animal euthanasia every effort must be made to avoid causing unnecessary suffering. The present paper describes a study seeking to shed light on the killing of farmed mink (*Mustela vison*) with carbon monoxide (CO) and carbon dioxide (CO_2).The study has four components to outline: (1) Current euthanasia methods and the situation on fur farms (in 2010), (2) Functionality of impure CO equipment (in 2010), (3) Efficacy of the euthanasia method s(2010-2011), and (4) Guidelines on euthanasia (2011-2013). The study is being performed by MTT Animal Production Research, Kannus, Finland. Different concentrations of engine-produced CO are being compared to establish an effective level for killing mink. Preliminary results revealed that CO concentrations of 1.2-3% may be too low because either the mink did not die at all or killing took too long (> 7-15 min). Evaluations of dying processes were based on behaviour of animals, and are therefore still estimates. Concentrations of 4-6% seems to be effective, causing death of the animal within 3-6 min from gas input. Preliminary results with cylinder CO of 4% in the killing box let us assume that mink will die on average within 5-6 min since gas input to box was started. Typical behaviours before death were agitation, hyperventilation, incoordination of movements and recumbency. A cylinder CO_2 concentration of 70% in the box was not able to kill the mink within 7 min. A concentration of ≥80% was effective, leading to death within about 4-6 min. The cost of equipment was markedly higher for cylinder CO than for cylinder CO_2. CO and CO_2 concentrations in the air of the laboratory were below the daily safety allowance for each group. A comprehensive electrodiagnostical study is under way to evaluate the dying process in detail. Until these findings are available, final conclusions about a humane way of killing mink cannot be drawn.

NJF Seminar No. 440, Oslo, Norway, September-October 2010, 7 pp. Authors' abstract

Black spots in subcutis of minks: No bite marks

F.C. Kleyn van Willigen, J. de Rond, L. Boekhorst

Black spots in the subcutis of pelts can be found after pelting in the inguinal region, the back, the abdomen, the neck or spread over the whole body. The subcutis is the "meat side" of the pelt. The black spots have been indicated by the fur farmers as bite marks in the past. The density of the spots was variable, from high to low, as well as the distribution of the density of the spots. Examination of the animals learns that the distribution of the black spots did not concur with the places where bite marks usually develop. The males generally had less black spots than the females, but when pelted in December almost all the females and males were free of black spots. Microscopical examination of the skin samples with black spots did not reveal scars indicative of bite wound trauma.

NJF Seminar No. 440, Oslo, Norway, September-October 2010, 6 pp. Authors' abstract

Blue foxes' choice between sand floor and mesh floor

T. Koistinen

Overall, the results suggest that the sand floor provides the foxes an opportunity for manipulation and exploration; even novelty may have invited foxes to visit the sand floor in some experimental settings. It seems that in general, farmed blue foxes seek for opportunities for exploration, novelty, and possibility to control and manipulate their environment. In my experimental settings, sand floor provided this possibility, but in practical fox farming these can possibly be provided by other means, e.g. by various activity objects. It might also be beneficial if the activity object is regularly changed to maintain some level of novelty. Considering all the previous and present results, it seems that access to a sand floor improves the welfare of farmed foxes, but it may not be essential for a fox without early experience of a sand floor. In other words, if the fox has no experience of the sand floor early in its life, its' welfare can be more easily improved by other means than provision of a sand floor.

NJF Seminar No. 440, Oslo, Norway, September-October 2010, 6 pp. Authors' abstract

Feed control and environmental enrichment in mink – consequences for behaviour and welfare

S.W. Hansen, S.H. Møller, B.M. Damgaard.

This experiment compared the behaviour of mink during two different feeding routines; slightly restrictive (an idle time of 6 h (12 h)) or standard (an idle time of 2 h), respectively, and the mink's use of two different types of occupational material; an attached tube and a loose tube, respectively. The behaviour of the mink was observed on two days in weeks 4, 10, 14, and 18 after weaning. On the first day the mink were fed at normal feeding time but on the second day the feeding time was postponed. The daily feed ratio, live body weight, behaviour, temperament, and fur quality were measured.

The results indicate that a slightly restrictive feeding, based on 6 h of idle time, is difficult to practise because mink increase their eating speed. The mink were not able to compensate for an idle time of 12 h, which may cause the feeling of hunger and increased stereotypic behaviour. However, a slightly restrictive feeding may be profitable for the health of the mink by increasing the anticipatory behaviour and reducing the occurrence of urine drip. The mink used the attached tubes more than the loose tubes and the average activity level was decreased in mink with access to attached tubes. However, the attached tubes (shelves) and the removable loose tubes did not affect the fur quality differently, and none of the two types of enrichments seem valuable for reducing the occurrence of fur chewing in mink.

