SCIENTIFUR

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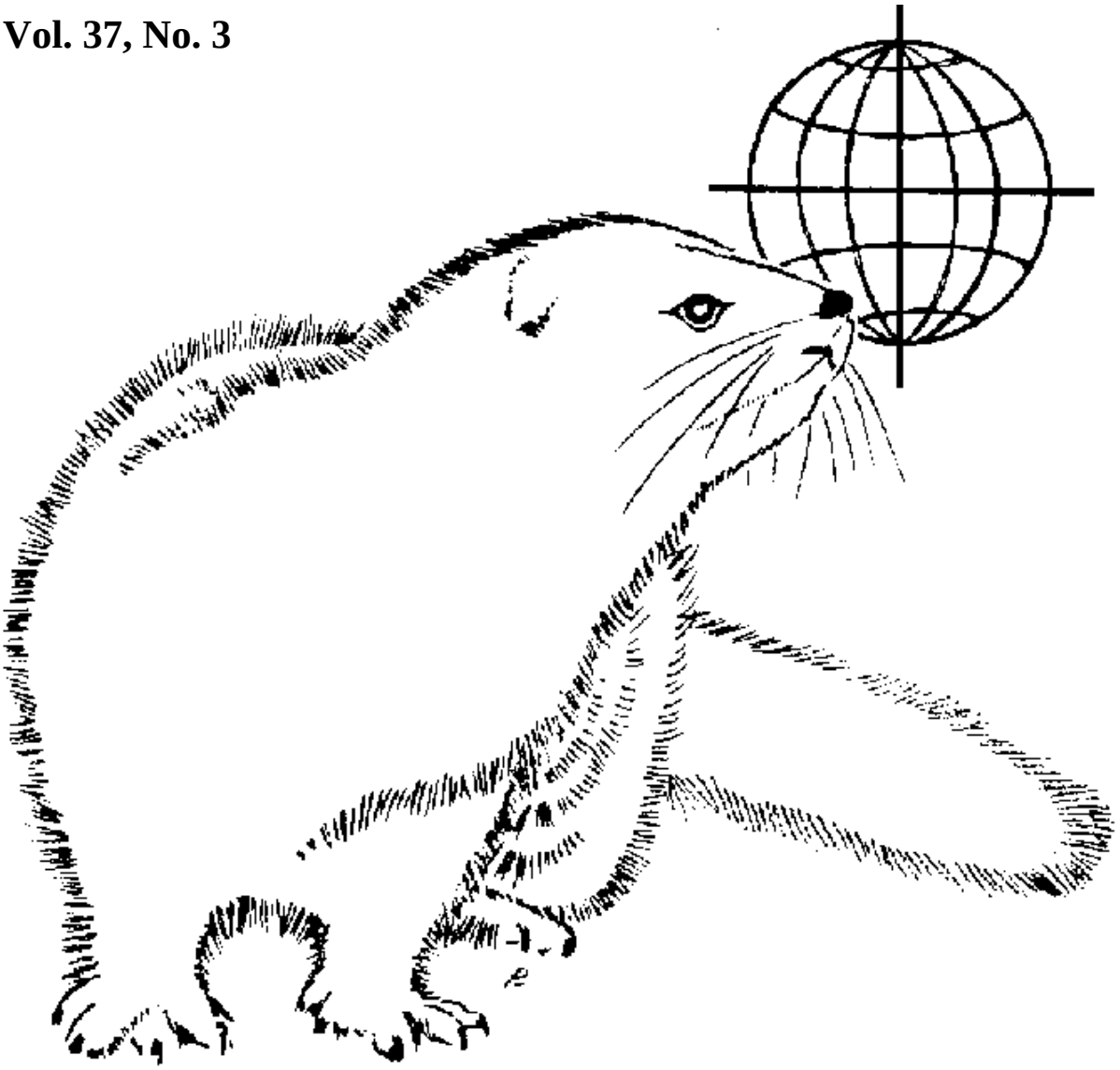

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INTERNATIONAL FUR ANIMAL SCIENTIFIC ASSOCIATION

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SCIENTIFUR is the contact link between fur animal researchers all over the world and serves as an outlet for scientific and other communication between researchers and others who are interested in the production of fur bearing animals. As such **SCIENTIFUR** contains reports of scientific and applied nature as well as abstracts of information published elsewhere and information regarding congresses, scientific meetings etc.

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Notes from the Editor

The 464 Seminar of the Nordic Association of Agricultural Scientists (NJF) dealing with Fur Animal Research was held 28-30 August 2013 on Iceland. Abstracts from the seminar within ethology and welfare, nutrition and management, and breeding, genetics and reproduction in fur animals are published in this issue of Scientifur.

Fur animal research was also presented at 11th World Conference on Animal Production (WCAP 2013) held in Beijing, China October 15-20 2013 primarily at the session entitled "Other Livestock Production; Fur animal production. Fox, mink, and deer". Eighteen presentations were within fur animal research. It included one invited oral presentation, 5 additional oral presentations and 12 poster presentations.

The 31th Mustelid Colloquium organized by Polish Society for Conservation Genetics LUTREOLA was held at Teaching and Research Center of Nanotechnology, Szczecin, Poland October 25-26 2013

Coordinators are appointed for Scientific Sessions e.g. within Fur Animal Production at the 65th Annual Meeting of the European Association of Animal Production (EAAP) to be held in Copenhagen 25-29 August 2014. Focus is on including fur animal research in the various scientific sessions.

Education of scientist at all levels within fur animal production is important. It is a pleasure to bring a summary of a PhD thesis performed at Aarhus University, Denmark in this volume of Scientifur.

Vivi Hunnicke Nielsen
Editor Scientifur

BREEDING, GENETICS AND REPRODUCTION

Assessing the cryptic invation of a domestic conspecific: American mink in their native range

K.B. Beauclerc, J. Bowman, A.I. Schulte-Hostedde

Control of invasions is facilitated by their early detection, but this may be difficult when invasions are cryptic due to similarity between invaders and native species. Domesticated conspecifics offer an interesting example of cryptic invasions because they have the ability to hybridize with their native counterparts, and can thus facilitate the introgression of maladaptive genes. We assessed the cryptic invasion of escaped domestic American mink (*Neovison vison*) within their native range. Feral mink are a known alien invader in many parts of the world, but invasion of their native range is not well understood. We genetically profiled 233 captive domestic mink from different farms in Ontario, Canada and 299 free-ranging mink from Ontario, and used assignments tests to ascertain genetic ancestries of free-ranging animals. We found that 18% of free-ranging mink were either escaped domestic animals or hybrids, and a tree regression showed that these domestic genotypes were most likely to occur south of a latitude of 43.13°N, within the distribution of mink farms in Ontario. Thus, domestic mink appear not to have established populations in Ontario in locations without fur farms. We suspect that maladaptation of domestic mink and outbreeding depression of hybrid and introgressed mink have limited their spread. Mink farm density and proximity to mink farms were not important predictors of domestic genotypes but rather, certain mink farms appeared to be genotypes can be mitigated by improved biosecurity important sources of escaped domestic animals. Our results show that not all mink farms are equal with respect to biosecurity, and thus that the spread of domestic.

Ecol. Evol. 2013: 3(7): 2296-309

http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3728966/

New insights into the melanophilin (MLPH) gene controlling coat color phenotypes in American mink

S. Cirera, M.N. Markakis, K. Christensen, R. Anistoroaei

Gene. 2013: 15: 527(1): 48-54

http://www.ncbi.nlm.nih.gov/pubmed/?term=New+insights+into+the+melanophilin+(MLPH)+gene+controlling+coat+color+phenotypes+in+American+mink

NUTRITION, FEEDING AND MANAGEMENT

Low protein provision during the first year of life, but not during foetal life, affects metabolic traits, organ mass development and growth in male mink (*Neovison vison*)

K. Vesterdorf, D. Blache, A. Harrison, C.F. Matthiesen, A.H. Tauson

Low protein provision in utero and post-partum may induce metabolic disorders in adulthood. Studies in mink have mainly focused on short-term consequences of low protein provision in utero whereas the long-term responses to low protein (LP) provision in metabolically programmed mink are unknown. We investigated whether low protein provision in utero affects the long-term response to adequate (AP) or LP provision after weaning in male mink. Eighty-six male mink were exposed to low (19% of ME from CP; crude protein) or adequate (31% of ME from CP) protein provision in utero, and to LP (~20% of ME from CP) or AP (30-42% of ME from CP) provision post-weaning. Being metabolically programmed by low protein provision in utero did not affect the response to post-weaning diets. Dietary protein content in the LP feed after weaning was below requirements; evidenced by lower nitrogen retention ($p < 0.001$) preventing LP mink from attaining their growth potential ($p < 0.02$). LP mink had a lower liver, pancreas and kidney weight ($p < 0.05$) as well as lower plasma IGF-1 concentrations at 8 and 25 ($p < 0.05$) weeks, and a higher incidence of hepatic lipidosis at 25 weeks ($p < 0.05$). Furthermore, LP mink had a higher body fat ($p < 0.05$) and lower body CP content ($p < 0.05$) at 50 weeks of age. It is concluded that some effects of low protein provision

in utero can be alleviated by an adequate nutrient supply post-partum. However, long-term exposure to low protein provision in mink reduces their growth potential and induces transient hepatic lipidosis and modified body composition.

