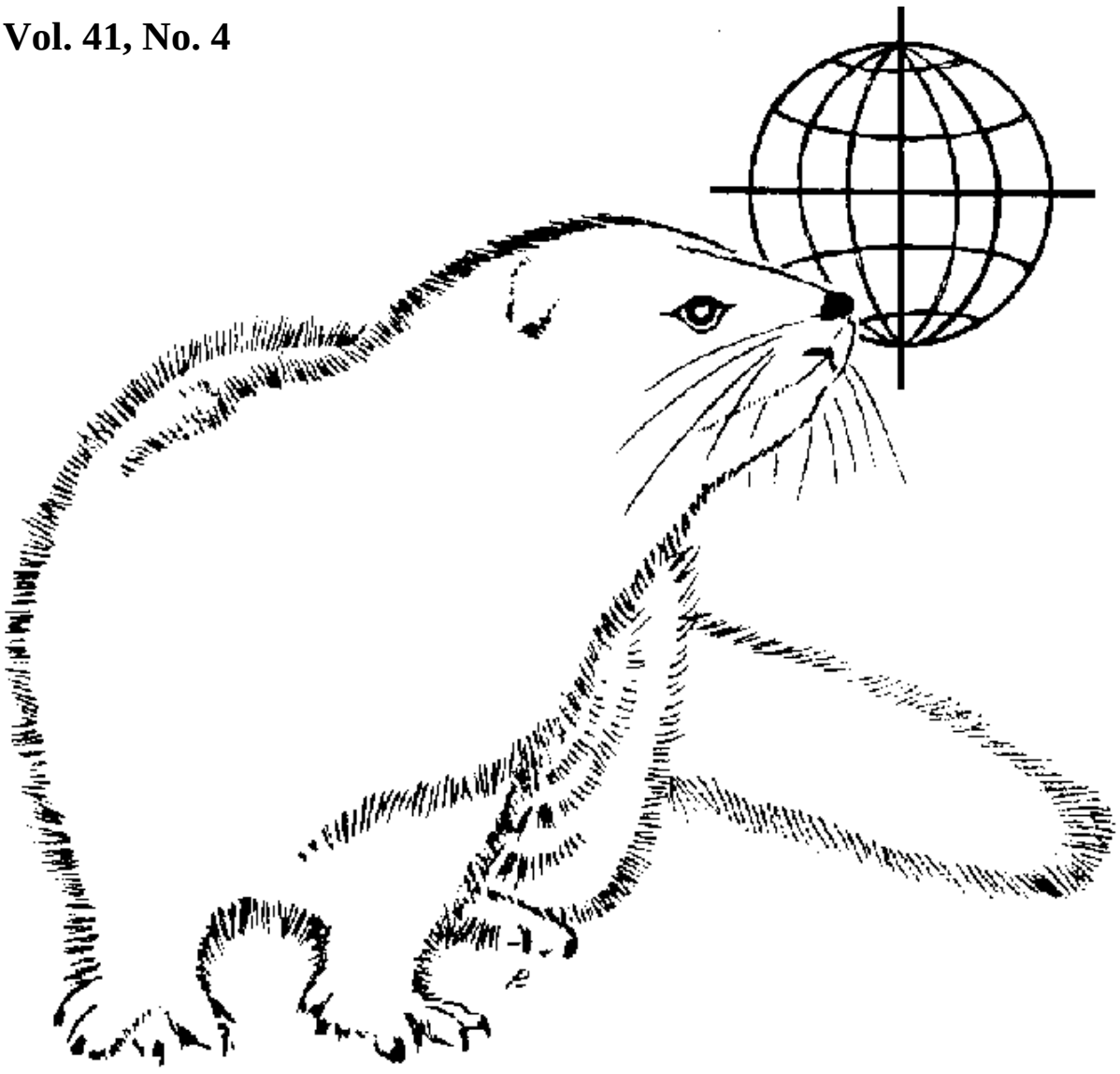
SCIENTIFUR

SCIENTIFIC INFORMATION IN FUR ANIMAL PRODUCTION

Vol. 41, No. 4



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SCIENTIFUR is published as four issues per year (one volume).