NJF Seminar No. 440, Oslo, Norway, September-October 2010, 12 pp. Authors' abstract

Effects of increased fibre content and enriched climbing cages to female mink during the winter

L. Lidfors, H. Axelsson, T. Thierfelder, S.W. Hansen, E. Aldén

Stereotyped behaviour is most common in female mink during the winter time when the diet usually is restricted to 90% of the animals energy demand. If the mink could get a larger amount of feed without getting more nutrition this could increase the feeling of satiety. The aim of this study was to investigate if added fibre in the diet and housing in enriched climbing cages would lead to reduction in stereotyped behaviour in female mink during the winter period? In addition we investigated if ad lib. feeding or added fibre in the diet lead to fewer pups? The study was done on a private mink farm in Southwest of Sweden. We used 360 Half sapphire females. Half of the mink were kept in climbing cages and the other half in standard cages from weaning. Within each cage type three feeding treatments were applied: beat pulp (BP, 2% +10% water) in restricted feed, ad libitum feed (AL) and restricted feed (RF) to 90% of energy need. All cages were enriched with net shelf, plastic cylinder and straw on the roof of the nest. Individual feeding was done once a day with Norcar BSB (Denmark). Behavioural observations were carried out during December-March before, during & after feeding (1 h. each) with 0-1 recording 6 times/mink per hour. Each mink were weighed and scored for body condition once per month. Number of pups born, any complications at birth and number of pups at 6 weeks after birth was also recorded. Descriptive

statistical analysis has been done with Wald statistics in Statistica.

Preliminary results show that stereotypies were lower in the climbing cages than in the standard cages ($p<0.000$), and lowest with AL and highest with BP ($p<0.000$). Stereotypies increased with time in the standard cage ($p<0.000$), but not in the climbing cage. Eating feed was performed more in the standard cage than in the climbing cage ($p<0.01$), and more in BP than in AL and RF ($p<0.001$). Feed seeking was higher in standard cages than in climbing cages ($p<0.000$), and higher in BP than in RF and lowest in AL ($p<0.000$). Interacting with straw was higher in BP than in both RF and AL ($p<0.05$), but there were no differences between cage types (n.s.). Mink with AL were more in the nest in standard cages than in climbing cages ($p<0.05$), but there were no cage differences for RF or BP. Mink were least in the nest with BP ($p<0.001$). Lying on the net floor was done more in the climbing cage than in the standard cage ($p<0.000$), and most in AL and least in BP ($p<0.000$). Being inactive, i.e. being in the nest and lying on the net floor, decreased with time ($p<0.000$), but did not differ between cage types (n.s.). Standing still on the net floor was done more in the standard cage than in the climbing cage ($p<0.001$), and most in the RF ($p<0.000$). Walking had a significant interaction between cage type and feeding treatment ($p<0.001$), and BP had the highest recordings in climbing cages whereas RF had a higher number in standard cages than in climbing cages and AL lowest in both cage types. In standard cages RF had 5.5 pups, BP 4.6 and AL 3.9 pups at 6 weeks, whereas in climbing cages AL had 5.2, BP 5.1 and RF 4.2 pups at 6 weeks. It is concluded that climbing cages and ad lib. feeding was the most effect ways of reducing stereotyped behaviour in female mink during the winter.

NJF Seminar No. 440, Oslo, Norway, September-October 2010, 1 pp. Authors' abstract

Methodology to register water balances in mink

L. Tinggaard, K. Hvam

For registration of water balances, the mink were offered a known amount of water via the feed and in a drinking bottle. Amounts of allotted and left over's of feed and water were registered daily. Water spillage was registered daily. Faeces and urine were collected, weighed and registered daily after a visual evaluation. A sample of faeces was taken for determination of dry matter content. A control bottle was placed in the stable and showed no detectable amount (<0.1 g) of evaporated water. The collection bottles for eventual water spillage were necessary, since water spillage between 0.00 g to 32.88 g were registered. The method allows to measure water intake, excretion of water and a potential spillage of water.

NJF Seminar No. 440, Oslo, Norway, September-October 2010, 5 pp. Authors' abstract

Water balance in 8 week old mink kits

T. Clausen

Water is very important for the wellbeing of mink kits. A way to make it easier for the kits to get enough water, is to increase water content in the feed. This can be done by adding different products that binds the water in the feed. To se if we could increase water intake by the feed in 8 week old mink kits, we added different fibres (Arbocel 1 and 2 %, Pea fibre1 and 3 %, Beet pulp 1½ %) and a Feed binder (Scanpro T95 ½ and 1 %) to wet feed and measured the water balance.

Adding different kinds of fibres and Feed binders to mink kits at 8 weeks of age, can have an influence on their water intake and faecal water excretion. Arbocel seemed to reduce the amount of drinking water, whereas Scanpro T95 increased total water uptake but resulted in very loose faeces.

NJF Seminar No. 440, Oslo, Norway, September-October 2010, 7 pp. Authors' abstract

A review of stereotypic behaviour in farmed foxes

R. Anttila, T. Koistinen, J. Mononen, L. Ahola

The present review shows that there is not consistent data available on the level and development of the stereotypic behaviour under commercial farming conditions in farmed foxes. Various definitions of stereotypic behaviour and various sampling methods complicate drawing final conclusions of the

fragmented data. It seems that stereotypic behaviour is not a very common behaviour in juvenile farmed foxes. Conclusions regarding breeding animals cannot be drawn due to limited data. Social housing during growing period and access to an activity object seem to prevent development of stereotypic behaviour in juvenile foxes.