J. Anim. Physiol. Anim. Nutr. (Berl). 2013: Aug 3. doi: 10.1111/jpn.12108. [Epub ahead of print]

http://www.ncbi.nlm.nih.gov/pubmed/?term=Low+protein+provision+during+the+first+year+of+life%2C+but+not+during+foetal+life%2C+affects+metabolic+traits%2C+organ+mass+development+and+growth+in+male+mink+(Neovison+vison)

Effective Control of Non-Native American Mink by Strategic Trapping in a River Catchment in Mainland Britain

J.C. Reynolds, S.M. Richardson, B.J. Rodgers, O.R. Rodgers

The introduction of American mink (*Neovison vison*; hereafter mink) into Europe has had severe impacts on many native wildlife species, including the water vole (*Arvicola amphibius*) in mainland Britain. Although trapping has been widely used to attempt to control mink, managers have little direct evidence of its effect on mink density or distribution, particularly where immigration of mink from nearby areas is inevitable. Such evidence is needed to justify the use of lethal methods in conservation policy. During 2006-2010 we removed mink from the River Monnow Catchment in western Britain, using track-recording rafts to monitor continuously for mink presence, guiding a strategic trapping effort. The area monitored and trapped was increased in stages, from a core sub-catchment with 109 km of water-course in 2006, to a 421-km^2 catchment with 203 km of water-course in 2009. In each successive sub-catchment, mink detection and capture rates declined rapidly to near-zero levels after trapping began. Detections and captures showed seasonal peaks in every year corresponding to known dispersal periods, but also declined steadily from year to year, with increasing periods in which we did not detect mink. These results suggested that each sub-catchment was cleared of mink within a few months, with subsequent captures attributable to immigration. On average, we detected each mink 5.1 times before capture (daily probability of detection = 0.059 per mink and raft), and trapped them 3.4 days after deploying traps in response. On average, mink entering the area were likely to have been present for less than 13 days before capture. Water voles had been extinct in the Monnow Catchment since the 1980s. During 2006-2008 (starting 6 months after mink trapping commenced), we released 700 captive-bred water voles into the treatment area to re-establish a wild population. Persistence of this population through the 4 years of the project was considered indicative of effective mink control. This study demonstrates that, even in a mainland context, a systematic trapping strategy can have a substantial impact on the density and distribution of a damaging species, in this case allowing the restoration of a native prey species.

J. Wildl. Manage. 2013: 77(3): 545-554

http://www.ncbi.nlm.nih.gov/pubmed/?term=Effective+Control+of+Non-Native+American+Mink+by+Strategic+Trapping+in+a+River+Catchment+in+Mainland+Britain

BEHAVIOR AND WELFARE

Age-dependent baseline values of faecal cortisol metabolites in the American mink (*Neovison vison*) under semi-natural housing conditions

E. Rauch, S. Bergmann, A. Hagn, J. Meixensperger S. Reese, R. Palme, M.H. Erhard

The welfare of an animal is ensured if it is able to fully satisfy its essential species-typical needs in all functional aspects of behaviour. In mink, stereotypies and apathy, internal and/or external injuries as well as increased susceptibility to disease have been known to occur as a result of chronic stress. The non-invasive method of analysing faecal cortisol metabolites (FCM) allows conclusions to be drawn about the stress level in the respective housing system. The objective of this study is to find out how the cortisol metabolites content in the faecal changes with increasing age of the mink under semi-natural housing conditions. Thus, 40 American mink (*Neovison vison*) were housed in two outdoor enclosures imitating natural conditions. Throughout the entire study (13th to 32nd week of life), faecal samples were collected to measure cortisol metabolites. No differences in FCM

concentrations between the two outdoor enclosures were found. In the young mink lower, less fluctuating FCM levels were found than in older animals. After the first faecal collection in the 13th/14th week of life, the level of metabolites decreased slightly (p = 0.032; 17th/18th week). From the 22nd/23rd week onwards until the 30th/31st week, shortly before the animals were pelted, continuously increasing concentrations were then measured. Increasing FCM levels with advancing age of the animals are probably attributable to the onset of sexual maturity and/or the respective season. This has to be taken into account in future studies using this method for assessing welfare and when comparing different mink housing systems.

J. Anim. Physiol. Anim. Nutr. (Berl). 2013: Sep 3. doi: 10.1111/jpn.12098. [Epub ahead of print]

http://www.ncbi.nlm.nih.gov/pubmed/?term=Age-dependent+baseline+values+of+faecal+cortisol+metabolites+in+the+American+mink+(Neovison+vison)+under+semi-natural+housing+conditions

Situation and context impacts the expression of personality: The influence of breeding season and test context

M. Haage, U.A. Bergvall, T. Maran, K. Kiik, A. Angerbjörn

Behav. Processes. 2013: Aug 26. pii: S0376-6357(13)00184-8 [Epub ahead of print] doi: 10.1016/j.beproc.2013.08.009.

http://www.ncbi.nlm.nih.gov/pubmed/?term=Situation+and+context+impacts+the+expression+of+personality%3A+The+influence+of+breeding+season+and+test+context

Development of vocalization and hearing in American mink (*Neovison vison*)

C. Brandt, J. Malmkvist, R.L. Nielsen, N. Brande-Lavridsen, A. Surlykke

American mink (*Neovison vison)* kits are born altricial and fully dependent on maternal care, for which the kits' vocalizations appear essential. We used auditory brainstem responses (ABRs) to determine: (1) hearing sensitivity of adult females from two breeding lines known to differ in maternal behaviour and (2) development of hearing in kits 8-52 days of age. We also studied sound production in 20 kits throughout postnatal days 1 to 44. Adult female mink had a broad hearing range from 1 kHz to above 70 kHz, with peak sensitivity (threshold of 20 dB SPL) at 8-10 kHz, and no difference in sensitivity between the two breeding lines (P>0.22) to explain the difference in maternal care. Mink kits showed no signs of hearing up to postnatal day 24. From day 30, all kits had ABRs indicative of hearing. Hearing sensitivity increased with age, but was still below the adult level at postnatal day 52. When separated from their mothers, kits vocalized loudly. Until the age of 22 days, 90% of all kits vocalized with no significant decline with age (P=0.27). From day 25, concurrent with the start of hearing, the number of vocalizing kits decreased with age (P<0.001), in particular in kits that were re-tested (P=0.004). Large numbers of mink are kept in fur industry farms, and our results are important to the understanding of sound communication, which is part of their natural behaviour. Our results also suggest mink as an interesting model for studying the development of mammalian hearing and its correlation to sound production.

J. Exp. Biol. 2013: 15: 216(Pt 18): 3542-3550

http://www.ncbi.nlm.nih.gov/pubmed/?term=Development+of+vocalization+and+hearing+in+American+mink+(Neovison+vison)

HEALTH AND DISEASE

Genome Sequence of Mink Enteritis Virus Strain SD 12/01, Isolated from a Mink with Severe Diarrhea in China

J. Wang, H. Zhao, Y. Cheng, L. Yi, S. Cheng

The mink enteritis virus (MEV) SD12/01 strain was isolated from a mink showing clinical and pathological signs of enteritis in Shandong, China, in 2012. The genome of MEV SD12/01 was sequenced and analyzed, which will promote a better understanding of the molecular epidemiology and genetic diversity of MEV field isolates in northern China.

