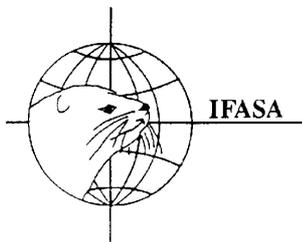
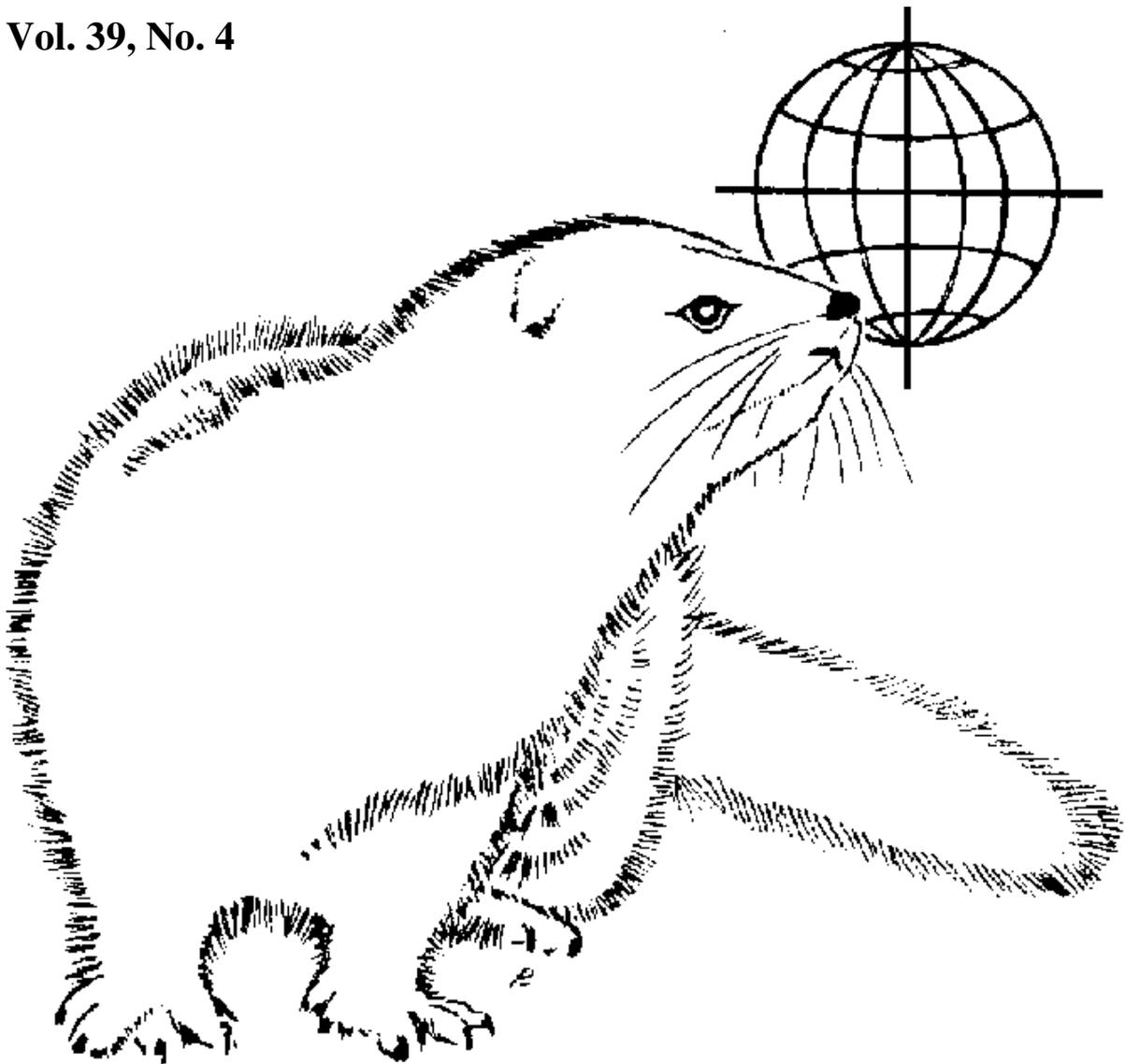


SCIENTIFUR

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SCIENTIFUR encompasses studies in breeding, genetics and reproduction, nutrition, feeding and management, behaviour and welfare and health and diseases.

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Notes from the Editor

The International Scientific Congress in Fur Animal Production is held every fourth year. In 2016, the XIth IFASA Congress will be organized by ProFur and held in Helsinki, Finland from August 23-28. The congress covers research topics within fur animal production such as breeding, genetics and reproduction; nutrition, feeding and management; behaviour and welfare, and health and diseases. An invitation for the XIth IFASA Congress 2016 is presented in Scientifur 39,4. Please notice that the deadline for submission of abstracts is February 1st. The Congress is also announced at the IFASA webpage: <http://ifasanet.org/>

Aleutian mink disease virus (AMDV) is the largest health problem in the mink production worldwide.

Mink Plasmacytosis is caused by a parvovirus and results in reduced resistance to other infections, reduced fertility and degraded fur quality. The permanent prevalence in some farms and sudden outbreaks in a range of farms makes AMDV and host-AMDV interactions important research topics. Studies of new methods for detection of AMDV and analysis the molecular mechanisms of cross-host transmission of AMDV are presented in Scientifur 39,4. Research studying the effect of AMDV on the decline of the native European mink is also presented.

Recent detection of swine Methicillin Resistant Staphylococcus Aureus (MRSA) in diseased mink in Denmark will be followed by investigation of the presence of MRSA in healthy mink.

Vivi Hunnicke Nielsen

Editor Scientifur



We are pleased to invite you to the **International Fur Animal Scientific (IFASA) Congress 2016**.

The conference will be held in **Helsinki, Finland, 23-26 August 2016** at Saga Congress Center - and accommodation in hotel Scandic Park Helsinki.

Please note that a genetic workshop will take place on the first day, **the 23rd of August 2016**, and that the actual conference will be on **the 24-26th of August 2016**.

The conference intends to highlight the ongoing research in different topics concerning fur animal research.

The Organizing Committee of IFASA2016

For registration and more information, please visit www.ifasanet.org or contact us on e-mail: ifasa2016@profur.fi

The topics are as follows:

- * Health & Disease
- * Nutrition, feeding & Management
- * Breeding, Genetics & Reproduction
- * Behavior & Welfare
- * Genome of the mink and fox - Aleution disease - Environment (*these three topics are optional, the final 5th topic will be decided after receiving the abstracts*).

Abstracts (oral or poster) are welcome from authors from all over the world and should be submitted via the conference website: <https://www.lyyti.in/IFASA2016abstracts>

Deadline for submission of abstracts is February 1st, 2016.

The conference is organized by ProFur and IFASA



BREEDING, GENETICS AND REPRODUCTION

Population genetic structure in farm and feral American mink inferred from RAD sequencing-generated single nucleotide polymorphisms

J.P. Thirstrup, A. Ruiz-Gonzalez, J.M. Pujolar, P.F. Larsen, J. Jensen, E. Randi, A. Zalewski, C. Pertoldi

Feral American mink populations, derived from mink farms, are widespread in Europe. In this study we investigated individuals from 14 populations, 4 feral and 10 from farms, the latter including a total of 7 color types (Brown, Black, Mahogany, Sapphire, White, Pearl, and Silver genetic diversity and genetic differentiation between feral and farm mink using a panel of genetic markers (194 SNP) generated from RAD sequencing data. Sampling included a total of 211). Our study revealed similar low levels of genetic diversity in both farm and feral mink. Results are consistent with small effective population size as a consequence of line selection in the farms and founder effects of a few escapees from the farms in feral populations. Moderately high genetic differentiation was found between farm and feral animals, suggesting a scenario in which wild populations were founded from farm escapes a few decades ago. Currently, escapes and gene flow are probably limited. Genetic differentiation was higher among farm color types than among farms, consistent with line selection using few individuals to create the lines. Finally, no indications of inbreeding were found in either farm or feral samples, with significant negative values found in most farm samples, showing farms are successful in avoiding inbreeding.

J. Anim. Sci. 2015: 93(8): 3773-3782.
doi: 10.2527/jas.2015-8996

Genetic variation and population structure of American mink *Neovison vison* from PCB-contaminated and non-contaminated locales in eastern North America

I. Wirgin, L. Maceda, J. Waldman, D.T. Mayack

American mink *Neovison vison* may be particularly vulnerable to toxicities of persistent contaminants such as PCBs because of their aquatic-based diet, position near the top of the food web, and small

deme sizes. Furthermore, ranched mink are sensitive to reproductive toxicities of fish diets from PCB-polluted sites. The upper Hudson River is highly contaminated with PCBs and previous studies have shown elevated hepatic burdens of total and coplanar PCBs in mink collected near the river compared with those from more distant locales in New York and elsewhere. We hypothesized that bioaccumulation of PCBs in Hudson River mink has reduced their levels of genetic diversity or altered their genetic population structure. To address this, we conducted microsatellite DNA analysis on collections made in proximity to and from more distant locales in the Hudson River watershed, elsewhere in New York State, and at other sites in eastern North America including New Brunswick, four locales in Ontario, multiple drainages in Maine, and two ecoregions in Rhode Island. We did not find reduced genetic diversity at the individual or population levels in mink collected near (<6 km) to PCB hotspots in the Hudson River nor evidence of altered population structure. Consistent with their distribution in small localized and isolated demes, we did find significant genetic population structure among many mink collections in New York State and elsewhere. Depending on the analytical approach used, genetically distinct populations numbered between 16 when using STRUCTURE to 19-20 when using Exact G tests, F_{ST}, or AMOVA analyses. Genetically distinct population units were found among major ecoregions and minor ecoregions in New York State, among different hydrologic subunits within the Hudson River watershed, among spatially separate locales in Ontario, and among most watersheds in Maine. However, despite this localization and potential heightened impact of stressors, genetic diversity and genetic population structure in mink does not seem to be affected by their bioaccumulation of high levels of PCBs of Hudson River origin.

Ecotoxicology. 2015: 24(9): 1961-1975.
doi: 10.1007/s10646-015-1533-6.

Physiological level of cortisol and testosterone in the blood of Arctic fox females

E. Gorajewska, A. Filistowicz, S. Nowicki, P. Przysiecki, A. Filistowicz

The aim of this study was to determine physiological levels of stress hormones (e.g. cortisol

and testosterone) in the blood of polar fox females characterized by a specific genotype and karyotype and also the type of behavior. In 2010, an estimation of the type of behavior of all females from a pack based on the type of behavioral response (empathic test, alimentary test, acoustic test) was provided. In the blood of 136 females randomly selected from the fundamental pack, physiological levels of stress hormones (e.g. cortisol and testosterone) were determined. Additionally, the analysis of polymorphism of karyotypes of 72 females in this group was conducted. Heritability and repeatability coefficients in the base levels of cortisol and testosterone in the blood serum was evaluated. The average basal level of cortisol in the blood serum of polar fox females was 46.04 ± 25.86 nmol/l, and testosterone 0.45 ± 0.22 nmol/l. The heritability coefficient of the basal cortisol level stated 0.30 ± 0.11 and testosterone 0.24 ± 0.13 ; the repeatability coefficient of the basal levels of cortisol was 0.42 and 0.37 of testosterone. The multivariate analysis of variance revealed non-significant differences between the studied groups of animals. Some tendencies were noted explaining the differentiation in hormone levels within particular effects (participation of genes of Finnish variety, karyotype and type of behavior: empathic test, alimentary test and acoustic test). The highest basal levels of cortisol (51.98 nmol/l) and testosterone (0.51 nmol/l) were found in the group of foxes of national breeding. The highest value of cortisol was obtained in the female group of 48 chromosomes (55.20 nmol/l) and lowest in a group of foxes with karyotype $2n=50$ (49.06 nmol/l). Studies have shown the highest physiological level of testosterone in the blood of gentle individuals. It was also noted that foxes with a high concentration of this hormone were simultaneously characterized by a low cortisol level.