NJF Seminar No. 440, Oslo, Norway, September-October 2010, 5 pp. Authors' abstract

Consequences of social housing during autumn on adult silver fox vixens' body weight, wounds and later reproduction

A.L. Hovland, M. Bakken

Farmed silver foxes are usually housed singly throughout adulthood. Due to their flexible social nature group housing may act as an alternative housing procedure for adult vixens. However, sociality may result in aggression during competition for e.g. dominance with negative effects on foxes' welfare and reproduction, in particular for subordinate vixens. This experiment examined consequences of housing adult vixens in triplets for 13 weeks from September to December on their body weight development, occurrence of wounds and future reproduction. To evaluate effects of social competition dominance relations were recorded. 358 one to four year old silver fox vixens housed in six different commercial farms participated in the study. In each farm half of the vixens were housed in single cages as controls whereas the other half were housed in triplets in three connected cages consisting of one 1-year-old, one 2-year-old and one 3 or 4-year-old vixen. After the triplets were separated in December all animals were housed singly until mated in February and throughout the breeding period. The dominance rank within each triplet was assessed by a competition test. Body weight was recorded at: start, 3 and 8 weeks after start, the end and mating. Simultaneously, wounds were recorded by physical examination (palpation). Reproduction variables included number of estrus controls, mating date, litter size at 1 and 3 weeks and at weaning. Group housed vixens gained more weight and were heavier at the end of the experiment compared to the singly housed vixens. At the end of the experiment the lowest ranked vixens had significantly lower body weight compared to vixen no. 2 (P=0.015). Injuries were higher in the group housed vixens compared to the controls during examination week 3 ($\chi 2$=65.2, N=352, df=3, P<0.0001) and week 8 ($\chi 2$=13.3, N=342, df=3, P=0.004) after the experiment started and at the end of the experiment in December ($\chi 2$=8.6, N=342, df=3, P=0.035). Apart from a significant effect of housing procedure on number of days to first mating and days to whelping there was no significant effect of housing procedure on any of the reproduction variables. The proportion of mated vixens that did not deliver or lost their cubs immediately after birth was not significantly different between group housed (20.6% (27/131)) or singly housed vixens (18.5% (35/135)) ($\chi 2$=0.124, P=0.724). A significant effect of dominance rank was found for litter size per mated vixen at weaning, where high ranked vixens weaned approximately one more cub compared to vixens ranked as number two and three. Although adult vixens kept in groups gained more weight compared to singly housed controls, body weight differences within groups indicated some competition over food. Aggression during social housing in autumn may jeopardize vixens' welfare and have negative consequences for future reproduction in subordinate vixens. Therefore, at present, group housing cannot be recommended as an alternative housing procedure for adult silver fox vixens.

NJF Seminar No. 440, Oslo, Norway, September-October 2010, 1 pp. Authors' abstract

Energy metabolism of growing blue foxes, *Alopex lagopus*

N. Koskinen, A-H. Tauson

The main objective of this project was to establish baseline data on the energy requirement of growing blue foxes by measuring feed intake, energy expenditure, and protein and fat retention. The data will be used to develop practical farming feeding recommendations for young future breeding blue fox vixens, in order to avoid excessive fat retention during the autumn, and then severe weight reduction during the winter.

Mean live weights were similar (4.9-5.1 kg) among groups at the beginning of the trial, but at the end of the experiment the group mean weights were significantly different (9.2-12.8 kg), as intended. Animal live weight reflected strongly the energy supply.

NJF Seminar No. 440, Oslo, Norway, September-October 2010, 2 pp. Authors' abstract

Table 1. Metabolizable energy (ME) , heat production (HE), retained energy (RE) kJ/kg$^{0.75}$and retained nitrogen (RN, g/kg$^{0.75 \cdot}$ day) for blue fox vixens raised on different energy supply and measured in five periods from 10 to 30 weeks of age

	Group	Period					*RR*	*P*-value; effect of	
		I	II	III	IV	V		Group	Period
ME	1	1616	1392	1074	835	819			
	2	1634	1392	1017	820	711			
	3	1502	1250	855	753	598			
	4	1458	1133	752	593	462	137	0.0017	<.0001
HE	1	570	388	291	479	489			
	2	567	407	345	487	421			
	3	568	378	289	454	461			
	4	466	368	232	397	363	68	0.0661	<.0001
RE	1	1046	1004	783	356	330			
	2	1067	985	673	332	290			
	3	934	872	554	298	137			
	4	992	764	529	196	99	139	0.0086	<.0001
RN	1	1.09	0.94	0.46	0.21	0.15			
	2	1.14	0.77	0.33	0.21	0.15			
	3	1.06	0.61	0.33	0.22	0.07			
	4	1.11	0.58	0.34	0.29	0.07	0.13	0.1703	<.0001

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