Genome Announc. 2013: 1(3). pii: e00306-13. doi: 10.1128/genomeA.00306-13.

http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3707587/

Detection of mink enteritis virus by loop-mediated isothermal amplification (*LAMP*)

J. Wang, S. Cheng, L. Yi, Y. Cheng, S. Yang, H. Xu, Z. Li, X. Shi, H. Wu, X. Yan

J. Virol. Methods. 2013: 187(2): 401-405

http://www.ncbi.nlm.nih.gov/pubmed/?term=Detection+of+mink+enteritis+virus+by+loop-mediated+isothermal+amplification+(LAMP)

NJF SEMINAR 464

ANNUAL AUTUMN MEETING IN

FUR ANIMAL RESEARCH 2013

28-30 AUGUST 2013

RADISSON BLU SAGA HOTEL

REYKJAVIK - ICELAND

Fur Animal Feed in Scandinavia; past, present and future

T.M. Lassén, M.L.E. Christiansen

Feed is essential for all animal production and much focus has been put on nutrition and feeding during the last 60 years. In the early years of fur farming in Scandinavia not much was known about the energy requirements and requirements for essential nutrients in fur animal feed. The first trials regarding nutrition and controlled experiments with different feed ingredients was conducted in the early 1950´s and the first feed table for feed ingredients were published. In the 1950´s more research facilities was established in the Nordic countries and more knowledge on fur animal nutrition was gained. In this period the primarily task was to compose a usable feed ration based on examination and description of the individual feed ingredients. This was used to determine standards for energy requirements and nutrient supply in the different stages of the production cycle of the animal. In the same period the first trials regarding digestibility of protein, fat and carbohydrates was conducted. In the 1980´s research on more basic subjects was initiated, but still at this time, the knowledge compared with other domestic animals was limited. This knowledge was published in 1992, when the Committee for Nutrition and Feeding made their second recommendation on Energy and Main Nutrients in Feed for Fur Animals. From 1990´s until now much has been focused on increasing knowledge on basic nutrition and utilisation of nutrients like amino acids, fatty acids, glucose, water, minerals and vitamins. A detailed literature review and evaluation of the latest knowledge has recently been published. However, there is still need for more research to cover all the sides of fur animal nutrition, especially in basic nutrition of blue foxes and, furthermore, more knowledge is needed on minks need for fatty acids and digestible amino acids.

The stability of amino acids in mink feed when stored at different temperatures

M. Engbæk, P.F. Larsen

Loss and degradation of added amino acids could potentially be a problem in mink feed. The stability of synthetic amino acids was investigated in mink feed when stored at 5, 20 and 35 °C during a period of three days. The results showed that feed stored at 20 and 35 °C had a higher degradation of amino acids over time, compared to feed stored at 5 °C. Based on the results it is recommended that mink feed are stored at a temperature at 5 °C is sufficient to prevent degradation of amino acids and a low bacteria count.

The effects of nutritional supplements to a low protein diet on blood and liver parameters in growing-furring mink

B.M. Damgaard, P.F. Larsen, V.M. Thorup, T.N. Clausen

The aim of the present investigation was to investigate the effects of nutritional supplements to low protein diets on growth, health and physiological blood and liver parameters in growing-furring male mink. Effects of dietary protein levels ranging from 20% of metabolizable energy (MEp) to 30% MEp and the effects of nutritional supplements to 20% MEp were included in the study. The liver content of fat and fatty acids was higher in mink fed low dietary protein levels than in mink fed high dietary protein levels during one month before pelting. The liver seemed to be able to regenerate after fat infiltration when fed high protein diet during one month. High dietary protein content seemed to have positive effects on the general health status. Nutritional supplements to a low protein diet could not prevent the negative effects of a low protein diet on growth and health.

Low protein diets to mink in the early post weaning period

Ø. Ahlstrøm, A-H. Tauson, C.F. Matthiesen, M.T. Tjernsbekk

Three protein sources, lamb meal (poor), poultry meal (intermediate) and LT-fish meal (best) with known different amino acid composition and digestibility were examined in N-balance experiments as with mink kits in early post weaning period (8-11 weeks). The respective protein sources were used as only protein source in feeds with protein levels at 23-24 % of ME. A Latin-square design with 12 male mink was used in three balance periods of one week. Feed intake was reduced with

the lamb meal diet. N-digestibility was different among the three diets, 66.7, 73.0 and 81.8 %, respectively. For all diets the N-digestibility was 2-3 % lower than found in adults given the same diets. N-retention and subsequently growth rates were lowest with lamb meal diet (8.2 g/d) and much higher with the poultry (24.8g/d) and fish meal diet (35.3g/d). Lower feed intake was partly the cause of the low growth rate with the lamb meal diet. Generally, feed intake increased from 8 to11 weeks, but N-digestibility and N-metabolism values did not change during the experiment. The clear difference in growth response among diets was due to different dietary amino acid supply, which for methionine was estimated to be 0.19, 0.28 and 0.35g/MJ for the three diets, respectively. Current standard for methionine is set to 0.33g/MJ, thus the result of the study confirmed this level. Generally, the study demonstrated the importance of taking into account the palatability, digestibility and amino acid level of protein ingredients used in feed with low dietary protein levels.

The level of protein provision to mink dams before implantation affects the fetal survival rate

C.F. Matthiesen, A-H. Tauson

The protein and amino acid requirements are still not completely known in all parts of the mink production cycle and it is important to investigate whether the levels of protein commonly used today can be reduced because according to Danish legislation there is a demand to reduce overall protein consumption. Our objective was to investigate and determine the protein requirement before implantation needed to support a good reproduction performance. Six different levels of protein (20, 25, 30, 35, 40, and 45% of metabolisable energy – ME- from protein) were fed to 96 female mink from the 24th of February until the 10th of April. Three females from each treatment were euthanized the 16th of April to investigate the implantation rate, fetal survival, fetus length and weight. The remaining dams were used to measure the reproductive performance. The number of implanted fetuses was not affected by the protein provision whereas the survival rate of implanted fetuses was significantly (P=0.02) lower in the group fed the 20% of ME from protein compared to the other groups. The protein requirement before implantation estimated by a broken line linear regression approach from the fetus survival rate indicates that the requirement was 30.5% of ME from protein. This was however not confirmed by the reproductive performance data where the group fed 30% of ME from protein had a significantly higher number of barren dams and a tendency towards increased kit losses compared to the groups fed 35% and 25% of ME from protein, respectively.

Low protein provision to mink during several generations

C.F. Matthiesen, A-H. Tauson

An overall reduction in protein content in mink feed may affect the mink production in both a short- and long-term perspective. Our objectives were to investigate how low protein provision during late gestation affects the reproductive performance, kit survival rate and pre-weaning growth performance of several generations of mink dams exposed to low protein provision during late fetal life. The effect of low protein provision was measured on reproductive performance, kit birth weight and pre-weaning growth of F1, F2 and F3-generation offspring of protein restricted mothers, raised in small (4-6 kits) or large (8-10 kits) litters until weaning. Sixty-nine mink dams including 20 control dams (C), 22 adequately treated dams (APAP), 13 dams born by mothers fed a low protein diet during late gestation (APLP) and 14 dams born by mothers exposed to low protein provision during late fetal life and fed a low protein diet during late gestation (LPLP). The APAP, APLP and LPLP dams were all fed a low protein diet during the last 2/3 of their own true gestation whereas C dams were fed an adequate protein diet the entire gestation. The reproductive performance was not significantly affected by the gestation diets but the results indicate that dams exposed to a low protein provision during fetal life and fed a low protein diet during late gestation gave birth to larger litters and had fewer stillborn kits than adequately treated dams fed a low protein diet during late gestation. The kit birth weight of offspring born by mothers fed a low protein diet during late gestation was significantly ($P<0.05$) lower than that of controls which confirms previous results. The growth rate of the kits during lactation indicated that offspring exposed to low protein provision during fetal life performed better in larger litters than adequately treated ones especially in the

transition period from milk to solid feed and around weaning (P<0.05).