Medycyna Weterynaryjna (Veterinary Medicine – Science and Practice) 2015. 71(10): 638-642.

Comparison of the craniometric parameters of wild and farm American mink (*Mustela Vison*)

M. Taraska, M. Sulik, B. Lasota

Comparison of the craniometric parameters of wild and farm American mink. Skulls of 65 American minks from the West Pomeranian Province were examined (farm: $n = 33$, male $n = 16$ and female $n =$

17; wild: $n = 32$, male $n = 20$ and female $n = 12$). Craniometric parameters in the number of 24 were determined and measured on each skull. Results were averaged and compared, maintaining the division into sex groups. Males were found to have statistically significant differences between wild and farm animals in 20 parameters; measurements showing no statistically significant differences were: nasal length, postorbital constriction, brain case height and greatest height of the mandibular body. Females were found to have statistically significant differences between wild and farm animals in 6 parameters - condylobasal length, tooth row length, greatest length of the mandible, brain case basis length, postorbital length and palatal length. The percentage conversion of measurements into the greatest length of the skull showed differences in its proportions. Among male skulls, the parameters for which the ratio of differences was more than 2% were palatal length, zygomatic breadth and brain case height. For female skulls, no craniometric parameters showed differences in the skull proportions being greater than 2%. The occurrence of measurable changes in the craniometric parameters between domestic and farm mink populations may indicate that the domestication process is still ongoing and allows distinguishing the population affiliation of an individual specimen.

Folia Morphol (Warsz) 2015.

doi: 10.5603/FM.a2015.0092. [E-pub ahead of print]

Embryonic Diapause and Maternal Recognition of Pregnancy in Diapausing Mammals

M.B. Renfree

The dynamic nature of early embryonic growth is at odds with the phenomenon of mammalian embryonic diapause, because embryos in diapause are in a state of suspended animation of varying duration. The signals that control embryonic diapause differ between species, but in all cases, it acts to synchronise reproduction with external factors to maximise the survival of the offspring. This chapter provides an overview of current understanding of the control of embryonic diapause, with an emphasis on the three species about which most is known, namely, the mouse, the mink and the tammar wallaby.

Adv. Anat. Embryol. Cell. Biol. 2015: 216: 239-252.
doi: 10.1007/978-3-319-15856-3_12

Conception rates in farm mink (*Neovison vison*) in relation to first mating date, age and color variety

L. Felska-Błaszczuk, B. Lasota, B. Seremak

Anim. Sci. J. 2015.
doi: 10.1111/asj.12517. [E-pub ahead of print]

NUTRITION, FEEDING AND MANAGEMENT

Nutrient digestibility and colonic fermentation processes in species of the families *Mustelidae* and *Canidae* fed the same diet

A. Gugolek, J. Juśkiewicz, J. Strychalski, M. Konstantynowicz, C. Zwoliński

J. Exp. Zool. A Ecol. Genet. Physiol. 2015: 323(9): 637-644.
doi: 10.1002/jez.1954. [E-pub ahead of print]

Uptake of selenium and mercury by captive mink: Results of a controlled feeding experiment

R.D. Evans, N.M. Grochowina, N. Basu, E.M. O'Connor, B.E. Hickie, K. Rouvinen-Watt, H.E. Evans, H.M. Chan

Chemosphere. 2015: 144: 1582-1588
doi: 10.1016/j.chemosphere.2015.09.096
[E-pub ahead of print]

Growth and reproductive effects from dietary exposure to Aroclor 1268 in mink (*Neovison vison*), a surrogate model for marine mammals

W.R. Folland, J.L. Newsted, S.D. Fitzgerald, P.C. Fuchsman, P.W. Bradley, J. Kern, K. Kannan, R.E. Remington, M.J. Zwiernik

Environ. Toxicol. Chem. 2015.
doi: 10.1002/etc.3201. [E-pub ahead of print]

BEHAVIOUR AND WELFARE

Effects of environmental enrichment and stereotypic behavior on maternal behavior and infant viability in a model carnivore, the American mink (*Neovison vison*)

M. Díez-León, G. Mason

Zoo. Biol. 2015
doi: 10.1002/zoo.21249. [E-pub ahead of print]

Partial Weaning at Six Weeks of Age Reduces Biting among Mink Kits (*Neovison Vison*)

T.N. Clausen, P.F. Larsen

Recent studies have demonstrated that postponed weaning age from 6 weeks to 8 weeks in mink increases the number of bites among mink kits. Therefore, a series of studies have been conducted in order to quantify effects of weaning age on mortality, number of bites and growth rates in mink kits weaned at 42 and 56 days after birth during two consecutive breeding seasons. Partial weaning of large litters on Day 42 reduced the number of mink kits and litters with bites from an average frequency of 1.6% to 1.0% for kits and 8.1% to 5.1% for litters and increased growth rate of male kits. These results are highly important for ensuring optimal welfare in mink production, and we recommend that partial weaning (dividing) of large litters should be considered in practical mink farming in the future.

Open Journal of Animal Sciences 2015: 5: 71-76.
doi: 10.4236/ojas.2015.52009

HEALTH AND DISEASE

Development of an ELISA Based on Fusion VP2332-452 Antigen for Detecting Antibodies against Aleutian Mink Disease Virus

X. Chen, C. Song, Y. Liu, L. Qu, D. Liu, Y. Zhang, M. Liu

J. Clin. Microbiol. 2015.
pii: JCM.02625-15. [E-pub ahead of print]

Prevalence of antibody to Aleutian mink disease virus in European mink (*Mustela lutreola*) and American mink (*Neovision vison*) in Spain

S. Mañas, A. Gómez, V. Asensio, S. Palazón, P.D. Dra, O.E. Alarcia, J. Ruiz-Olmo, J. Casal

The European mink (*Mustela lutreola*) has undergone a dramatic decline and is one of the most endangered mammals in the world. The invasive American mink (*Neovision vison*) is considered the main factor for this decline. However, the American mink's introduction and the subsequent ecological concurrence of the two species cannot solely explain the decline or disappearance of the European mink. Aleutian mink disease virus (AMDV) is the main health problem in fur farming worldwide, causing varied clinical syndromes that depend on the viral strain and host factors. Infection with AMDV has been speculated to contribute to the decline of the European mink, but a detailed study has not been performed. To assess the potential effects of AMDV infection on the conservation of the European mink, we surveyed AMDV antibody in samples from 492 native European mink and 1,735 feral American mink collected over 16 yr. The antibody prevalence in European mink was 32%. There were no statistically significant differences in antibody prevalence between sexes, among years, or among weight classes. For recaptured European mink, incidence of seroconversion (negative to positive) was 0.46 cases per animal-year at risk. For positive animals, the incidence of conversion from positive to negative was 0.18 cases per animal-year at risk. In 1,735 feral American minks, the overall prevalence was 32.4% and varied among the six wild populations studied. Infection with AMDV appears to be endemic, distributed across the entire ranges of both species, and no effects on the population dynamics of either species were observed.

J. Wildl. Dis. 2015. [E-pub ahead of print]

Sequencing Analyses of the Hypervariable Region within the VP2 Gene of a Strain of the Aleutian Mink Disease Virus

L. Zhang, B. Hu, X. Bai, H. Zhang, J. Zhao, Z. Wang, F. Ma, X. Yan, W. Wu, S. Xu

To analyze the molecular mechanisms of cross-host transmission of the Aleutian mink disease virus (ADV), the hypervariable region fragment of the VP2 gene of the ADV in Jilin Province (China) was amplified. Sequencing analyses showed diversity at residue 174 by comparison with other VP2 genes in GenBank. The phylogenetic tree indicated that the ADV-JL strain had a close relationship with the highly pathogenic strain from Denmark: ADV-K. Results implied that residue 174 may be associated with ADV infectivity.

Bing Du Xue Bao. 2015; 31(3): 226-230.

Associations between biosecurity and outbreaks of canine distemper on Danish mink farms in 2012-2013

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During 8 months from July 2012 to February 2013, a major outbreak of canine distemper involving 64 mink farms occurred on the Danish peninsula of Jutland. The canine distemper outbreak was associated with exposure of farmed mink to infected wild carnivores and could represent a deficit in biosecurity on the mink farms. The aim of this study was to investigate the extent and association of specific biosecurity measures with the outbreak. The study was carried out in an epidemiological case-control design. The case group consisted of the 61 farms, which had a confirmed outbreak of canine distemper from July 2012 to February 2013. The control group included 54 farms without an outbreak of canine distemper in 2012 or 2013, selected as the closest geographical neighbor to a case farm.

The results showed that significantly more control than case farms had vaccinated their mink against canine distemper virus. Mortality was only assessed on the case farms, and there was a non-significantly lower mortality on vaccinated farms than on the non-vaccinated farms. Furthermore, the proportion of farms with observations of wild red foxes (*Vulpes vulpes*) inside the farm enclosures were larger for case farms, indicating that the control farms had a better biosecurity or were not equally exposed to canine distemper virus. Generally, all farms had very few specific precautions at the gate entrance in respect to human visitors as well as animals. The

use of biosecurity measures was very variable in both case and control farms. Not using plastic boot covers, presence of dogs and cats, presence of demarcated area for changing clothes when entering and leaving the farm area and presence of hand washing facilities significantly lowered the odds of the farm having a canine distemper virus outbreak.

The results of the study indicate that consistent use of correct vaccination strategies, implementation of biosecurity measures and limiting human and animal access to the mink farm can be important factors in reducing the risk for canine distemper outbreaks.

Acta. Vet. Scand. 2015; 30: 57:66.
doi: 10.1186/s13028-015-0159-2

Amdoparvoviruses in small mammals: expanding our understanding of parvovirus diversity, distribution, and pathology

M. Canuti, H.G. Whitney, A.S. Lang

Many new viruses have been discovered recently, thanks in part to the advent of next-generation sequencing technologies. Among the Parvoviridae, three novel members of the genus Amdoparvovirus have been described in the last 4 years, expanding this genus that had contained a single species since its discovery, Aleutian mink disease virus. The increasing number of molecular and epidemiological studies on these viruses around the world also highlights the growing interest in this genus. Some aspects of amdoparvoviruses have been well characterized, however, many other aspects still need to be elucidated and the most recent reviews on this topic are outdated. We provide here an up-to-date overview of what is known and what still needs to be investigated about these scientifically and clinically relevant animal viruses.

Front. Microbiol. 2015; 6:1119.
doi: 10.3389/fmicb.2015.01119. *eCollection* 2015.

A natural reassortant and mutant serotype 3 reovirus from mink in China

Y.W. Zhang, Y. Liu, H. Lian, F. Zhang, S.F. Zhang R.L. Hu

Mammalian orthoreoviruses (MRVs) are widespread and infect virtually all mammals. We report here the first case of a natural mutant and reassortant serotype 3 reovirus from mink in China, known as MRV3 SD-14. Whole-genome sequence analysis showed that the MRV3 SD-14 may have resulted from a reassortment involving MRVs that infected swine, humans and mink. Interestingly, the S1 segment, which encodes the viral attachment protein $\sigma 1$, which influences viral virulence and cell tropism in the host, had a stop codon mutation at amino acid 246. Surveillance of the virulence and evolution of MRVs in humans and other animals deserves more attention.

Arch. Virol. 2015. [E-pub ahead of print]

Host-dependent morphology of *Isthmiophora melis* (Schrank, 1788) Luhe, 1909 (*Digenea, Echinostomatinae*) - morphological variation vs. molecular stability

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Echinostomes are cosmopolitan digenean parasites which infect many different warm-blooded hosts. Their classification is extremely confused; the host spectrum is wide, and morphological similarities often result in misidentification. During our long-term studies on the helminth fauna of rodents and carnivores we have collected 27 collar-spined echinostomes which differ in morphology to an extent that suggests the presence of more than one species. Here, we describe this material, and the extent of host-related variation in this parasite.

Specimens of *Isthmiophora* isolated from four host species (badger, American mink, hedgehog, striped field mouse) were subject to morphological and molecular examination; the data were statistically analysed.