SCIENTIFIC ARTICLES. Papers forwarded can be published in Scientifur. The scientific content of the article is the sole responsibility of the author(s)

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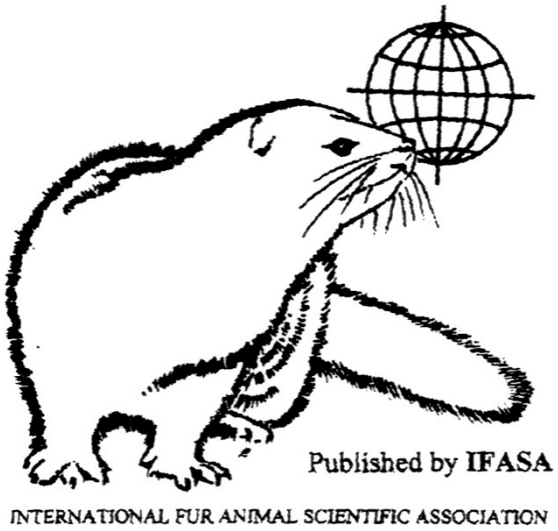
INDEXING: Titles that have been published in SCIENTIFUR are covered in an electronic SCIENTIFUR INDEX.

ISSN: 2445-6292

SCIENTIFUR
ISSN 0105-2403
Vol. 41, No. 4



Notes from the Editor

Antimicrobial resistance (AMR) in livestock production is of increasing concern worldwide. Results from a study in mink presented in Scientifur 41.4 show that antimicrobial resistance is common also in most pathogenic bacteria from mink. This needs attention with development of new veterinary guidelines and prudent management at the farm to reduce the use of antibiotics in fur animal production.

More studies examine the status of on-farm biosecurity and point at areas where practices in mink production could be improved. A study shows that the proportion of 1-year old females, total number of females on the farm, energy supply per female in the late gestation period, and dogs on the farm are risk factors causing the need for additional use of antibiotics. Results from another study suggest an association between low crude protein content in the feed and the use of antibiotics. Furthermore, early-life use of antibiotics such as amoxicillin may affect future health of the mink due to dysbiosis of the microbiota.

The potential of using alternatives to antibiotics was examined in a study where growth and gut microorganism density were examined in mink fed a standard diet and a diet supplemented with Chinese herb additives. Growth was larger and microorganisms more abundant in mink fed a diet with added herbs. The herbs thus influenced the gut microbiota composition.

The results point to the fact that proper feeding and management may contribute to reduced use of antibiotics in mink production and that the use of some alternative additives may contribute to better health in mink.

The 7th International Conference on the Assessment of Animal Welfare at Farm and Group Level took place 5-8 September 2017 in Ede, The Netherlands. Work related to the implementation of Welfur-Mink in Europe was presented at the conference – three presentations about mink and two presentations about foxes. References to the presentations are given in Scientifur 41.4.

The Nordic Association of Agricultural Scientists (NJF) meeting will be held in Oslo in Norway from October 18 to 20 2017. Further information can be obtained at: ssa@kopenhagenfur.com

Vivi Hunnicke Nielsen

Editor Scientifur

BREEDING, GENETICS AND REPRODUCTION

Inhibition of polyamine synthesis causes entry of the mouse blastocyst into embryonic diapause

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Biol Reprod. 2017 Jul 1; 97(1): 119-132.
Doi: 10.1093/biolre/iox060.

The urinary metabolome in female mink (*Mustela neovison*) shows distinct changes in protein and lipid metabolism during the transition from diapause to implantation

Hedemann M.S.[1]

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Metabolomics (2017) 13: 64.
Doi:10.1007/s11306-017-1200-4.

NUTRITION, FEEDING AND MANAGEMENT

On-farm biosecurity practices and causes of preweaning mortality in Canadian commercial mink kits

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Background
Mink are an important animal commodity group in Canada and excessive kit mortality represents a significant loss to production. National biosecurity standards have been developed for Canadian mink farms, but it is unclear how well these standards have been implemented as there are no studies correlating management practices of mink producers with causes of death in mink kits. To that end, we surveyed Ontario mink producers on their biosecurity and management practices and conducted almost 5660 post mortem examinations on found-dead, preweaned kits to characterize mink farm biosecurity practices and causes of death in preweaned kits.

Results
We found that very few biosecurity and management practices were uniformly used by producers, despite good awareness of appropriate practices. Use of personal protective equipment was implemented by fewer than 50% of respondents, while control of mink shed access, disinfection of feed containers after use, and use of a rodent control program were the only practices implemented by greater than 70% of respondents. Only 18% of producers reported regular use of antimicrobials in feed or water, although 91% stated they used antimicrobials for treatment of bacterial diseases on a regular basis. On post mortem examination, no gross abnormalities were noted in 71% of the kits, 45% were thought to be stillborn or aborted, 27% had some form of abnormal fluid distribution in the body, and 2% had a congenital malformation. A subset of 69 gastrointestinal tract samples was submitted for bacterial culture, of which 45 samples yielded sufficient growth. Most interesting was the identification of Salmonella enterica serovar Heidelberg in 11% of samples.