Pathology of skin lesions in farmed mink

A-S. Hammer, H.E. Jensen, A. Jespersen

Skin wounds in farmed mink are considered an indicator of reduced welfare and previous studies have shown that a significant number of farm mink kits die or are euthanized due to skin wounds. The aim of a newly initiated PhD study "Skin wounds in farmed mink" is to increase knowledge on pathological and microbiological aspects of skin wounds in mink and to develop a classification scheme for guiding of wound management. The project is based on patoanatomical, histopathological, microbiological, epidemiological – as well as experimental studies. Preliminary studies of 1973 mink collected in 2012 and 2013 as part of field studies have shown considerable variation in morphology as well as anatomical localization and microbiology of wounds in mink. Accordingly, wounds have been grouped using a pathoanatomical system. In order to establish a clinically relevant classification scheme for guiding of wound management in mink, there will be a need for further studies into each of the different types of wounds found in farmed mink. The aim will be to identify clinically relevant parameters related to each wound type, which can be used to ensure optimal decision-making regarding choice of therapy or euthanization.

Proliferative enteropathy caused by Lawsonia intracellularis in blue foxes in Finland

H. Kallio, H. Ahola

Proliferative enteropathy has been reported in several animal species, including the pig, horse, dog, white-tailed deer, blue fox, guinea pig, ferret, hamster, rat and rabbit. In blue foxes disease has previously been called adenomatosis based on the typical thickening of the proctal mucosa. In domestic pigs enteritis with proliferative enteropathy is commonly caused by Lawsonia Intracellularis- bacteria. Lawsonia intracellularis (L. intracellularis) is an obligate intracellular gram negative bacterium. In addition to pigs, L. intracellularis has detected from wide variety of domestic and wild animals, including wild red foxes and it is also suggested to be found in farmed blue foxes. In recent studies in foals and pigs there has been evidence also of host adaption in L. intracellularis infections. However, pathogenesis of L. intracellularis enteritis in fur animals is poorly studied. During summer and autumn 2011 and 2012 L intracellularis was detected in several enteritis cases from blue foxes in Finnish fox farms.

Urolithiasis in blue fox, underlying cause of persisting urinary tract infection

A-M. Moisander

Female blue foxes suffer from urinary tract infections especially in winter months. In winter blue foxes drink little amounts of water; even when automated water nipples are present. This causes high osmolality and mineral content of urine which is part of the problem as it leads to urolith formation. Most common mineral compound in calculi obtained from blue fox is struvite (magnesium ammonium phosphate). Bacterial urinary tract infection (UTI), especially caused by urease-producing bacteria is often an important predisposing factor in an initiation and growth of struvite uroliths (Osborne and others 1999).

It is presumed that usual UTI pathogens in blue foxes are streptococci sp. and in silver fox E. coli is more common causative agent. This is undetermined because quite few specimens of foxes with UTI are introduced to full microbiological analysis lately. One case with betalactamase positive Staphylococcus aureus from adult male blue fox was found in 2011 at Finnish Food Safety Authority Evira at Seinajoki (Microbiological analysis, Evira 2011). For comparison: The bacteria most commonly found in canine UTIs include Eschericia coli, Proteus, Staphylococcus, Streptococcus, Klebsiella, Enterobacter and Pseudomonas species (Jarvinen 2002).

Foxes presenting signs of UTI are most frequently medicated with injection of long acting penicillin preparat witch contains 150,000 IU procaine penicillin and 150,000 IU benzathine penicillin per ml (Duplocillin LA; Intervet). In some cases where injection treatment with penicillin hasn't been successful some other products were used against common guide lines of antibiotic treatment protocols. For example marbofloxacin has been used (oral notice, fur breeder, Finland), it is active

against E. coli and other gram negative bacteria. After unsuccessful treatments some of the animals were obducted and large amounts of uroliths were found, no microbiological analysis were done. Uroliths were analyzed by IDEXX laboratories, Germany. Laboratory analysis confirmed that calculi were 99% of struvite.
Struvite calculi were experimentally induced by inoculating Staphylococcus aureus –strain to healthy dogs (Klausner and others 1980). Calculi were detected in one dog after two weeks of induction of UTI and mean time between induction of UTI to detection of calculi was four weeks (range, 2-8 weeks) (Klausner and others 1979). This shows that formation of calculi may be much faster than it is thought to be in foxes. It is possible to a blue fox female to be healthy at December and form detectable calculi by March.
Treating foxes presenting signs of UTI is often frustrating and useless. If treatment of UTI is wanted, choice of antibiotic should be done after microbiological analysis and not just by guessing. Starting the treatment in time is another important thing, if infection has been going on long time, cure is unexpected and unlikely.

Comparing CIEP and an automated ELISA for detection of antibodies against ADV

R. Dam-Tuxen, J. Dahl, T.H. Jensen, T. Dam-Tuxen1, T. Struve, L. Bruun

Aleutian Disease is caused by the parvovirus Aleutian Disease Virus (ADV) and is diagnosed primarily based on anti ADV antibody serology sometime supplemented with organ PCR analysis. In Denmark, 3.5-4 million serum samples are tested every year for the presence of anti ADV antibodies. The present study compares the diagnostic performance of counter current immunoelectrophoresis (CIEP) and a newly developed fully automated ELISA. Samples from 3810 mink were analyzed by CIEP and ELISA. The results show, that the two assays have a comparable diagnostic performance although the ELISA assay has a higher sensitivity but lower specificity than the CIEP assay. Thus, for screening purposes the study concludes that the ELISA can replace the current CIEP analysis.

The Danish health care system on mink farms

M.K. Jensen

Since 1st of April 2011 a mandatory health care system were introduced in Denmark. The background for this new legislation was "welfare visits" on all Danish mink farms resulting in remarks on 50% of the farms. The remarks cover a wide field of items from for example housing of mink to registration of medicine use and number of dead minks. The health care system demands 4 annual visits of vets on the farms. The first year a farm has a health care agreement with a vet, he has to have 5 annual visits, and thereafter it is mandatory to have 4 annual visits. If the farm gets a fine or a verdict for animal welfare, animal health, or handling of medicine, the farm are required to have 6 annual visits. After one year without any further fines or verdict’s the farm are required to have 5 annual visits and after yet another year they go to standard consulting with 4 annual visits. The visits are spread all over the year with time scales for every visit. There has to be one visit between 1st December – 1st March; two visits in the period 1st April-1st August, one visit before weaning and one visit after weaning and the last visit has to be in the period 1st September – 31st October. For all the visits there are clear points the vet has to go through on the farm and discuss with the manager of the farm. All visits end with a written report by the vet, describing the health situation on the farm, what has happened since the last visit, review of the farm diagnoses, the development in medicine use and follow-up on whether the farmer has followed the advices given at the last visit.
The new health care system has some beginner’s challenges because the farmers are not used to this kind of advising, the visits from the vets are not free and they are not voluntary. But the system gives despite the challenges an excellent potential to focus on animal health and welfare and cause improved health and improved protection against infections and thereby lesser costs of treatment and increased productivity. Together with campaigns from Kopenhagen Fur the visits from vets have resulted in a better dialogue between vets and farmers and much better welfare on the farms which has resulted in lesser farms with remarks about welfare in the control visit from the government. In 2010, 100 % of the farms were controlled by visits from the government, which resulted in 50 % of the farms having remarks. In 2011, 50 % of the farms were

controlled and 29 % of the farms had remarks. In 2012, 20 % of the farms were controlled and 20 % of the farms had remark. In 2013 the government will make visits in 5 % of the farms as for other production animals in Denmark.
In addition to legislation about mandatory health care system new legislation were also made about education of the farmers. New farmers and farm managers have to have a 'driver license' for mink. They have to go through an education concerning legislation, the health care system, biology and yearly cycle of the mink and legislation about handling medicine on the farm. Every third year this 'license' has to be renewed with update on health, welfare, management and legislation. Farm workers have to go on a one day training course in order to obtain basic information on mink farming and Danish legislation.

Genetic characterization of canine distemper virus involved in outbreaks in farmed mink in Denmark 2012

R. Trebbien, T. Struve, C.K. Hjulsager, M. Chriel, L.E. Larsen

Danish farmed mink herds experienced a large outbreak of canine distemper virus in 2012. Full-length sequence analysis (1824 nucleotides) of the variable hemagglutinin (H) gene were performed on 27 viruses collected from mink and on 7 viruses collected from wild foxes. Results of the study showed that the farmed mink and wild fox population were infected by identical viruses which strongly indicate an epidemiological link between these populations. Accordingly, diseased and dead foxes were observed in some of the mink herds in connection to the outbreak. The Danish virus strain clustered phylogenetically with other European canine distemper viruses and showed the highest level of similarity (99.3 - 99.6 %) to viruses isolated from wild foxes in Germany. The fox should therefore be considered as an important wild life reservoir of canine distemper virus and may also contribute to the transmission of the virus between mink farms during outbreaks.