Our results show that genetically all the *Isthmiophora* specimens obtained from all the examined hosts are conspecific and represent *I. melis*. On the other hand, the individuals isolated from *Apodemus agrarius* are morphologically distinct and, based on this criterion alone, should be described as a new species.

The morphological traits of *Isthmiophora melis* are much variable and host-dependent; without molecular analysis they would suggest a necessity to describe a new species or even genus. Such a high

level of intraspecific variability may be affected by the host's longevity.

Parasit. Vectors. 2015: 8(1): 481.

doi: 10.1186/s13071-015-1095-8

Distribution and molecular phylogeny of biliary trematodes (*Opisthorchiidae*) infecting native *Lutra lutra* and alien *Neovison vison* across Europe

E. Sherrard-Smith, D.W. Stanton, J. Cable, P. Orozco-terWengel, V.R. Simpson, M. Elmeros, J. van Dijk, F. Simonnet, A. Roos, C. Lemarchand, L. Poledník, P. Heneberg, E.A. Chadwick

Parasitol. Int. 2015: pii: S1383-5769(15)00191-9.
doi: 10.1016/j.parint.2015.11.007. [E-pub ahead of print]

Sedation of Mink (*Neovison vison*) for Electrophysiological Procedures

H.T. Korhonen

The aim was to apply medetomidine sedation for electrophysiological measurements in mink (*Neovison vison*). Adult animals (N=15) of standard type were used. Initially, sedation with an i.m. injection of medetomidine (Dorbene 0.20 ml, 200 micrograms) was used. However, sufficient sedation was not reached. The next step was to sedate with 0.8 ml of medetomidine (Dorbene 0.80 ml, 800 micrograms). These animals woke up and the experiment needed to be interrupted. The next animal was injected with 1 ml of medetomidine (Dorbene 1 ml, 1 mg) but it never got sufficiently sedated. The fifth and sixth animals were sedated with combination of 0.8 mg medetomidine and butorphanol (Butador) (2 mg in one mink and 4 mg in another). These animals got sedated to some extent so that the electroencephalography (EEG) recording was possible. The further animals (N = 9) were sedated with the combination of the 0.4 mg medetomidine (Dorbene 0.4 ml, 400 micrograms) and 10 mg tiletamine with 10 mg zolazepam (Zoletil 0.2 ml). The combination of Dorbene (0.4 ml) and Zoletil (0.2 ml) were mixed within one syringe and injected intramuscularly. The rest of mink got the same combination of anesthetics and all animals reached the sufficient level of sedation to measure

properly electroencephalography (EEG), electrocardiography (ECG), respiratory rate and brainstem auditory evoked responses (BAER).

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Prevalence of intestinal parasites and Salmonella in the feces of farm-bred foxes and mink in Lublin Voivodeship as a potential risk in agricultural use

T. Kłapeć., A. Cholewa, K. Kostro, J. Karamon, J. Zdybel

The aim of the study to evaluate the occurrence of intestinal parasites and Salmonella bacteria in fox and mink faeces and to assess potential biological risk related to their use as a natural fertilizer in agriculture. The study included 12 randomly selected fox-breeding farms with a total population of 2800 animals and 9 mink farms with a total of 24650 animals. The material examined comprised 120 samples of fox faeces and 66 samples of mink faeces. In addition, the intestines of 45 foxes from 3 farms were examined by the SCT method. The samples of feces and intestines of slaughtered foxes were examined parasitologically and bacteriologically. In 13 samples of fox faeces, the presence of parasites of the genus *Isospora* was observed, whereas 2 samples contained the eggs of nematodes of the alimentary tract of *Toxocara canis* and *Strongyloides* spp. The examination of the intestines confirmed the presence of mature forms of *Toxocara canis* in 2 foxes. In mink, only parasites of the genus *Isospora* were found. The presence of pathogenic bacteria was noted in the faeces of foxes. In 5 samples of fox faeces, *Salmonella* bacteria were found. No *Salmonella* bacteria were isolated in mink faeces. The present study confirmed a considerable decrease in the extensiveness of *Toxocara* spp. invasion in foxes bred on farms in Lublin Voivodeship. At the same time, it was confirmed that farm-raised foxes, unlike mink, are not entirely free of intestinal parasites and *Salmonella* bacteria, which highlights the need for continued monitoring.

Medycyna Weterynaryjna (Veterinary Medicine – Science and Practice) 2015. 71(12), 787-790.

Evaluation of the first oral rabies vaccination campaign of the red foxes in Greece

L.M. Korou, K.E. Tasioudi, M. Tzani, A. Konstantinidis, A. Plevraki, P. Iliadou, P. Kostoglou, D. Kaimaras, S. Doudounakis, O. Mangana-Vougiouka

Vaccine. 2015. pii: S0264-410X(15)01673-4. doi: 10.1016/j.vaccine.2015.11.031 [E-pub ahead of print]

Atrioventricular valvular anomalies and their role in the etiopathogenesis of cardiorespiratory syndrome in farmed common foxes (*Vulpes vulpes*)

A. Noszczyk-Nowak, T. Piasecki, A. Cepiel, M. Nowak, I. Janus, U. Pastawska

Cardiorespiratory syndrome of common foxes is associated with a mortality rate ranging from 2.1% to 20%.

The aim of this study was to analyze the prevalence of cardiac abnormalities in common foxes (*Vulpes vulpes*) from Polish farms with a history of cardiorespiratory syndrome.

The prevalence of cardiac abnormalities in common foxes from a Polish farm with a history of cardiorespiratory syndrome was assessed as well as morphological examination of 60 heart specimens from clinically healthy animals. In addition, 38 foxes were examined echocardiographically and subjected to postmortem examination.

Atrioventricular valvular abnormalities were found in 57 out of the 98 (58%) analyzed hearts. The abnormalities of the mitral valve documented in more than 20% of the foxes in involved tendinous chords (completely lacking or shortened), papillary muscles and mitral cusps associated with both insufficiency and stenosis of the left atrioventricular orifice. Abnormalities of the tricuspid valve

included significant shortening of the tendinous chords and thickening of the valve cusps with the impairment of their mobility. The results of the echocardiographic and postmortem examination were consistent in 79% of the cases. The specimens collected from animals with and without atrioventricular valvular anomalies did not differ significantly in terms of cardiomyocyte width, number of inflammatory cells, adipose tissue content and presence of polychromatic cardiomyocytes.

Congenital atrioventricular valvular defects may be involved in the etiology of cardiorespiratory syndrome in common foxes, and echocardiography can be used as a measure of stock's health and a criterion for selection for mating.

Vet. Q. 2015. 1-6. [E-pub ahead of print]

Pseudorabies in farmed foxes fed pig offal in Shandong province, China

H.L. Jin, S.M. Gao, Y. Liu, S.F. Zhang, R.L. Hu

Pseudorabies (PR, Aujeszky's disease) is an acute, highly contagious viral disease resulting in major economic losses to the swine industry. PR is endemic in wild and domestic animals, although its natural host is the pig. Here, we report an outbreak of PR in foxes on a fur-producing farm in Yuncheng county, Shandong, China, that were fed pig offal. The diagnosis of PR was based on nervous signs and standard PCR methods and by isolation of PRV from fox brain tissue in Vero cells. The diagnosis was confirmed by an indirect immunofluorescence assay and electron microscopy. Phylogenetic analysis of a partial (804 nt) viral glycoprotein gC gene sequence indicated that it was likely to be a field strain closely related to a cluster of PRV previously identified in China.

Arch. Virol. 2015. [E-pub ahead of print]

Faglig Årsberetning

2014

Kopenhagen Forskning



Annual Report

2014

Kopenhagen Research

Production and welfare consequences of keeping female mink in groups, in standard cages vs. climbing cages and having access to occupational tubes with large and small diameter

S.W. Hansen

Group housing of mink has been introduced in order to increase cage size, cage complexity and social stimulation in farmed mink. The aim of this study was to compare the number of bite marks in female mink kept in groups of two, three and four female mink in the same cage. Furthermore, the aim was to test if the number of bite marks was reduced in male-female pairs kept in climbing cages (developed for group housing) compared to male-female pairs in standard cages, and whether the diameter of the occupational tube affected the occurrence of fur chewing in mink.

Results showed that two, three and four females together had 1.5, 2.5 and more than 5 times as many bite marks as mink kept in male-female pairs. The consequences of a single bite mark in relation to welfare can be discussed, but the important part is that an increased occurrence of bite marks indicates increased risk for wounds, which reduces welfare. The number of females in the cage reduces their use of the shelf. Legislation of changing the production environment from standard cages to climbing cages does not reduce the welfare of the female, but it is hard to document improvements for mink kept pairwise in climbing cages. The diameter of the occupational tube does not affect the occurrence of fur chewing differently in mink.

Annual Report 2014, 7-16. Copenhagen Research, Denmark

The nest box floor area affects mink use of the nest box

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

The aim of the investigation was to test whether the area of the nest box affected the mink's use of the nest box, when the volume of the nest box was constant. The result showed that mink used a nest box with a large area more than a nest box with a small area. However, we were not able to document that other behavioral elements were affected by the area of the nest box. Consequently, we were not able to document whether the reduced use of a small

nest box area had other welfare consequences for the mink.

Annual Report 2014, 17-22. Copenhagen Research, Denmark

Evaluation of genomic selection in mink with the use of stochastic simulations

K. Meier, A.C. Sørensen, J.P. Thirstrup, M.S. Lund

The aim of this study was to evaluate the use of genomic selection in mink breeding with stochastic simulations. Our simulation results show that using genomic selection will improve total economic gain compared to traditional breeding value estimation. Total economic gain varies depending on the accuracy and genotyping strategy, but even at low accuracy and genotyping only the 10% best males, total economic gain is increased compared to traditional breeding value estimation. Simulations suggest that using genomic selection will increase genetic gain, especially for difficult traits such as litter size and pelt quality compared to traditional breeding value estimation. Finally, our simulations suggest that higher genetic gain is obtained by using a model in breeding value estimation that takes genetic correlations between traits into account compared to traditional breeding value estimation, where a single trait model is used.

Annual report 2014, 23-28. Copenhagen Research, Denmark

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

B.K. Hansen, M. Blæsbjerg-Obitsø

Earlier research has shown that the body condition of animals in the period from December to April has an effect on reproduction. Advisors in management did a systematic monthly control of the body condition of breeding animals on 13 Danish mink farms during winter and early spring in 2012-2013, and each time adjusting the feeding strategy according to the recommendations. The aim was to try different methods to get a representative picture of the overall body condition of the breeding stock, furthermore to see if 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.

Annual Report 2014, 29-36. Copenhagen Research, Denmark

The supplementation of selected nutrients to a low protein diet may affect the incidence of fatty liver in mink

C.F. Matthiesen, A-H. Tauson

Fatty liver, an infiltration of fat in the liver, is a multifactorial disease, and can be caused by low protein provision, decreased food consumption, and fast deposition or mobilization of body fat. The aim of this study was to investigate if a dietary supplementation of selected nutrients, which function as methyl donors, anti-oxidants, or which stimulate insulin secretion, could lower the incidence of lipid infiltration of the liver in mink from August to November, when mortality, caused by fatty liver, often is high. The low protein level (LP, 20% of metabolizable energy from protein) and thus a lower content of all amino acids compared to traditional farm feed, showed a tendency to increased occurrence of fatty liver. When methionine was added to the LP diet and was just above the content in the farm feed (control) there were no signs of fatty liver. These findings were confirmed by the chemical composition of the liver, where the fat content of the liver was similar in the control group and LP group with added methionine.

Annual Report 2014, 37-41. Copenhagen Research, Denmark

Water balance after addition of LactiGel fiber to the feed

T.N. Clausen, K. Hvam, L. Tinggård, P.F. Larsen

A new fiber product with high water binding capacity was tested partly to females with kits from day 28 after birth, and partly to 8 week old male kits in a water balance study.

Use of 1% Lacti Gel and 17% water in the feed for mink females and kits from day 28 gave unsatisfying results, most likely because the added amount was too high, feed consistency changed significantly, and the females reduced their feed and calorie intake.

Water balance study with the product showed that the water was not released in the kits but passed out with the faeces resulting in an osmotic diarrhea, this also meant a loss of Na with the faeces. Urine pH was changed, probably due to changes in mineral balance.

Annual Report 2014, 43-50. Copenhagen Research, Denmark

Reduced protein to mink kits in the growing furring period

T.N. Clausen, P.F. Larsen

Protein and amino acids is very important for the skin development in mink in the growing furring period. In this investigation, five groups of 150 black mink males and females and 5 groups of 135 brown mink males and females were used. Feed protein content varied between 32 and 24 MEp with and without the addition of synthetic amino acids. One group of brown mink, fed a very low protein diet throughout the period from mid-September to pelting, was used to test different feed additions in an attempt to prevent/cure fatty liver.

Calorie allocation at the different protein levels was similar and the group fed as recommended to feed kitchens had a protein saving of around 9%. The group with very low protein (24 MEp from September) had in addition to a protein saving of about 20% also reduced caloric uptake (about 5%). Groups fed according to the recommendations for the protein content of the feed given to the feed kitchens since 2012 showed no significant difference to the control group in skin length and skin quality. Addition of various substances from Mid-September to feed with very low protein content (22 MEp from August) did not appear to have any effect, but awaits further analyzes of blood and organs. Fatty liver was observed at all protein levels, but there was a tendency to the highest frequency at a very low protein content.

Annual Report 2014, 51-64, Copenhagen Research, Denmark

Selection of mink that perform well on a low protein feed - Status for growing-furring period 2013 and breeding period 2014

T.N. Clausen, P.F. Larsen

It is important that mink feed is composed from a consideration of optimal production. At the same time it is relevant to examine mink's adaptability over time, by selecting the animals that perform best under different conditions. At the start of the growing season 2011 two selection groups that will continue for generations was created. A control group assigned to feed with a protein content similar to the average level at the feed stations in 2009, and a selection group assigned to feed with a 15% reduction in protein content compared to the level in 2009.

The third growth period (2013) in the two groups showed little shorter skins in the selection group, but the quality was not significantly different from the control group. Development in skin quality through 3 years of selection clearly shows that by selection we can find animals with as good quality at a low protein level. In 2013 there was a slightly higher mortality in the selection group as a result of fatty liver.

The third reproduction period (2014) in the two groups resulted in fewer kits per litter in both groups compared to previous years. There was a tendency for the lowest litter size at birth in the control group, most likely because the females in the control group was slightly fatter at the end of February and flushing thus was not optimal in that group. The lactation period was best for the selection group who had the largest kits day 28, fewest "thin" females and the largest feed allocation.

Annual Report 2014, 65-73, Copenhagen Research, Denmark

Reduced feed in April and early May to pregnant and lactating females

T.N. Clausen, P.F. Larsen

In recent years it has become more common to feed mink dams more restrictive before birth and again after birth and during start of the lactation period. The purpose of this investigation was to look at the feeding intensity in the period April 20 to birth and during the first 14 days after birth.

The results showed that within the same color type there was similar total feed consumption per kit, regardless of feeding principle. Body conditioning and heavier feeding up to birth did not result in more birth problems or more dead kits at birth. For both black and brown kits body weight, there was a positive effect of heavier feeding immediately after birth and among black females in this group, there was fewer "thin" females at weaning.

Annual Report 2014, 75-87, Copenhagen Research, Denmark

The digestibility of industrial fish is influenced by the quality

M.E. Engbæk, P.F. Larsen

The aim of the trial was to study the digestibility of degrading industrial fish, and to compare the found digestibilities with the contents of TVN and biogenic amines.

The results showed that the apparent digestibility of crude protein and crude fat decreased over time. At the same time the level of TVN and biogenic amines increased. The increased level of TVN and biogenic amines affected the health status of mink that have been allocated the most depraved industrial fish.

Annual Report 2014, 89-94. Copenhagen Research, Denmark

Acidification of drinking water has no effect on water intake and urinary pH in mink

M. Engbæk, P.F. Larsen

Drinking water with different acidity levels were tested on 20 brown/glow male mink. The mink were given the choice between drinking water with respectively pH 8.5 and pH 5.4 during a trial period of 24 days. The trial showed no difference regarding preference in water type or water intake. Urine production and the pH-value of the urine were not affected by the acidity of the drinking water. The urinary pH was respectively, 6.5 and 6.6 in the two experimental groups. There was no difference in the animal's feed intake or weight gain.

Annual Report 2014, 95-97. Copenhagen Research, Denmark

Effect of formic acid preserved fish silage on performance in mink

D. Clausen, B.M. Damgaard, T. Clausen

An increasing import of formic acid preserved fish silage concentrate from Norway, to be used in mink feed, makes it necessary to investigate how much fish silage the animals can tolerate. However, there are some limitations in the usage of formic acid preserved fish silage due to palatability, the content of formic acid and thereby negative effect on performance. A production trial was carried out with 810 male mink (*Neovison vison*) of Brown genotype to demonstrate the effects two different formic acid preserved fish silage concentrates (Scanbio K2 (K2) and H-Pro) had on growth and fur quality from weaning until pelting. The treatments were 1) Control, 2) 4 % K2, 3) 8 % K2, 4) 12 % K2, 5) 4 % H-Pro and 6) 8 % H-Pro. Initially all treatment groups had an inclusion of 4% silage and gradually increased to the inclusion percentage indicated by the group designation. Body weight gain and pelt length were significant different between groups. The group with 12% K2 was significant lighter and shorter than the other treatments. Animals that received 4 % H-Pro and 8% K2 were significant lighter than the control group, 4% K2 group and 8% H-Pro-group. There was no significant difference in pelt quality between the treatments.

Annual Report 2014, 99-106. Copenhagen Research, Denmark

Investigation of lung samples from mink with hemorrhagic pneumonia for respiratory syncytial virus

C.M. Salomonsen, S.Ø. Breum, L.E. Larsen, N. Høiby, A.S. Hammer

Hemorrhagic pneumonia in mink is caused by the bacterium *P. aeruginosa*. Pneumonia caused by bacteria can be initiated by a viral infection and some studies have shown that respiratory syncytial virus (RSV) possibly can augment infection with *P. aeruginosa*. In this study, lung tissue from mink, which died from hemorrhagic pneumonia caused by *P. aeruginosa*, was tested for the human and bovine variant of RSV. No RSV was found in any of the samples. There are no findings in this study that indicate RSV is contributing to the pathogenesis of

hemorrhagic pneumonia in mink, but such a relation cannot be firmly rejected based on this study.

Annual Report 2014, 107-110, Copenhagen Research, Denmark

Typing of *Pseudomonas aeruginosa* isolated from outbreaks of hemorrhagic pneumonia on Danish mink farms from 2001-2011

C.M. Salomonsen, N. Høiby, A.S. Hammer

Hemorrhagic pneumonia is an acute and fatal disease among mink. It is caused by an infection with the bacterium *Pseudomonas aeruginosa*, which is considered a common environmental inhabitant. In this study *P. aeruginosa* from outbreaks of hemorrhagic pneumonia in mink was typed by pulsed-field gel electrophoresis, which is a widely used and sensitive typing method that is able to identify the bacteria on DNA-level. The results show that outbreaks of hemorrhagic pneumonia often are caused by a local variant of *P. aeruginosa*, but some types or related types, which give rise to more than one outbreak, are also identified. Furthermore, the same type of *P. aeruginosa* is identified in repeated outbreaks of hemorrhagic pneumonia as much as five years apart, which demonstrates that *P. aeruginosa* is able to survive on the mink farm for several years. More than one type of *P. aeruginosa* was encountered in some outbreaks of hemorrhagic pneumonia. This emphasize that the disease likely occurs due to bacteria from the local environment on the mink farm and not is caused by a special type of *P. aeruginosa*.

Annual Report 2014. 111-115. Copenhagen Research, Denmark

Simulation modelling of interventions to control Aleutian Disease in mink

A. Boklund, T. Halasa, T. Struve, J. Østergaard, J. Clausen, M. Chriél

Danish mink farmers implemented a control program for Aleutian Disease and in the recent years only few farms were not declared free of the infection. However, there re-infections are recorded imposing restrictions on the sale of live animals and

costs of stamping out, cleaning and disinfection of the premises. The purpose of this study was to evaluate different control strategies and to study whether a change in the control strategy could reduce the number of re-infected farms.

Data were obtained from CHR register and from Copenhagen Fur from the period March 2010 to February 2012. Spread of disease was simulated through movement of live animals, feed trucks and local infection within a radius of 1 km. The current strategy were compared with different strategies, which were: no extra tests in region Nord, stamping out either shortly or very shortly after diagnosis and monthly stamping out in region Nord or in the entire country, respectively. Sensitivity analyzes was carried out.

The results showed that omitting the extra tests in region Nord will increase the number of undetected cases, which might increase the spread of the infection. The results of the simulations showed that reducing the time span between diagnosis and stamping out of the infected farms is important in the control of the disease. Frequent testing combined with immediate stamping out gave the greatest reduction in the number of infected farms.

Annual Report 2014, 117-123. Copenhagen Research, Denmark

Consumption of medicine in the mink production in Denmark 2007-2012

V.F. Jensen, H.M. Sommer, T. Struve, J. Clausen, M. Chriél

The consumption of medicine in the fur animal production has steadily increased without any direct cause. To elucidate possible reasons behind the increasing consumption, data regarding the production was analysed. Data included farm size, number of males / females in the given month, the size of animals, diagnosed outbreak, information on feed kitchen, feed quality and prescribing veterinarian as well as data from Vet-stat. In order to compare the consumption of medicine, the biomass on a given farm was calculated for a given month in a given year. Furthermore, all consumed medicines were made comparable by converting it to kg mink that could be treated with the prescribed amount. Data were analyzed using multiple regression models. The results showed that the proportion of farms using medication in a given year

has increased during the period 2007-2012 with an extraordinary large increase in 2011 - the same year as mandatory health advice for mink in Denmark was introduced. The analyzes also showed that the general level of feed quality - measured by the feed kitchen - affects the amount of antibiotics prescribed to a farm, but the results also suggest that lapses in feed quality can result in use of medicine on the affected farms. The veterinarian performing health advice or visit the farm due to clinical outbreaks is associated with the number of months medicine is prescribed as well as the amount prescribed. Outbreaks of specific diseases like *Pseudomonas aeruginosa*, influenza, astrovirus, and mink enteritis virus increases the consumption of drugs

Annual Report 2014, 125-134. Copenhagen Research, Denmark

Pathological investigations of the testes of male mink (*Neovison vison*) and associations with litter size and willingness to mate

C. Vangsgaard, T. Clausen, H.E. Jensen, J.F.G. Agger, A.S. Hammer

Currently, the knowledge on causal factors of reproduction problems and pathology of the testes in male mink is limited. In the present study 256 male mink were examined histologically at the end of the mating season. The investigated mink included 145 Brown/Glow colored and 111 Black colored mink. Both macroscopically and microscopically, the testicles from mink had a comparable anatomical structure to testes of other mammalian species. The overall testicular structures (such as seminiferous tubuli) had a similar appearance as in other animals. In total, histopathological changes in the testes of breeding mink were observed in 69.7% Brown/Glow colored mink and in 76.6% Black colored mink. The most frequent findings were inflammatory changes and fibrosis, and the pathologic findings were common in both Black colored and Brown/Glow colored mink, but to a higher extent in Black. The presence of atrophy and hypoplasia was more frequent in the Brown/Glow colored mink. By examining the average litter size in the two color types, there was a tendency for Black colored mink to deliver fewer pups than Brown/Glow colored mink. Overall, it seems to be a correlation between dark coat color and multiple histological findings and litter size. When looking at

mating willingness compared to histological findings, it showed that significant more mink had epididymitis in the group with normal mating willingness than in the group without mating willingness.