De novo SNP calling from RAD sequences for a mink (*Neovison vison*) specific genotyping assay

J. Thirstrup, J.M. Pujolar, P.F. Larsen, J. Jensen, R.O. Nielsen, C. Pertoldi

The genetic marker of choice in mink has until now been microsatellites, but recently has single nucleotide polymorphism (SNP) been used more and more in other species. In several species, SNP panels have been established through SNP chips. However, generations of such chips are expensive and require a large market to cover the cost. New technologies based on next generation sequencing (NGS) have made it possible to identify thousands of SNPs using a cost effective and fast method. The method can be used for non-model organisms in conservation biology and for production species with small population sizes.
The aim of this study was to create a mink specific SNP panel well suited for population genetic studies, parental testing and forensic investigations.
A SNP panel specific for American mink (*Neovison vison*) has been generated from Restriction site-Associated DNA (RAD) sequencing. Fourteen mink from Brown and Black color types were obtained. A mean of 49,789,860.2 (± 9,813,587.2) raw reads of high quality per sample were sequenced. SNPs were called using the software pipeline Stacks. The populations program was used to estimate population structure and genetic divergence between the two color types. 1,576,944 catalog tags were generated with a 10X minimum depth of coverage. 224,095 candidate SNPs polymorphic for the two color types were called. Using strict filtering criteria in order to increase the success of assay design a total of 1,256 SNPs were finally identified.

WebSampo

S. Gerke

WebSampo is an effective new assortative breeding program designed for farmers to help them choose the right breeding animals. It helps to upgrade the quality and quantity of pelts offered at Saga Furs auctions. With it, fur breeders will have access to a data bank that will facilitate and improve the breeding of mink, fox and Finnraccoon.
WebSampo is an IT tool for controlled breeding. It has the potential to increase the health of the animals and the size of animal stocks, and the

quality of the fur they produce. WebSampo was developed by the Agricultural Processing Centre MLOY in Vantaa, Finland and is owned by Saga Furs.
WebSampo has been in stages of planning for many years and the feeding of data from the old ProFur program was done last year. The program is now available in the Finnish, Swedish and Norwegian languages, with English to follow in 2014.

Response to selection for litter size in Icelandic mink

K. Gautason, E. Albertsdóttir, B.K. Hansen

Litter size is an extremely important economic trait for fur farmers. More kits per female means lower average costs per skin produced. The objective for this study was to obtain an overview on the response to selection for litter size in Icelandic mink. A sub goal was to estimate inbreeding in Icelandic mink. A total of six farms were included. The farm was selected based on the premise of number and quality of records. From these farms, a total of 36.815 dams with more than 1 kit and 88.928 individuals were included in the pedigrees. Litter size is (ideally) recorded in the data as kits alive at 3 weeks of age. Variance components were analyzed within a Bayesian framework. The DMU software was used for calculation. The genetic trend for litter size has been positive for the last ten years. Based on the result of this exploration of field data it can be assumed that selection for litter size works in the sense that the response to selection has been positive. Based on this dataset inbreeding is not a problem in Icelandic mink. It is however highly likely that the total level of inbreeding is higher than reported here due to the incomplete pedigree records of imported males.

Body condition as a tool to improve reproduction results in mink production

B.K. Hansen

Earlier research has shown that the body condition of animals in the period from December to April has an effect on reproduction. Systematic monthly control of the body condition of breeding animals and each time adjusting the feeding strategy according to recommendations of an advisor has been practised on 13 Danish mink farms during winter – early spring in 2012-2013. The aim was to try out different methods to get a representative picture of the overall condition of the breeding stock, furthermore to see if the success in keeping animals close to the recommended body condition also improved breeding results compared to the previous year. Positive differences from previous year were seen on most farms as lower percentage of barren females and higher litter size.

Unknown environmental factors disguise the effect of group selection against bite marks in group-housed juvenile mink

S.H. Møller, S.W. Hansen

This investigation set out to test two hypothesises for bite-marks in the skin side of mink pelts: 1. It is possible to reduce the bite-mark score by group selection, compared to an unselected control. 2. Early separation of juveniles into group housing, compared to late separation, decreases the bite-mark score. We scored the number of bite-marks in a group selection line against bite-marks and an unselected control line of brown, group-housed mink over four successive years. The fourth year we also investigated the effect of early and late separation of litters into group-housing, in combination with continued selection. Early and late separation into group-housing was also tested on a private farm.
The bite-mark score in the line selected against bite-marks decreased the first year and has gradually increased since then while the unselected control line has generally increased all years. The difference between selection and control has increased in every generation and the bite-mark score in the control line is now double of that in the selection line for both sexes. At the research farm there was no difference between bite mark scores in group housed males from early and late separation while early separated females had significantly lower bite mark score than late separated females. Contrary to this, the early separated males had significantly higher bite-mark score than late separated males while there was no difference between bite-mark scores in group housed females from early and late separation at the private farm. We accept our hypotheses that it is possible to reduce the bite-mark score by group selection compared to an unselected

control line. Due to unknown environmental factors the bite-mark score increased in both the selected and the unselected control line after the first generation. Contrary to our second hypothesis, time of separation was not an influential factor and we reject the hypothesis that early separation of juveniles into group-housing, compared to late separation, decreases the number of bite-marks. Therefore the search for environmental factors affecting the bite-mark score in group housed mink continues.

Temperature and humidity in mink nest boxes in May

M. Sønderup, M.S. Blæsbjerg

Mink farmers often ask about the optimal conditions in the nest box in the lactation period. The aim of this report is to inspire to more research, under controlled conditions on research farms and in practice by describing a practical method, and furthermore show some examples of measuring the temperature, humidity and the dew point in the nestboxes of Danish mink farms during the lactation period in May 2011 and 2012.

Environmental challenges in mink production – an overview of the Danish approach

H. Bækgaard, E. Mortensen, V.H. Lund, I.K. Aagaard, M. Lassén, P.F. Larsen

This paper describes the challenges that follow a strongly regulated mink production, concerning the environmental impact. Looking at the historical change in environmental regulation, it is clear that this regulation has a strong priority in Denmark and the European Union. In this paper the focus is mainly on the impact of Nitrogen (N) both as airborne ammonia and N bound in manure. Several ways are possible for a reduction in N emission. The approach made by the Danish fur breeders association has been to focus on both the N intake in the animals and to reduce the emission of ammonia from the production. Reducing N intake is done by reducing the protein level in the feed, to an extend that do not jeopardize animal welfare or skin parameters. Several studies have been conducted for reducing the loss of airborne ammonia. The environmental impact from mink production is an area that we need to take very seriously, because it is very important how the outside world sees the production and thus important for the continued support for this production.

Code of Good Practice for CO and CO_2 Euthanasia in Mink

H.T. Korhonen, H. Huuki

The new council regulation (EC) No 1099/2009 on the protection of animals at the time of killing was put in practise from the beginning of 2013. The regulation lays down rules for the killing of animals bred for the production of food, wool, fur or other products as well as the killing of animals for the purpose of depopulation and for related operators. Regulation also emphasizes the meaning of education, competence and self-monitoring. This Code of good practice can be used as an instructive tool for the operators, when planning and reporting the killing procedures. The operators are obligated to draw up and implement standard operating procedures (SOP). The purpose of SOP is to unify the methods and practices used in killing of animals, and thereby improve the welfare of animals and the competitiveness of operators on the market. Standard Operating Procedures need to set objectives, operating procedures, define the main parameters to be monitored and guidelines for situations in which an animal is not stunned or killed as expected.The regulation obligates killing device manufacturers to give instructions and recommendations, which are to be taken in to account when drawing up SOP. The killing device must be maintained and checked according to the manufacturers' instructions by persons specifically trained for this purpose on a regular basis. The record of maintenance must be kept for at least one year. The new regulation allows the mink to be euthanized with carbon monoxide (CO), carbon dioxide (CO2), electricity, shooting and passing through the bolt gun, and the emergency killing of animals weighting less than 5 kg with a blow in the head. Killing will be monitored by observing the animals and monitoring the key parameters affecting the efficiency of euthanasia. With pure CO2 and pure CO methods, these are: concentration, the exposure time and temperature; and with exhaust gas method: concentration, the exposure time, temperature and sufficient filtration. Upon request,

standard operating procedures, records and other documents must be given to the competent authority.

Experiences of implementation of WelFur on-farm welfare assessment protocols

H. Huuki, L. Ahola, T. Koistinen, J. Mononen

Fur farm 2020 (FF2020) project was initiated in Finland in 2012. The project's specified objectives are the evaluation of farmed fur animals' welfare on farm level with the European WelFur protocols, counseling fur farmers on animal welfare, and the development of an on-farm welfare protocol for Finnraccoon. One of the main aims of the ongoing project is also to test the implementation of WelFur assessments for foxes and mink in practice.
The aim is to assess 40 mink, 100 fox and 10 finnraccoon farms during the years 2012-2014, and gather information about the present welfare status of farmed fur animals. The assessment visits are carried out in all three production periods stated in the WelFur protocols, i.e. in winter, summer and autumn. With the help of Finnish Fur Breeders' Association, 164 farmers in the Ostrobothnia area of Finland were contacted. Out of all these farmers, 109 (66%) agreed to participate in the project. Many of these farmers have both foxes and mink. The recruitment of the assessors as well as execution of assessments was outsourced to Luova Ltd. All together 12 assessors were trained to perform the assessments by researchers involved in the WelFur project during a four day intensive training period and one revision day. Out of these 12, only five assessors are able to participate in both mink and fox assessments and two assessors only in fox assessments. The fox farm assessments started in January 2013 but were discontinued shortly after the Distemper finding (on one farm). The fox and mink assessments continued in period 2 (i.e. when the cubs were 4-8 weeks old) from May 2013 onwards.
Already the experiences have shown that a good informing about the goals and benefits of the assessments and prevention of spreading of disinformation are the key factors when recruiting farms. Also the proper education and orientation of assessors (at least 4+1 days) is of key importance to achieve reliable and valid results. Once completed, the results of FF2020 –project will give a good insight of the current welfare status of mink and fox farms in Finland.

WelFur-assessment of mink in the period from parturition to kits weaning, changes significantly with date of assessment

B.I.F. Henriksen, S.H. Møller

The objective of the present study was to test the hypothesis that welfare measures change significantly with the date of assessment within the data collection period from parturition to weaning, influencing the scores of WelFur at the criteria level. We further expect, however, that the number and magnitude of changes will not be enough to change the welfare score at the principal level or the overall category of mink welfare according to the WelFur-Mink protocol. Data from a representative sample of 120 dams on four farms was collected three to four times, in the period from parturition to weaning according to the WelFur-Mink protocol, by the same, experienced external personnel at all assessments. WelFur-scores between 0 (worst) and 100 (best) were calculated, aggregated, and compared at criteria and principal level. The score for 'Absence of prolonged hunger' dropped from 100 to below 20 after about four weeks of lactation, affecting the principal score 'Good feeding' as well as the overall welfare category. The score for three other measures also varied with date of assessment but not enough to affect the principal scores.
The hypothesis is accepted as the WelFur score on criteria level is dependent on the date of assessment. Estimation of a WelFur score per principle and the overall category also indicates a change with the date of assessment. Further analysis are needed to evaluate the need for reducing the time-window for assessment, or if a valid correction factor can be developed, so that this important period can be maintained in the general WelFur-assessment of mink farms.

Fur Farm 2020: Preliminary results from an on-farm welfare assessment for the Finnraccoon

T. Koistinen, H. Huuki, J. Mononen, L. Ahola

In the Fur Farm 2020 project, we are developing an on-farm welfare assessment protocol for the Finnraccoon. In the present work, we measure health and behaviour of Finnraccoons on 12 commercial farms in Finland in autumn 2012. The results showed that Finnraccoons are, in general, healthy animals, i.e. the prevalence of various health

disorders was low and only a few other (not specifically measured) health disorders were found. The most common health disorder was diarrhoea (in 27 % of observed Finnraccoons). Bent feet, not previously documented in Finnraccoon, were found in 1.5 % of observed individuals. The incidence of stereotypic behaviour was relatively high. The behaviour and/or temperament of the adult and juvenile Finnraccoons differed in autumn, the adults being more active and reactive than the juveniles in behavioural tests. In conclusion, the used health measurements covered well the health problems of Finnraccoons, and, therefore, provide a good foundation for the development of the protocol. Instead, behavioural measurements, that were originally designed for farmed foxes, except that for stereotypic behaviour, need some development work before they can be used for assessing the welfare of Finnraccoons.

Bite marks on mink reveal the social tolerance in group housed mink

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

The aim of the study was to examine whether bite marks actually could be caused by bites. Forty mink housed individually from week 34 were successively subjected to artificial bites in week 38, 40, 42, 44 and 46, and another group of 160 mink was housed in groups of 4 mink and successively split to single housing in week 38, 40, 42, 44 and 46. The artificially inflicted pressure applied to mink could be observed as bite marks on the leather side of the matured skin in dark coloured mink. The number of bite marks in group housed dark mink increased with week of separation. The results support the hypothesis, that bite marks are produced when the hair follicles during growth of the winter coat are put under pressure and the melanin granules inside the hair follicles burst out into the dermis and become visible as a bite mark.

Multi-enriched cage environment for farmed blue foxes: the extent of the use of the various enrichments

L. Frondelius, H.T. Korhonen, H. Huuki, J. Mononen

Environmental enrichment (EE) can be used to improve animal welfare. In the present study, a traditional fox cage was furnished with both activating environmental enrichments (EE) (a bone, a scratching plate, a hockey buck, a ceiling rope and a wall rope and straw) and EEs enabling resting or observation (a wire-mesh platform and a top nest box). The aim was to find out to which extent blue foxes (*Vulpes lagopus*) utilize these EEs, and to collect practical experiences of the EEs. The experimental animals were 12 adult blue fox vixens that had been housed in cages furnished with a platform and a bone for about 1.5 years before they were transferred to the multi-enriched cages in December. The frequency and duration of the active contacts with the EEs was measured with continuous recording on Days 1, 2, 7 and 16 after the transfer, three hours (13:30-14:30, 18:00-19:00 and 2:00-3:00) on each day. The total use of the EEs was 15 times per hour and more than 20% of the time. For most EEs both the time spent in contact and the frequency of contacts with the EEs declined steeply after Day 1, reflecting a novelty effect of the EEs. This decline was not so evident for the platform, top nest box and wall rope. These three EEs were also the ones used the most by the foxes. The ropes (made of sisal) were badly damaged during the experiments, whereas other EEs remained in good condition. Our preliminary results indicate that the adult blue foxes used readily the opportunities for more diverse behaviour. The possible welfare effects of the multi-enriched cages remain to be shown by future studies.

Activity and stereotypic behaviour at dusk, dawn and around feeding in farmed mink during autumn

L. Olofsson

Reducing stereotypic behaviours are desired since these originates from constrains in behaviour and lack of stimulations and generally are signs of reduced welfare. The aim was to follow the development of stereotypic behaviour in young mink during autumn. In total 300 mink where observed for one day from September to November. Observations where done in dawn, midday feeding and at dusk. The activity level was highest in October observations and lowest during midday feeding. None of the young animal studied showed stereotypic behaviour and only ten of the older

animal during the October observation. In conclusion, the environment that most Swedish mink are kept in is not likely to cause stereotypic behaviour in the young mink fed ad libitum during autumn.

Protein reduction strategies in mink studied by non-targeted metabolomics

M.S. Hedemann, B.M. Damgaard, T.N. Clausen, P.F. Larsen

The purpose of the investigation was to study the effect of feeding mink different protein levels on the composition of metabolites in plasma. The effect of three protein levels: 20%, 24 % and 28% of metabolizable energy (MEp) was studied. In the group fed 20 % MEp the effect of various additives was investigated as well. Blood samples were collected from the mink in August, September, October, and November. I the present investigation the samples from October was analyzed. The samples were analyzed on LC-MS and the data were analyzed using multi variate data analysis. A clustering of the data was observed mink fed 20 % MEp formed one group and mink fed 24 % and 28 % MEp formed another group. There was no difference between mink fed 24 % or 28 % MEp and there was no effect of the additives in the group fed 20 % MEp either. Some of the metabolites responsible for the separation were tryptophan and phenylalanine; the level of tryptophan was high in plasma from mink fed 24 % and 28 % MEp whereas the level of phenylalanine was high in mink fed the lowest protein level.