Annual Report 2014, 135-142. Kopenhagen Research, Denmark

Effects of high and low dietary protein content on the level of antibodies against mink enteritis virus (MEV) and on blood, liver and health in mink

B.M. Damgaard, P.F. Larsen, C.M. Salomonsen, R. Dam-Tuxen, T.N. Clausen

The purpose of the project was to investigate the effects of the dietary protein content on the immunological response of revaccination against mink enteritis virus (MEV). Further, to investigate the effects of the dietary protein content and revaccination against MEV on blood, liver and health in mink. Four groups of each 25 brown male mink were included in the study. Two control groups (KON) were fed a feed with high dietary protein content during the growing-furring period (KON) and for two groups (LP) the dietary protein content were reduced in August to 22% of metabolizable energy from protein (MEP). One control group (KON-VACC) and one group fed low dietary protein content (LP-VACC) were revaccinated against MEV in September. The dietary protein content had no effect on the level of antibodies against MEV after revaccination against MEV. The dietary protein content had limited effects on blood parameters. The body weight was higher and the liver content of triglycerides (TAG) and free fatty acids (NEFA) were lower at high dietary protein than at low dietary protein content. Revaccination against MEV increased the level of antibodies against MEV. Revaccination against MEV had no effects on body weight and blood and liver parameters.

Annual Report 2014, 143-147. Kopenhagen Research, Denmark

Correlation between ambient temperature and mortality due to wounds and other causes of death in mink kits in June 2012 and 2013

N. Bloksgaard, L. Jensen, A.S. Hammer, A. Jespersen, T. Clausen, J.F. Agger

This observational study was conducted on Kopenhagen Farm during the month of June in 2012 and 2013. The purpose was to study associations between temperature around the mink cages and the mortality risk due to wounds and due to other reasons than wounds. Three randomly selected housing sections were fitted with climate data loggers, which logged the temperature (Celsius) every hour. All the dead mink were collected, autopsied and the causes of deaths diagnosed. 24,801 mink kits were included in the study. The mortality risk in June (2012 and 2013 together) due to wounds was 0.33%, and 0.85% due to other reasons than wounds.

A statistical coherence was found between the temperature and the mortality risk in the mink kits where the cause of death was other factors than wounds. Statistics show that the average daily temperature could explain 6.5% of the mortality risk in the mink kits in June 2012 and June 2013, where cause of death was other factors than wounds. There was no association between temperature and mortality due to wounds.

Based on this investigation it is hypothesized that within the temperature interval 13-15°C, the mortality risk is less than at higher or lower temperatures. This should be investigated further.

Annual Report 2014, 149-154. Kopenhagen Research, Denmark

Individual variation in wound healing in farmed mink

A. Jespersen, A.S. Hammer, K. Dich-Jørgensen, I. Østergaard, H.E. Jensen, J.F. Agger

Currently, there exist no scientifically sound guidelines for assessment of wounds in mink.

Furthermore, there is a lack of knowledge concerning which criteria can be used to support decision making regarding practical management of wounds. A wound model was developed for the purpose of studying the inter-individual variation in wound healing in farmed mink. The focus was on the factors sex, color type and location of wounds. Macroscopic and microscopic pathology was evaluated together with degree of wound contraction and infection in males and females, mink of the color types Brown, Silverblue and Blue Iris as well as wounds located differently (on the back and on the side of the neck). There were trends for minor differences in pathology and degree of contraction for all the factors studied. Results for degree of wound contraction was specified as the average relative reduction of wound size during the two-day course of the study, which was greatest in males, in brown mink and in wounds located on the back. The greatest tendency for wound infection was found in females, in the color type Blue Iris and in wounds located on the neck.

Annual Report 2014, 155-161. Copenhagen Research, Denmark

Dividing big litters Day 42 reduce biting in mink

T.N. Clausen, P.F. Larsen

To optimise weaning of mink kits and thereby increase welfare an investigation on partial dividing day 42 of the large kits (at least 4) in the large litters (6-9 kits per litter) was conducted.

Dividing large litters day 42 resulted in increased growth rates for male kits and reduced frequency of bitten kits and litters with 37%.

Annual Report 2014, 163-166, Copenhagen Research, Denmark

Basis for higher milk yield 6 weeks after birth if mink dams are fed ad libitum from early lactation

M.N. Pinkalski, S.H. Møller

According to Danish legislation mink kits should not be weaned before they are 8 weeks old. But the welfare of the mother and the kits may be compromised if she has no or very little milk left

before the kits can manage without. We therefore investigated if the feeding strategy after birth could prolong the lactation period. We expected that the amount of mammary gland tissue 1) Is sustained for a longer time in females fed ad libitum than in females fed restrictively during early lactation. 2) Depends on litter size and 3) Is almost gone 8 weeks after birth. We compared the weight of the mammary gland tissue from dams with a litter size from 3 to 8 kits, 4 to 8 weeks after birth, which were fed either ad libitum or restricted from birth to 4 weeks of lactation. Six weeks after birth the females fed ad libitum had significantly more mammary gland tissue than the restricted females. By 7 weeks there was no difference in the amount of tissue which was under liquidation and this was almost completed by 8 weeks. We found no effect of litter size on the amount of mammary tissue in this study. The study showed that the females that are fed restricted in early lactation had less mammary gland tissue available in the critical period around 6 weeks after birth.

Annual Report 2014, 167-173, Copenhagen Research, Denmark

An interview study regarding pest problems on Danish mink farms

M. Knorr, A-M. Rasmussen, K.S. Larsen

During the period January to March 2014, the farmers on 151 Danish mink farms were interviewed about presence of pests and pest problems on their farm, and which control and preventive measures they are using. The aim of the survey was to identify new initiatives and recommendations needed for handling the pest problems. Special interest was given to the squirrel flea (*Ceratophyllus sciurorum*), the lesser housefly (*Fannia canicularis*), the larder beetle (*Dermestes lardarius*), the Norway rat (*Rattus norvegicus*), mice/voles (unspecified species), birds (gulls, starlings, sparrows and others) and the red fox (*Vulpes vulpes*). Other animals of significance, mentioned by the farmers, were primarily feral cats. The investigation showed that especially the three insect species and the birds can be problematic and difficult to handle. New improved control measures ought be identified and implemented. In general, problems with rodents, foxes and cats are limited, and can be solved using means and measures

already known by the farmers. The investigation in total, with all results presented, is given, in detail, in the report "Skadedyr på minkfarme – en interview undersøgelse", 2014 (in Danish). In the present paper, methods and some overall results of the survey are given, and perspectives for better solutions to some of the highlighted issues are discussed.

Annual Report 2014, 175-182. Copenhagen Research, Denmark

Environmental impact on land and groundwater quality after application of mink-manure

V. Ernsten, O.S. Jacobsen

Since June 2011, the content of various phosphorus and nitrogen compounds have been investigated in two fields at Copenhagen Fur's experimental Farm southeast of Holstebro. Mink-manure has been applied in 4 and 16 years, respectively. From 4 wells were sediment samples collected down to 15 meters and samples of groundwater were collected

from the wells equipped with two or three 1-m long screens. The two fields are located in an area of 8-15 m thick clay layer on top of unsaturated sand. Below an upper 3-5 meter oxidized and brownish colored zone follows at the redox interface a grayish, reduced zone. Nitrate is present in the oxidized zone whereas the reduced zone is free of nitrate due to reduction processes. The inherent content of phosphorus has been depleted in surface-near approximately 2-3 meters. Due to application of mink-manure the total content of phosphorus and the amount of dissolved phosphate has increased significantly in the upper 40 cm after 16 years application, but only total phosphorous has slightly increased in the field with 4 years of mink-manure application. In the long-term mink-manured field, phosphorus adsorption capacity was exhausted (1.5 times) in the upper 20 cm and markedly reduced in the layer of 20-40 cm. In the field with short-term mink-manure, the use of adsorption capacity was less pronounced.

Annual Report 2014, 183-190. Copenhagen Research, Denmark



Nordic Association of Agricultural Scientists

SEMINAR 485

AUTUMN MEETING IN FUR ANIMAL RESEARCH 2015

Turku, Finland, 29 September -1 October 2015

Proceedings



WELFUR SESSION

The welfare of farmed mink should be easy to assess in a correct way and lead to animal welfare improvements

B.I.F. Henriksen

A three year PhD-study in assessment of mink welfare has contributed with methods and knowledge on how to get the welfare assessments as efficient and correct as possible and how to use the assessments in order to increase the welfare of the animals. The study found, that it might be possible to reduce the number of measurements needed in the welfare assessment system WelFur-Mink in the different production periods without compromising the validity of the assessment. There seems to be an effect of date of the assessment in the nursing period, which can be handled elegantly if the other two periods have the same effect of date of assessment. The study also found that mink farmers are generally positive towards the structural way of working in stable schools and that including a discussion of the WelFur results related to the different farms in a stable school will make the feedback practically relevant and enable the farmers to set the results into a practical context

Do the WelFur-assessment of mink in the growth and the winter period change with date of assessment?

A.F. Marsbøll, B. I.F. Henriksen, B.K. Hansen, S. H. Møller

Even if the welfare assessment periods in WelFur-Mink are limited to three periods of six to eight weeks each, the prevalence of welfare problems in each period may still vary with date of assessment. This has been shown in the nursing period for several animal based measurements, with increasing welfare problems closer to weaning. The aim of this investigation was, therefore, to explore if there is a variation within the winter and growth assessment period that need to be taken into consideration in the WelFur assessment of mink. We hypothesised that the prevalence of mink in too low body condition, stereotypy and fur chewing increase with the date of assessment within the winter period, and the prevalence of injuries, diarrhoea and exploratory

mink increase with the date of the assessment within the growth period. Eight private Danish mink farms were included in this study. Each farm was assessed three times during the winter period and four times during the growth period according to the WelFur-Mink protocol. The preliminary results support the hypotheses, except for the percentage of too thin animals in the winter period, which seemed to decrease with date of assessment. Further analysis will investigate the effect of assessment date on criteria, principle and overall assessment level.

WelFur fox: correlation of animal-based measurements between the three production periods

E. Ojala, T. Koistinen, L. Ahola, J. Mononen

While developing the WelFur welfare assessment protocols for farmed foxes, it was decided that only three out of the 15 animal-based measurements in the protocol are carried out in all three production periods, and a majority (ten) of them only in one period. Most of the animal-based measurements are under the principles Good health and Appropriate behaviour, and it was reasoned that one period could reflect the situation also in other periods. In the testing phase of the protocol on Finnish fox farms all, however, data was collected in two (5 farms) or all three (78 farms) production periods to study the validity of this reasoning. Here we present between-periods correlation results for those 13 animal-based measurements for which this was sensible (*Cleanliness of the fur* and *Mortality* not included). The Spearman correlation (r_s) analyses were based on the percentages of animals on farm in each scoring class of each measurement, and the total number of pair-wise correlations calculated was 63. For the behavioural measurements (*Stereotypic behaviour*, *Fur chewing*, *Feeding test* and *Temperament test*), 15 out of the 18 correlations were significant ($p < 0.05$; r_s : 0.25-0.57, median 0.35). For the health measurements, 19 out of the 45 correlations were significant ($p < 0.05$; r_s : 0.23-0.51, median 0.32), correlation being found rather for health problems with higher ('mild scoring classes' or 'no problems' for *Difficulties in moving* and *Skin lesions and injuries to the body*, *Bent feet*, *Ocular inflammation*, *Diarrhea*) than lower ('severe scoring classes' for *Difficulties in moving* and *Skin lesions and injuries to the body*, *Urinary tract infection* and

Obviously sick fox) prevalence, except *Impaired mouth and teeth health* (with low prevalence but significant correlations). The correlations will help, for their part, in reconsidering whether some measurements should be carried out in all periods instead of one period or two periods only. Low or non-existing correlations particularly for some health measurements with low prevalence support earlier thoughts of a need to study merging these measurements to the *Obviously sick fox* measurement.

The effect of nest box temperature on kit growth rate and survival in the American mink (*Neovison vison*)

T.M. Schou, J. Malmkvist

In this study we investigate the effect of nest box temperature and humidity on the growth and survival of approx. 700 mink litters. Surprisingly this study did not find any general biological explanatory temperature and/or humidity effects within days on the number of live born kits dying and kits growth. Instead parameters concerning litter composition did have significant effects on kit growth and survival. Litters with high number of *Totborn* and kit *AliveDI* affected kit growth and kit viability negatively (increased number of live born kits dying), which indicates that factors acting on the female/litter prior to or during the parturition are an important determinant of early kit growth and viability. The results indicate that females with large litters have less success by taken care of the kits compared to females with small litters. In addition litters with high mean kit growth were also litters with high kit survival until day 7 and female kits grow significantly less than male kits.

The effects of winter fasting on the breeding success of the Finnraccoon (*Nyctereutes procyonoides ussuriensis*)

T. Koistinen, H. Korhonen, L. Ahola, J. Mononen, A-M. Mustonen, J. Asikainen, P. Nieminen

Wintertime passivity and food deprivation are integral parts of the wintering strategy of the wild raccoon dog (*Nyctereutes procyonoides ussuriensis*). Recently, it has been discussed whether the natural wintering habits of the species

could be better realized in Finnraccoons on farms by giving the animals access to a winter nest and by withdrawing food. The aim of the present study was to compare the breeding success between primiparous vixens fed throughout the winter and those fasted for eight weeks in winter. The 41 females and 14 males of the fasting group, and the 38 females and 12 males of the control group were housed singly in 1.2 m² cages furnished with activity objects, a platform and a winter nest box. The animals were weighed and their behaviour was observed every two weeks during the fasting period from 20 December to 14 February. After the end of the fasting period, the animals of both groups were fed according to standard farming practices and mated within the experimental group. The reproductive success was assessed in June, when the cubs had reached the average age of 5 weeks. The body mass of the fasting animals decreased more rapidly (approximately 2%/week) during the fasting period than that of the control animals (approximately 1%/week; $P < 0.05$, *t*-test). The Finnraccoons stayed 85–100% of the observations in the winter nest, and there were no differences between the groups in the nest box use ($P > 0.05$, Mann–Whitney U test), but the fasted females were more active than the control females ($P = 0.01$). No differences between the fasting and control groups were observed in the number of cubs per litter (5.8 ± 3.4 vs. 5.6 ± 2.8 ; mean \pm SD; $P > 0.05$, Mann–Whitney U test), mass of the whole litter (4.3 ± 2.4 vs. 4.9 ± 3.4 kg; $P > 0.05$, ANCOVA), average body mass of a cub (784 ± 232 vs. 940 ± 445 g; $P > 0.05$, ANCOVA) and proportion of males in the litter (47 ± 26 vs. $49 \pm 25\%$; $P > 0.05$, Mann–Whitney U test). In conclusion, winter fasting did not impair the reproduction success of primiparous Finnraccoon vixens.

Structure of nest box and cub mortality in blue foxes

M. Mohaibes, E. Ojala, J. Segervall, J. Korpela

Ninety-six primiparous blue foxes originate from three different stocks, used to investigate the effect of structure of nest box on cub mortality of blue foxes.

Animals were divided into four groups according to the nest box type. The numbers of born cubs were counted from birth until 5th weeks of age.

Temperature and moisture of nest boxes were monitored.

The results of this study showed that there were no significant differences in the number of cubs in different nest boxes. Nevertheless, among the three stocks of blue fox females, the cub mortality of one stock was less than others. The effect of added ventilation was not seen cause of exceptional springtime weather.

Effect of feeding intensity on hormonal variations and reproductive success in blue fox vixens

H.T. Korhonen, J. Sepponen, P. Eskeli, H. Lindeberg, N. Koskinen

Typically energy intake, body condition and reproductive function are highly related to each other. The aim was to evaluate impact of feeding intensity on hormonal balance and reproduction performance in blue fox vixens. Treatments used were: Group 1: heavy slimming. *Ad libitum* feeding during Sept-Nov., aimed to produce extremely fat animals. Heavy slimming before breeding season, aim to have animals with normal breeding body condition. Group 2: maintenance of condition. Restricted feeding 35-45% from the level of Group 1 during Sept-Nov. Natural slimming to normal breeding condition. Group 3: Rising condition. Restricted feeding 50-60% from the level of Group 1 during Sept-Nov. Aim here was to produce lean animals. Rising body condition before breeding season, aimed to have animals with normal breeding body condition. During Sept-Nov blood samples were taken once a month. After the start of slimming, samples were taken on days 1, 2, 3 and 7. Thereafter, samples were taken every second week until insemination. Samples were taken from mated vixens on weeks 3, 5 and 7 during pregnancy. After whelping, samples were taken when the kits were age of 2 and 4 weeks. Results showed that urea concentration varied seasonally ($P<0.001$). Concentrations were lowest during winter period. In Group 1, heavy slimming before mating season lowered urea concentration significantly ($P<0.001$). During autumn period, concentration was lowest in Group 3 because of pronounced feeding restriction. Creatinine levels were highest during summer

period in all groups. Glucose concentration varied seasonally in all groups ($P<0.001$). Intensive feeding clearly affected on triglycerides, glucose and insulin levels ($P<0.01$). Growth hormone (GH) and IGF-1 levels were highest during autumn period. Leptin concentration was highest in December in all groups. Thereafter, it clearly declined towards summer ($P<0.001$). Concentration of non-esterified fatty acids (NEFA) was highest in Group 1. Prolactin levels were same in all groups until insemination. During pregnancy, levels increased similarly in groups. After whelping, prolactin levels were lowest in Group 1. Whelping result was poor in Group 1. It can be concluded that feeding intensity essentially influences on hormonal levels and reproduction success in blue foxes.

NUTRITION SESSION

Identification of the bacterial composition of the gut microbiota in Danish farmed minks

L. Andresen, A.S. Hammer, T. Clausen, M. Lassén, C.F. Matthiesen, A-H. Tauson, M.I. Bahl

Mapping of the mink microbiome will form a scientific basis for an improved understanding of the mink gut biology in health and disease. Using a cross-disciplinary approach including high throughput sequencing and pathological and experimental methods, the Mink Microbiome Map (3M) project was initiated in November 2014 in collaboration between DTU Food and University of Copenhagen. The aim of the project is to apply modern molecular biological methods in the investigation of mink microbiota composition. At present, we have identified the bacterial composition of the gut microbiota in mink from several farms, and characterized variations in individual mink microbiota independent of the feed microbiota.

Our preliminary data show a distinct microbiota composition in the mink gut, very different from the feed composition. Similar to reports of microbiota in other carnivores and humans the gut microbiota of the mink is dominated by anaerobic bacteria within the Firmicutes phylum. Using this new resource we aim to develop better and more reasoned prophylactic probiotic candidates and related food additives for use in mink production.

Concentrated feed silage made from category 2 salmon by-products as feed for blue foxes in the growing-furring period

Ø. Ahlstrøm

A protein concentrate made from self-dead farmed salmon (category 2 by-product, trade name SP K2) with these chemical characteristics: dry matter; 49.4%, protein; 33.3 %, fat, 7.2%, ash; 5.3%. TVN %; 4.3, pH 4.0, formic acid; 4.3 % were given to five groups of blue fox cubs at 0 (control), 0, (positive control), 3.5, 7.0 and 14 % during the growing-furring period (110 d). All groups obtained satisfactory BW at pelting (17.1-18.9 kg in males, 14.7-16.8 kg in females), but the SP K2 groups revealed significantly lower (1.5-2 kg) lower BW than the controls. The reason for this was most likely partly because of lower fat and ME content in the SP K2 diets than the controls, and partly reduced feed intake because of poor palatability due to low pH and high formic acid content. Body lengths were not different, but there was tendency for shorter skin length with the SP K2 diets irrespective of inclusion level. Fur quality parameters were satisfactory for all groups. It was concluded that 3.5 % SP K2 can be used in diets for blue foxes in this period.

Optimal feeding of mink in the lactation period

T.N. Clausen, P.F. Larsen

In recent years it has become more and more common to feed mink dams slightly restrictive just before birth and the first days of the lactation period. In the lactation period 2014 feeding intensity in the period April 20th to birth and during the first 14 days after birth was investigated.

The results showed that higher feeding intensity up to birth did not result in more birth problems or more dead kits at birth when females are fed after body condition in the winter period. For both black and brown mink kit weight, there was a positive effect of higher feeding intensity immediately after birth.

In the lactation period the females and kits do not have the same requirement for feed composition. Females need concentrated feed with a high energy content to produce milk, and kits need higher protein content and a lot of water to grow optimally. In the lactation period 2015 we studied whether different feeding of females and kits from birth / day

28, had beneficial effect on milk production and kit growth.

The results showed that females fed on top of the cage during the whole lactation period did not lose as much weight as females fed only on the nest box together with the kits from day 28 and onwards. Moreover, weight of the dam day 28 and day 49 and the male and female kits day 28 were higher when the dams were fed high energy feed from April 20.

Mink's requirement of vitamin E in the growing and furring period – effect of natural and synthetic forms

D. Clausen, S.K. Jensen, M. Lassén, T.N. Clausen, P.F. Larsen

A well balanced vitamin supplementation is a prerequisite for a good growth and well being of mink. Vitamin E is one of the most expensive vitamins to add to the feed. Commercial vitamin E is available as both natural and synthetic supplement. The vitamin E recommendation for mink varies in the Nordic countries between 50-80 mg per kg feed of synthetic *all-rac- α -tocopheryl acetate* in order to maintain a plasma status of 10-15 $\mu\text{g/ml}$. The vitamin E requirement is linked to the content of poly-unsaturated fatty acids in the feed or if the feed is oxidized. Natural vitamin E is more expensive than the synthetic form, but has higher biological efficacy.

The present paper comprises an experiment with two doses of either natural (20 or 40 mg RRR- α -tocopheryl acetate) or synthetic (40 or 80 mg *all-rac- α -tocopheryl acetate*) vitamin E per kg feed to mink kits from weaning to pelting. In the growing and furring period 2014 (July-pelting) 1080 mink of the genotype Brown were grouped together pairwise (male and female). Treatment was randomly assigned to 4 groups so each treatment consisted of 135 pairs. Mink were weighed monthly and blood samples from 8 mink per treatment for plasma analysis of tocopherols were also taken monthly. At pelting (November 13) plasma, liver, heart, brain, lungs and abdominal fat from 8 mink from each group were sampled, weighed and analysed for tocopherol content. After pelting male pelts were sorted and ranked. Dead animals were registered and autopsied.

There was no difference in fur quality and growth of the animals between the treatments. Number of dead animals and the prevalence of hepatic lipidosis were

not affected by the vitamin E source and dosage. Total α -tocopherol concentration followed the dietary dosage with a great preference for the natural RRR stereoisomer in plasma and tissues. Generally in plasma and tissue, concentration of RRR stereoisomer was highest followed by RRS, RSR, RSS and the four 2S except in the liver, where the 2S concentration was higher than the RRS, RSR and RSS. In November, the average total α -tocopherol concentration in plasma in group 40 mg *all-rac*- α -T and 20 mg RRR- α -T was 13.3 and 11.4 μ g/ml, respectively. This may be a consequence of an increasing content of polyunsaturated fatty acids in the diets and thereby an increased vitamin E requirement. The ratio RRR/*all-rac* in plasma increased over time and ended in 1.7:1 in November.

Mineral need for mink in the growth period

P.F. Larsen, T. Clausen

During the last years some feed kitchens in Denmark have started to use more organic minerals in mink feed because of higher bioavailability than the normally used inorganic forms. In a growth experiment we compared performance of organic minerals and inorganic minerals in different levels ranging from current recommendation to no extra supplementation on skin traits in brown mink. Results showed no significant difference in weight at pelting, skin length, skin quality, colour or purity. Moreover the study demonstrated sufficient of most minerals in Danish mink feed to fulfill minks needs with use of current raw materials.