“Is it possible to prevent fatty liver by nutritional supplements in a low protein diet in growing-furring mink”

T.N. Clausen, B.M.Damgaard, P.F. Larsen

In October Fatty liver in mink seems to be an increasing problem especially if we use a very low protein diet. In an attempt to prevent fatty liver different substances were added to the feed of groups of brown mink kits from mid-September.

Effect of different fibres on mink kit water balance in the late lactation period

P.F. Larsen, T.N. Clausen

The purpose of the investigation was to study the effect of different fibres on mink kit water balance in 8 weeks old kits. Forty-eight brown male mink kits distributed in 6 groups, one control group and 5 experimental groups were used. Five fibres / feed binders products were studied - Sugar beet pulp (1.5 %), Quellmix 70/30 (1.3 %), Feed binder T95 (0.6 %), Cellulose (1.5 %) and Vivapur (0.5 %). None of the fibres / feed binders had any negative effect on kit body growth in the study period. All of the products increased the water consumption through the feed and reduced the need of drinking water. There were no negative effects on the mineral balance with these products at the applied concentrations. Therefore we conclude that water uptake from the feed can be increased using these five fibres / feed binders without any negative effects on the mink kits.

Digestibility trials on raw materials for fur animal feed production – Newest digestibility analyses from Kopenhagen Farm compared with the Nordic feed table from 2004

L. Tinggaard, T.M. Lassén, M. Engbæk, P.F. Larsen

The aim of this article is to compare digestibility values from the Nordic table of feed ingredients compiled by Ahlstrøm et al. in 2004 and the newest results obtained through digestibility trials at Kopenhagen Fur's research farm, Kopenhagen Farm. This study have shown lack of information about the digestibility on selected raw materials and underlines the importance of analyzing the digestibility on new or changed raw materials used in the feed production for fur animals in order to obtain optimal composition.
It is therefore recommended, that a new and updated table is compiled, containing the latest knowledge from the Nordic countries about the digestibility on various raw materials.

The effect of vitamin supplementation on the breeding result of blue foxes

N. Koskinen, J. Sepponen, T. Mikkola, T.M. Lassén

The addition of unnecessary vitamins to fur animal feed increases the costs for feed manufacturers and fur animal producers. Although the most of the feed ingredients used in fur animal feed are rich in fat-soluble vitamins. However in many cases for example vitamin A is added to the feed even though the feed most probably is in excess. The most commonly used vitamin supplement includes for vitamin A 350 000 IU / kg and vitamin D 35 000 IU /kg. During production period, the vitamin concentrate is added with 1% to the feed which gives a content of 3,500 IU / kg vitamin A and 350 IU / kg vitamin D in the feed.
For blue foxes the side effects of excess vitamins and vitamins needed in joint development and reproductive performance are yet not known. The results among pigs and dogs show excess of fat-soluble vitamins in the diet may lead to impaired growth, anorexia, bone and joint disorders and the development of a normal animal, loss of mobility (Wasserman 1975, Blair et al. 1989 & 1992, NRC 1985). According to the NRC (National Research Council, 1982), overdose of vitamin A to mink and foxes may include symptoms like anorexia, bone changes and spontaneous ruptures, dekalsifikaatio and hair loss. However, vitamins are needed for normal breeding of blue foxes and possible over- or underdosing adverse effects on growth, fur quality and performance puppy have not been adequately studied.

The Voluntary Feed Control (Den Frivillige Foderkontrol) -The Danish way to secure optimal feed quality

M.L.E. Christiansen, B.L. Støvring, T.M. Lassén

The aim of The Voluntary Feed Control is to maintain a stable mink feed of both high nutritional and high hygienic quality. The quality is measured both by microbiological and chemical tools. In order to obtain the most optimal feed it is necessary to monitor the quality of used raw materials to be able to produce high quality skins and secure optimal welfare of the animals and a high health status.

Mercury levels in mink feed in Spain

R. Fernandez-Antonio, A.V. Martínez

Mercury (Hg) is a contaminant which, in its organic form (methylmercury), tends to accumulate in long-life carnivore fishes (2). Some of these types of fish are frequently used in the feed for mink in Spain: Sharks (all species), Marlin (Makaira species), Swordfish (*Xiphias gladius*), Rays (Raja species), Tuna (Thunnus species). The clinical signs of Hg poisoning in mink include, lethargy, anorexia, weight loss, incoordination, head tremors, splayed rear legs and seizures (1).
The present study shows the results of the analysis of feed of 11 Spanish kitchens, as well as some of the fishes used. Finally, three farms were chosen with the criteria of feed Hg levels "high", "medium" or "undetectable" between the months of January and March 2013, to determine the accumulation of Hg in internal organs.

Feed efficiency in mink during lactation related to feed efficiency growth

J. de Rond Ing

At Edelveen Research Farm a method to measure feed efficiency in mink was evaluated. The aim was to investigate the relation between the feed efficiency of mink as juveniles and as adolescents. In 2011 (164 litters) and in 2012 (136 litters) were weighed at 7 weeks of age. All litters were fed once a day and the feed portion was recorded (Pilot Fur Feeding). The amount of food supplied during the lactation period between 3 and 7 weeks divided by the weight of the litter at 7 weeks (excl. mother) results in FC-lit (Feed Conversion per litter). In July 2012, 85 litters were grouped at FC-lit low (<5 kg food/kg litter), middle (5-5,5) and high (>5,5) and were split in 3 different housing combinations during growth period (single-pair-group). The weight of mink in each pen was measured from 28th of June to the 20th of October of 2012. We fed once per day and arbitrarily aimed for an empty feeding place of 2 hours. Feed intake / weight gain mink per pen (both between 28th of June and 20th of October) results in FC-gr (Feed Conversion Growth per pen).
Feed Conversion (feed to gain ratio) from the animals showed a large variation within litters (2011&2012). There is no significant difference

(p>0.05) in average FC-lit between the litter sizes from 7 to 10 kits. Low FC litters use 20% less food at same weight compared to high FC-lit litters. FC-lit from the same dam in 2011 showed a strong positive association with FC-lit in 2012 and also, but less, with her daughters.
The average FC-gr per FC-lit group showed a positive relation with FC-lit in all combinations of rearing the mink (pair-group-single); Low= 14,4 (kg food/kg growth)) – Middle= 14,8 and High= 15,8. The weight of male mink was higher in the Low and Middle group of FC-lit (3,4 and 3,3 kg versus 3 kg (p<0.05)). It was concluded that easy and effective selecting on Feed Conversion for subsequent growth is possible in June on the basis of FC-lit. Using data on FC-lit enables also selection on growth.

Weight loss of dams during the lactation period affects reproduction in the year thereafter

J. de Rond Ing

A study at the Research farm Edelveen aimed to investigate the relation between the weight loss of the female mink in the second part of the lactation period (June) and her reproductive performance during the next season. In 2011 and 2012 litters and their mother were weighed when the kits were 3, 5 and 7 weeks of age and at the beginning and at the end of June. Weight changes of the dam during lactation in 2011 (122 females) were related to reproduction data in 2012. The data from weight changes during 2012 were related to reproduction in 2013 (148 females). From 70 females the weight change in both years was measured.
There is a large variation in weight change between dams from 40% loss of body mass to 15% weight gain. We divided females over 3 groups of weight change classes: High losses of weight (>10% loss), Normal loss of weight (0-10% loss) and Growth. In 2012 the whelping result was significant higher for the 'Normal' group from 2011 compared to the 'High' group from 2011. This was due to large differences in litter size and in number of empty females (8,3 kits versus 6,7 kits/mated female). We saw similar results in 2013 with again a significant higher whelping result (p<0.05) for the group with 'Normal' weight loss in 2012 compared to the 'High' weight loss group (7,4 kits versus 5,9 kits/mated female). The reproduction results for the 'dams with growth' in June in both years was between the 'High' and 'Normal' dams.
Furthermore data of females which were weighed at the end of lactation both in 2011 and 2012 showed that lactation weight changes in the first and the second lactation period are related. The relation between lactational weight loss and subsequent pregnancy rates and litter size has also been described for sows (Thacker and Bilkei, 2005).
High weight loss in mink in this parity will give a lower number of kits in her next parity.