Yearling mink dams fed restricted in early lactation have less mammary gland tissue six weeks after birth

S.H. Møller, M.N. Pinkalski

According to European regulations mink kits should not be weaned before they are eight weeks of age. But the welfare of the mother and the kits may be compromised if she has no or very little milk left before the kits can manage without. We therefore investigated if the feeding strategy after birth could prolong the lactation period. We expected that the amount of mammary gland tissue 1) Is sustained for a longer time in females fed ad libitum than in

females fed restrictively during early lactation. 2) Is almost gone eight weeks after birth. 3) Depends on litter size. We compared the weight of the mammary gland tissue from dams with a litter size from three to eight kits and four to eight weeks after birth, which were fed either ad libitum or restricted from birth to four weeks of lactation. No difference in mammary gland tissue was found four weeks after birth. Six weeks after birth the females fed ad libitum had significantly more mammary gland tissue than the restricted females. By seven weeks there was no difference in the amount of tissue which was under liquidation and this was almost completed by eight weeks. We found no effect of litter size on the amount of mammary tissue in this study.

Fetal growth in mink

A-H. Tauson

Fetal growth and quantitative retention of nutrients and energy in fetal tissue were studied in a total of 116 mink dams that were euthanized at different time points after mating. Basic reproductive characteristics were recorded and uterine tissues and fetuses were collected. Uteri were weighed and when possible weight and length of fetuses were recorded. On a subset of fetuses the liver was excised and weighed. On a further subset of fetuses chemical analyses were performed (dry matter (DM), ash, N fat, gross energy, Ca, P and Mg) and energy retained in protein and fat was calculated. Until day 25 after mating the weight of the entire uterus remained low, and thereafter uterine weights increased in an exponential way. The weight of individual fetuses could be recorded from 35 days after mating when their weight was below 0.2 g and the entire fetal weight made up 6.8% of the uterine weight. At the last sampling at 50 days after mating individual fetuses weighed 6.4 g and the entire litter weight made up 45% of the uterine weight. Liver weights made up almost 12% of body mass in fetuses collected 40 days after mating, and this proportion decreased to 6.4% 50 days after mating. Fetal DM content increased from 10 to 13% in the period 40 to 50 days after mating and simultaneously crude protein content increased from 7.8 to 9.1% whereas fat content remained stable at just below 0.7%. Calcium content increased from 4 to 11 g/kg DM, P was stable at 16-17 g/kg DM whereas a minor decrease in Mg (1.12-1.05 g/kg DM) was

found. Energy retained in individual fetuses was very low, making up below 20 kJ 50 days after mating.

Protein requirement before and after implantation in mink

C.F. Matthiesen, A.H. Tauson

Protein and amino acid requirements are still not completely known in all parts of the mink production cycle. The objective was to investigate the protein requirement before and after implantation in order to support a high implantation and fetal survival rate. A total of 106 females was used in the present study. Sixty-six of the females were used in the study "before implantation" and the remaining 40 females were used in the study "after implantation". Different levels of protein (10, 15, 20, 25, 30, 35, 40 and 45 % of metabolisable energy – ME- from protein) were fed before and after implantation. Breath tests with the use of stable isotope techniques were used to investigate the protein requirement by the indicator amino acid oxidation method (IAAO). These data were combined with recording of number of implantation sites and fetal survival rates. It can be concluded that protein provision before implantation not affected number of implantation sites but a tendency towards an effect of protein supply on fetal survival rate was found. Our results suggested that 27% of ME from protein fulfill the requirements in the period before implantation. The fetal survival rate in the study "after implantation" was not affected by protein supply but 20% of ME from protein resulted in numerically lower values. No breakpoint appeared in the IAAO among females fed 20-45% of ME from protein which indicates that the protein requirement was fulfilled. The results show that implantation occurs even when protein provision is low, but fetal survival rate can be compromised.

POSTER SESSION

Effect of carotenoid-rich algae meals on production in farmed mink

H.T. Korhonen, P.Eskeli, H. Huuki, P. Niemelä

Mammals typically have a good ability to metabolize ingested carotenoids, and even re-form

species-specific carotenoids. Carotenoids are known to have antioxidative and immunological effects. Hence, they are expected to have positive influence on health and wellbeing in general. Carotenoids have been found to have an effect on fertility of animals. The aim was to find out how carotenoid supplement influences on body weights, feed consumption and reproductive success in standard farm mink (*Neovison vison*). Carotenoids were from microalgae *Haematococcus pluvialis*. A dose of 0.20, 0.25, 0.20, 0.20, and 0.10 g/animal of carotenoid supplement was added daily in feed in February, March, April, May and June, respectively. Study groups were: (1) control group; and (2) carotenoid group. Each group comprised 100 females and 25 males. The results showed that appetite of animals in all groups was good. Significant differences were not found in body weights before breeding. However, weights of control females were significantly ($P<0.05$) lower compared to those of carotenoid fed animals when kits aged 21 days. At the age of 21 and 42 days, body weights of kits were similar in both groups. However, kits from carotenoid group tended to grow better than those from control group. Number of females whelped was lower in control group (81 vs 85 females). Number of barren females was higher in control than in carotenoid group (16 vs 13 females). Significant differences were not found in number of kits per mated and whelped female. Number of kits lost was higher in the control group at age 21 days (24 vs 20 kits), and at age 42 days (40 vs 26 kits). The present study showed that carotenoid supplement could be used in mink diet.

Endogenous fat loss and true fat digestibility in adult mink

Ø. Ahlstrøm, F.R. Marx

To determine endogenous fat loss in mink 4 diets with 6.3, 13.9, 22.0 and 34% fat in dry matter was applied in a digestibility experiment. Soybean oil was the main fat source. Apparent fat digestibility values of the diets were 90.8, 95.9, 96.9 and 97.8%, respectively. From the results, endogenous excretion of fat was determined to be 0.5g/100g DM consumed. This is of similar magnitude as for other species. The relation between fat excretion and dietary fat level using soybean oil could be determined from the equation: Excretion (g) = 0.5 g + 0.0075 x g dietary fat/100g DM consumed.

True digestibility of soybean oil was determined to be 99%. In practice, true fat digestibility values will have negligible impact in feed formulation as they are close to apparent values with the fat levels normally used for mink.

X-ray evaluation of foot bending in foxes fed CA:P diets

H.T. Korhonen, P. Eskeli, H. Huuki, J. Sepponen

One of the most common medical diagnostic procedures is radiography or x-rays. The greatest benefit of x-rays is their ability to penetrate tissues and show internal structures. In the case of legs, the x-rays will be almost fully absorbed by the bones, while the muscles and ligaments will absorb varying amount of x-rays. The resulting image will be one of the white bones including black air surrounding the leg and various shades of grey representing muscles. The aim was to compare radiographic x-ray data to foreleg bending, moving difficulties and body size in juvenile blue foxes. Study groups were: (1) restricted feeding, Ca:P ratio 1.5:1 (R 1); (2) restricted feeding, Ca:P-ratio 2.9:1 (R 2); (3) restricted feeding Ca:P-ratio 2.0:1 control level (R 3); (4) ad libitum feeding, Ca:P ratio 1.5:1 (AL 1); (5) ad libitum feeding, Ca:P-ratio 2.9:1 (AL 2); (6) ad libitum feeding Ca:P-ratio 2.0: 1 control level (AL 3). Moving difficulties and foreleg bending was evaluated. Dimensions of ulna and radius were measured from the x-ray pictures. Conditions of carpal joint and elbow joint were evaluated. The results showed that final body weight was affected by feeding intensity ($P=0.001$). Ad libitum fed animals had more moving difficulties compared to restricted ones ($P=0.001$). The Ca:P ratio tended ($P=0.06$) to have an effect on feet bending. Bending was greatest in low Ca:P ratio (1.5:1) and, correspondingly, least in high Ca:P ratio (2.9:1). Moving difficulties were most common in heaviest animals. The moving difficulties tended ($P=0.07$) to be positively related to feet bending. Maximum width of ulna was lowest in low Ca:P ratio diet (1.5:1). Bending was negatively correlated with maximum width of ulna. It can be concluded that low Ca:P ratio in the diet (1.5:1) increases foreleg bending in juveniles. Moving difficulties are related to foreleg bending and high body weight.

VETERINARY SESSION

Coccidia in Finland

A-M. Moisander-Jylhä

Diarré is serious problem in fur production. It compromises animal welfare, causes economical losses and increases antibiotic usage. Pathogens causing diarré are various and some are very difficult to detect. Coccidia is easy to find with Ovatec®Plus and result is accurate enough to determine if medication is necessary. Coccidia as diarré causing agent is either understood better now or its significance has been underestimated before. Very often coccidia is found in fecal samples amongst other possible pathogens, but clinical point of view it is the one to be treated. Toltrazuril is the drug of choice with 20 mg/kg bodyweight. Usually symptoms disappear within days. Oocyst shedding varies between days, so enough samples should be taken, either three consecutive days from same animals or three to five samples at same day. Observing fecal samples on site together with clinical findings helps to choose between coccidia treatment and possible antibiotic medication. Before it has been said that coccidia is self-limiting no problem causing additional finding, but now it looks like it is the one with vast potential to cause diarré or serves as trailblazer to other infective agents.

Separating the mink dam from the litter at 7 or at 8 weeks after delivery

J. Malmkvist, R. Palme, T. Larsen, S.W. Hansen

The optimal timing of separating the mink dam from the litter is suggested to be a balance between the partly conflicting needs of the mother and the kits. Early removal of the dam or partial removal of the litter may protect the dam against exhaustion. Little is known about the maternal motivation around the time of separation. Therefore, we investigated the effects of separating the dam from the litter, using brown first-parity dams ($N=374$) randomly assigned within each date of delivery to two treatment groups: The dam was taken away from the litter either at day 49 ± 1 (7w, $N=185$) or at day 56 ± 1 (8w, $N=189$) after birth. The aim was to investigate

whether the dams had a different motivation to take care of the litter after 7 and 8 weeks, estimated by non-invasive determination of cortisol (FCM: Faecal Cortisol Metabolites) and dam calls the first week after separation. The two treatment groups had an equal litter size at the time of separation (age 7w: 5.5 ± 0.17 ; 8w: 5.5 ± 0.17 kits; range 1-11; $P=0.76$). Likewise, there was no significant difference in dam body weight (7w: 1420 ± 15.0 g, 8w: 1404 ± 14.7 g; range 930-1680 g, $P=0.43$). However, the litter size negatively influenced both the dam weight and her BCS ($P<0.001$) regardless of the separation age. Dams separated at the litter age of 7 weeks had higher concentrations of cortisol during the first week after removal (day of separation, D0: 18.8%, D1: 34.5%, D7: 36.9% higher FCM) than dams separated at the litter age of 8 weeks ($P=0.014$). Likewise, the dam calls increased on the separation day, peaking on the first day after separation (D1). The proportion of dams with calls decreased with litter age at separation ($P=0.024$). We interpret these results as a higher maternal motivation in dams at 7 weeks than at 8 weeks after delivery. Additionally, the amount of dam calls after separation decreased with the litter size ($P=0.022$). Thus in addition to litter age, the size of the litter is important for the maternal motivation. These factors should, therefore, be taken into account in studies of the optimal separation age in mink.

Project plan for phenomenon “Sitting blue foxes”

H. Nordgren, K. Aaltonen, A-M. Moisander-Jylhä, T. Sironen, O. Vapalahti

Every autumn, near pelting time, some blue fox farms in Finland suffer from a phenomenon called “Sitting foxes”. The cubs that are bred for fur show signs in the rear legs for proprioceptive deficits, incoordination, paresis and even paralysis. There is, so far, no data about the distribution and severity of the phenomenon in The Finnish fur farms. However, during veterinary visits incidence of a few affected individuals up to even 20 % diseased foxes on an individual farm has been detected.

In post mortem examinations variable lesions and changes have been diagnosed; fractured femurs, deformations of acetabulum or patella, signs of nutritional myodegeneration and arthritis, including bacterial arthritis. In several cases however no significant findings, either macroscopic or histologic, have been found.

Some animals seem to benefit from treatments with antibiotics or pain killers or B- vitamin, Selenium and E- vitamin supplements. In many cases the treatments do not help and the only procedure to do is euthanizing the animals.