The prevalence of endoparasites in Norwegian farmed foxes

C.K. Heimberg

Farm-bred silver foxes (*Vulpes vulpes*) and blue foxes (*Alopex lagopus*) are generally housed in standard farm cages with wire mesh flooring throughout their lives. They have little contact with their own faeces and intermediate hosts for endoparasites. Many Norwegian fox breeders treat their animals against endoparasites because former treatment guidelines recommend it. This study was performed to help establishing new guidelines for the use of anthelmintic drugs in Norwegian farmed foxes.

Effect of body condition on litter size in mink - Experience from Kopenhagen Farm

E. Nielsen, T. Clausen, P.F. Larsen

During the last decade several studies have documented large effects of body condition on litter size in mink from both research farms and commercial farms. Kopenhagen Farm has optimized and quantified body condition in all mink females on the farm and has increased the breeding result in brown mink from 6.6 kits per female giving birth to 7.7 kits during the last decade, and similarly from 6.05 to 6.7 kits in black mink. Results are summarized and discussed in relation to practical farm management in Denmark

Reduction of emission by frequent removal of mink slurry

E.L.K. Mortensen, M.N. Hansen, V.H. Lund, I. Knude, H. Bækgaard

The major ammonia source, on mink farms, comes from the manure in the gutters. Mink excretes the majority of the nitrogen as urea (CO(NH2)2). Urea is transformed into ammonia (NH3) and CO2 by the enzyme urease produced by microorganism in feces and soil (Elzing et al., 1992). Most mink farms remove the slurry weekly, but a more frequent removal of mink slurry has not been studied since 2001 (Pedersen og Sandbøl, 2001), where ammonia emission was measured in an in-closed housing system. This is therefore the first study where ammonia emission has been measured in a traditional housing system, with CO2 as a tracer gas. A comparative study of the ammonia emission from mink houses with daily, twice weekly, and weekly removal of slurry was performed at two commercial mink farms to document the ammonia reduction effect of frequent slurry removal.

Slurry separation at the source as a tool to reduction of ammonia emission

I. Knude, M.N. Hansen, V.H. Lund, E.L.K. Mortensen, P.F. Larsen, H. Bækgaard

To ensure approval of future expansions in the production of mink in Denmark, it will be necessary to find methods to reduce emission of ammonia in mink production. Therefore, a study in source separations of mink slurry has been conducted. Under Ideal conditions, where all faeces and urine are collected, and urine is continuously drained to an enclosed container, have shown great potential. Earlier studies have shown a reduced ammonia emission up to 95% in comparison with the reference system.

The study showed that urea from mink slurry have a slow turnover to ammonia and the emissions of ammonia increase significantly after 3 days, when left in the slutty pits.

It also became clear that there is a correlation between ammonia emission and temperature.

A later study, where separation is done only above the slurry pits, has shown a reduction potential of 36 –55%, depending on whether the urine is continuously drained from the slurry pits or not.

Individual benchmarking of mink production

H.H. Møller

From the national database at the Knowledge Center for Agriculture 103 useful statements for mink production for 2012 are reported. Key figures was calculated and ranked after "operating result per skin" and shown in tables. Benchmarking was made for selected key figure and compared to top both top 5 results and traffic light. Return on asset was 33 pct. for the group of farm from 1.500 to 2.600 breeding females. Return of labor was 291 DKK per skin.

Code of good practice for Euthanasia of farmed foxes

H. Huuki, H.T. Korhonen

The council regulation on the protection of animals during killing (EC) No 1099/2009 came to apply from 1st of January 2013 onwards. This regulation lays down rules for the killing of animals bred for the production of food, wool, fur or other products as well as the killing of animals for the purpose of depopulation and for related operations. The council regulation also emphasizes the meaning of education, competence and self-monitoring as means to improve the welfare of animals during killing. It encourages the making of guides to good practice in order to help business operator to plan and monitor the killing process accordingly. The code of good practice in humane killing of foxes (CGP) is created for that purpose.

The present CGP aims at providing the highest standards of welfare for farmed foxes (Blue fox *Vulpes lagopus*, Silver fox *Vulpes vulpes* and their colour variants and crossings) in killing. The regulation states many acceptable killing methods for foxes. The key aspects and parameters affecting the humanity of killing of those methods are presented in CGP. However, more practical and detailed description of killing is given for the most used killing method – electrocution. As well as describes the key parameters, the CGP also gives examples of how and why these parameters are to be monitored.

According to council regulation all business operators are obligated to plan the killing procedures ahead by drawing up a Standard Operating Procedure (SOP). The CGP gives

practical instructions for planning the content of SOP and examples of how the carrying out of SOP should be reported.

In addition CGP also discusses in short the competence requirements that are stated in the council regulation. However, it should be noted, that the member states of EU are also allowed to apply national regulations that are not necessarily described or taken into account in this CGP. Moreover, the interpretation of the council regulation, competent authorities and implementation practices of regulation may vary between EU countries.

The main objective of this paper is to introduce the content of Code of good practice for humane killing of foxes.

Behaviour related to energetics in mink during winter

H.T. Korhonen

The mink (*Neovison vison*) typically has an elongated body shape and small body mass. Due to high surface-to-mass ratio, it has to sustain high basal metabolic rate. The present study compares energetics and eating behavior of light (mean body weight 2096 ± 57 g) and heavy (mean body weight 2578 ± 118 g) male mink during winter. The results showed that the dependence of feed consumption (y) on the circadian minimum temperature (x) was described by the equation: $y=381.3 + 2.18x$ ($p<0.001$). Correspondingly, daily feed consumption (y) was related to circadian mean temperature (x) as following: $y=377.9 + 3.02x$ ($p<0.001$). Ambient air temperature regulated the daily activity of mink. With increasing cold the mink decreased its activity and vice versa. A decrease/increase in the ambient air temperature consequently decreased/increased the feed intake of the mink. Eating behavior played a marked role in the daily activity budget of the mink. The mink ate on average 13 times in a 24-hour period. The circadian activity of mink consisted of short bursts of activity between resting periods.

Adapting the cognitive bias approach to assess welfare in farmed mink

PhD thesis by Pernille Maj Svendsen

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American mink are bred in captivity for production of fur. The welfare of farmed mink is of great concern and is debated in Denmark as well as internationally. This is primarily due to the occurence of abnormal behaviours, stereotypic behaviour and fur-chewing; suggesting that the current environment is insufficient. Abnormal behaviour may develop when an animal fails to adapt its behaviour due to exposure to chronic aversive stimuli or in case normal behaviour responses are being compromised or thwarted. Traditionally, the occurence of abnormal behaviour is used as an indicator of reduced welfare. However, there are some conflicting results showing that stereotyping animals are not necessarily experiencing the worst welfare. Thus, there is a need to investigate the relationship between abnormal behaviours and the link to other welfare indicators.

The thesis aimed to 1) investigate the link between abnormal behaviours and welfare indicators in mink, housed under standard conditions, and 2) adapt and validate a judgement bias approach, as a novel indicator of mink affective state, to be used in the investigation.

Three studies were conducted in the effort to adapt the judgement bias approach to mink. The judgement bias approach consists of several components. In study 1, the use of auditory cues as discrimination stimuli for mink proved applicable. Also, mink relatively fast form associations between stimuli and outcomes and are able to discriminate between them. Study 2 revealed that handling and training of mink has a different effect on indicators of affective state. Study 3 revealed differences in learning behaviour between stereotyping and non-stereotyping mink.

A significant relationship between stereotyped behaviour and fur-chew was not established in the fourth study, in this thesis. However, we found that tail-chewing mink were more explorative towards novel objects and had higher levels of faecal cortisol metabolites than mink not performing tail-chew. This finding has not previously been shown in mink.

The thesis presents novel findings, in relation to welfare effects, of fur-chewing behaviour in mink. Further, the findings of the thesis constitute fundamental prerequisites for adapting a judgement bias approach to mink. Additional studies are needed to conclude whether stereotypic behaviour and fur-chewing are interrelated or are signs of current improved or reduced welfare.

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