The phenomenon causes remarkable welfare problem to the animal. It also causes economic losses to the farmers, when animals have to be euthanized before they have fully developed the winter fur. To be able to prevent and treat this disease, investigations of its possible aetiologies and development of proper diagnostic tools for the veterinarians to make a definitive diagnosis are needed.

Application of qPCR assays for diagnosing causes of viral mink diarrhea. Preliminary results

C.M. Hartby, L.K. Kvisgaard, L.E. Larsen, M. Chriél, C.K. Hjulsager

Gastrointestinal (GI) disorders is the main cause for submitting mink (*Neovison vison*) carcasses for post-mortem examination at the National Veterinary Institute in Denmark and has been described as the predominant cause of disease and mortality in the Danish mink production (Rattenborg et al. 1999). Diarrhea in mink can be caused by infectious agents (virus, bacteria and parasites) and food-related/multifactorial conditions. Known enteric viral infections are mink enteritis virus (MEV) and mink astrovirus. Coronaviruses and caliciviruses have also been implicated as potential causes or contributors to diarrhea in mink. Rotavirus is poorly described in mink, but has previously been demonstrated in feces from mink pups with and without clinical signs (Jorgensen et al. 1996). The pathogenicity of these viruses could be related to viral load, virulence and the age of the mink. Therefore, there is a need for a quantitative diagnostic approach. We have developed new or adapted previously published real-time PCR/RT-PCR assays for MEV, astrovirus, rota- and coronavirus diagnostics

The technical test validation was initially carried out on archived diarrhea samples from diagnosed positive animals and on normal and diarrhea samples from a case-control study. In order to further validate the applicability of the assays, a testing scheme for normal and affected farms was set up and initiated in June 2015. This protocol will

allow optimization of test characteristics (sensitivity, specificity and predictive value) and assessment of the validity of using pooled samples in order to reduce test costs.

Amdoviruses in domestic and wild animals – New challenges

A. Knuutila, K. Aaltonen, H. Nordgren, O. Vapalahti, T. Sironen

Aleutian disease (AD) is an immune-complex disease with mild to severe and even lethal outcome for the mink. It causes significant losses to farmers by reducing the quality of the pelts and number of pups being born. AD is caused by Carnivore amdoparvovirus 1 (AMDV, previously Aleutian mink disease virus), a parvovirus belonging to the genus amdovirus. This virus was also the only member of the genus, until in 2011 a novel amdovirus, Carnivore amdoparvovirus 2 (previously Gray Fox virus) was discovered by Li et al. Since then, new variants have been reported from several species of carnivores and mustelids with potential negative impact on their health and population.

An epidemiologic study was conducted to gain data on the distribution, transmission, and diversity of AMDV strains in Finnish free-ranging mustelids (Knuutila et al., 2015). Signs of AMDV-infection were searched from over 300 samples representing eight different mustelid species, originating from 17 regions across Finland. AMDV-positive samples were detected in 54% (31/57) of feral American mink, 27% (7/26) of badgers, and 7% (1/14) of polecats, and in 10 regions.

This study showed that AMDV is prevalent in certain species of Finnish free-ranging mustelids and widely distributed across the country. Furthermore, the free-ranging mustelids carry both strains similar to those found in farmed mink, but also distinct strains that may represent novel amdoparvoviruses. Further research is urgently needed to gain knowledge on pathogenicity caused by these viruses, and to understand the potential risks to farmed animals, and to wildlife.

Development of a method for prediction of pregnancy in mink using non-targeted metabolomics analyses

M.S. Hedemann, C.F. Matthiesen, A-H. Tauson, T.N. Clausen, P.F. Larsen

Urine samples were collected from female mink on March 24, April 8 and 15 2015, on a commercial farm. Furthermore, urine samples from mated female mink enrolled in studies at University of Copenhagen and housed in metabolism cages were used. The samples were analyzed using non-targeted LC-MS based metabolomics. The results showed a clear separation of urine samples collected between end-March and mid-April, the separation being especially evident between April 8 and 15. The metabolites causing this separation were primarily associated with protein metabolism. The number of barren females in the studies was too low to permit identification of biomarkers of “non-pregnancy”. Whether the metabolites causing the discrimination between April 8 and 15 can be used as biomarkers of pregnancy needs to be studied further.

Pelt length is correlated to body length and body weight

J. de Rond

The weight of mink is positively correlated with pelt length (PL) and therefore used as a selection criterion. However, within each PL class there is a rather large individual variation in body weight (BW). We measured both body length (BL) and BW to see whether which one would better predict pelt length (PL). In pelting period 2013 and 2014 at Edelveen Research Farm a total of 2798 mink (1380 male, 1418 female) were weighted, measured for BL and individually marked. After pelting and drying, the PL was measured. Male BL ranged from 45 – 54 cm (av. 48.5 cm) and BW from 2.2 to 4.4 kg (av. 3.2 kg). Female BL ranged from 37 – 44 cm (av. 40.5 cm) and BW 1.2 to 2.1 kg (av. 1,7 kg). BL and BW are each positively correlated with PL (R^2 resp. 0,46

and 0,58), but when they are combined the correlation is much stronger (R^2 0,64). Male mink PL increases at the same BW 0,9 cm per extra 1 cm BL. Within the same BL, male mink PL increases with 0,6 cm per extra 0,1 kg BW. Female mink PL increases with 0,8 cm per 1 cm BL and 0,9 cm per 0,1 kg BW. PL after processing can be estimated using both BW and BL during life.

Based on these results we propose that BL should be added as selection criterion in mink. Only a long mink can reach a high BW. Additionally, we propose that feed efficiency per cm pelt is more useful than the commonly used feed efficiency for BW. Future research at Edelveen will focus on the genetic basis of variation in BL and on improving methods to measure the BL of living minks.

BREEDING AND MANAGEMENT SESSION

Breeding for confident mink improves pelt quality and increases litter size

J.P. Thirstrup, J. Malmkvist, M.S. Lund

According to the Danish Legislation, breeding programs must include selection for confident mink. The objective is to increase animal welfare by selection for domesticated and well adapted mink with less fearfulness.

The objective of this study was 1) to evaluate the potential for selection against fearfulness and 2) to assess the potential consequence of this selection on other traits in the breeding goal. This was achieved by estimating the genetic components of the 'stick test', which is the most validated 'voluntary approach-avoidance test' to assess fearful and exploratory behaviour in mink at farms. In this study we estimated genetic variance components (additive genetic variance and environmental variance), and heritability (as proportion of total variance that can be explained by additive genetic variance). Secondly we estimated the genetic correlations between the voluntary approach-avoidance test and other economically important production traits such as fur quality, skin length and litter size.

For this analysis mink from two years (2013-2014), bred at Foulum research farm, Aarhus University, were evaluated for production traits. Pelt quality and body weight was evaluated during life grading in November. Skin quality and skin lengths were evaluated in skin evaluations after pelting.

Furthermore, number of offspring in a litter was recorded. Mink from 2014 were tested for behaviour using the voluntary approach-avoidance test. All traits were analyzed for males and females separately because results showed differences in variance components between the sexes. Heritability estimates for behaviour was 0.46 for males and 0.44 for females and was positively genetically correlated to pelt quality. Behaviour was not genetically correlated to fertility traits, but environmental factors increase confident female's ability to care for their offspring and increase their survival. These results suggest that selection for less fearful and more confident mink is feasible and will concurrently have a positive effect on pelt quality and the potential to increased litter size.

Risk rated economic values for blue fox breeding scheme

J. Peura, R. Kempe, I. Strandén, L. Rydhmer

Profit and production of an average Finnish blue fox farm was simulated using deterministic bio-economic farm model corrected by Arrow-Pratt absolute risk aversion coefficient and profit variance. Risk rated economic values were calculated for pregnancy rate, litter loss, litter size, pelt size, pelt quality, pelt colour clarity, feed efficiency and eye infection. With high absolute risk aversion economic values were lower than with low absolute risk aversion. Economic values were highest for litter loss (18.16 and 26.42 EUR), litter size (13.27 and 19.40 EUR), pregnancy (11.99 and 18.39 EUR) and eye infection (12.39 and 13.81 EUR). Economic value of feed efficiency was lower than expected (6.06 and 8.03 EUR). However, it was almost the same magnitude as in pelt quality (7.30 and 7.30 EUR) but higher than the economic value of pelt size (3.37 and 5.26 EUR).

Genetics of feed efficiency in brown mink of commercial farm

M. Shirali, B.K. Hansen, J. Jensen

The aim of this study was to investigate the genetic background of feed efficiency during the growth period, using residual feed intake (RFI), in brown mink kept under commercial farm conditions and only weighed once. Data was available from a farm

that recorded total daily feed allowance on each cage with one male and one female in 13 weeks from August till October (15 to 27 weeks of age) using electronic feeder. Data included feed allowance of 7356 cages collected in 2010 to 2013 and body weight (BW) in October of each individual. Weekly average daily feed allowance (FI) on farm was calculated for each cage in this study. RFI was obtained by phenotypically adjusting FI of each cage for BW records of males and females, considering separate genetic variance in feed efficiency for males and females. The analysis was performed by using random regression with Legendre polynomials of age with fixed and genetic effects modelled as intercept and linear. Furthermore, cumulative RFI in 15 to 20 (TRFI1) and 21 to 27 (TRFI2) weeks of age were estimated using covariance function. The results illustrates that RFI has varying genetic background during growth with higher heritability estimates of 0.12 and 0.18 in the beginning compared to 0.03 and 0.07 at the end of the test period for males and females, respectively. Furthermore, heritability estimates of TRFI1 was 0.10 for males and 0.17 for females which were substantially larger than heritability estimates of TRFI2 for males (0.03) and females (0.07), respectively. TRFI1 showed large positive genetic correlations (0.99 to 0.54) with RFI at 15 to 22 weeks of age, then from 23 weeks of age the correlations were negative (-0.13 to -0.55) for males; for females, TRFI1 had large positive correlations with 15 to 22 weeks of age (0.99 to 0.58) and thereafter reduced from 0.40 to -0.05. The results suggest that selection for feed efficiency is more effective by selecting for cumulative RFI at different stages of growth in mink. In addition, selection for TRFI1 is expected to results in larger genetic gain in feed efficiency. Furthermore, feed efficiency in mink has longitudinal genetic background; therefore, random regression method can be of advantages for dissecting the genetic background of feed efficiency.

A simulation study of a future infrastructure supporting genomic selection in mink

K. Meier, M.S. Lund, A.C. Sørensen

The aim of this study was to use stochastic simulations to evaluate different infrastructures at the industry level that are useful for disseminating genetic gain from genomic selection in mink breeding.

Previous simulations of genomic selection at the farm level suggest that total economic gain can be substantially improved compared to traditional breeding methods and that the gain is dependent on accuracy and genotyping effort. However, a major challenge is how to transmit this benefit to the industry level, which was the focus in the current study. With the means of stochastic simulations we evaluated different infrastructures based on different levels of collaboration between farmers; 1) within the breeding nucleus and 2) between farmers from the breeding nucleus, multiplier units and production units. Collaboration within the nucleus was used to determine whether one large farm within the nucleus was more effective compared to several smaller farms collaborating within the nucleus. Similarly, different dissemination rates of genetic improvement from the breeding nucleus to the multiplier units and production units within the pyramid were used to reflect different degrees of collaboration between farmers from these different units.

Our results suggest that the genetic improvement from genomic selection can be transferred to the production level. The dissemination of this benefit is effective at high accuracy, and for a narrow pyramid structure with a large degree of collaboration between units and little internal recruitment within multiplier and production units. Similar our simulations suggest that one large breeding nucleus with no collaboration increases total economic gain compared to several farms collaborating within the nucleus.

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Farid, A.H. & Ferns, L.E. (2011). Aleutian mink disease virus infection may cause hairdepigmentation. *Scientifur*, 35(4), 55-59.

Nielsen, V. H., Møller, S. H., Hansen, B.K. & Berg, P. (2011). Response to selection and genotype-environment interaction in mink (*Neovison vison*) selected on *ad libitum* and restricted feeding. *Canadian Journal of Animal Science* 91, 231-237.

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