Conclusions
The results of this study will provide a benchmark for Canadian mink producers and their veterinarians, defining the areas to which greater attention should be given to ensure more rigorous biosecurity practices are in place. Ultimately, these improvements in practices may contribute to increased mink production and animal well-being.

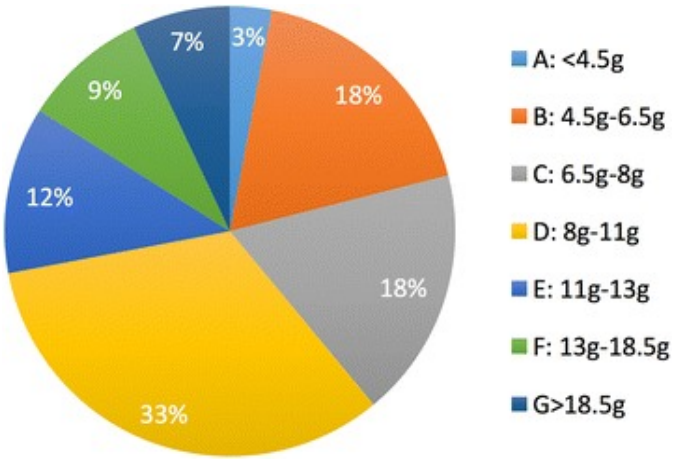

Fig. 1. Weight distribution of preweaned, found dead mink kits at the time of post mortem examination from 21 fur farms in Ontario (n = 5659)

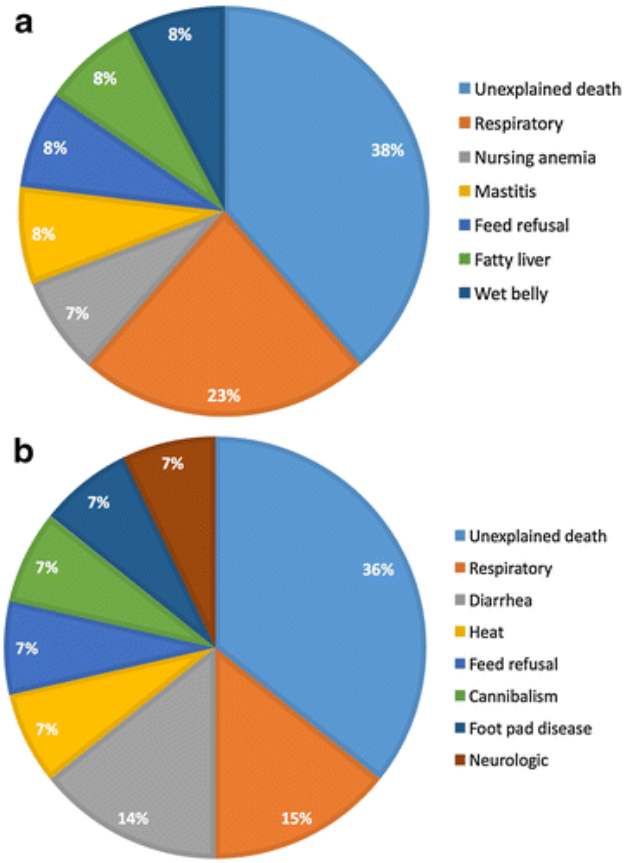

Fig. 2. Producer-reported common health problems as answered on biosecurity survey (n = 11). Percentages represent the number of producers identifying the condition as a problem of the total number of responses provided by producers

Acta Vet Scand. 2017 Sep 8; 59(1):57.
Doi: 10.1186/s13028-017-0326-8.

Risk factors associated with diarrhea in Danish commercial mink *(Neovison vison)* during the pre-weaning period

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Background
Pre-weaning diarrhea in mink, also known as "sticky kits", is a syndrome and outbreaks occur every year on commercial mink farms in all mink producing countries. Morbidity and mortality can be considerable on a farm with huge economic consequences for the farmer as well as compromised welfare for the mink kits. Although efforts have been taken to identify etiologic agents involved in outbreaks, the syndrome is still regarded as multifactorial and recurring problems on the same farms draw attention to management and environmental risk factors. In the pre-weaning period from May to June 2015, a case control study was carried out on 30 Danish mink farms. Data concerning management, biosecurity, hygiene, feed consumption, antibacterial prescription and production efficiency were analyzed.

Results
The proportion of 1-year old females, farm size (total number of females), energy supply per female in the late gestation period, and dogs accessing the farm area were significantly associated with being a case farm. Case farms were prescribed almost twice the amount of antibacterials per gestational unit (female and litter) as in control farms. Farmers on case farms spent significantly more time nursing and treating the animals and experienced more females with mastitis

compared to farmers on control farms. No significant differences in cleaning practices or hygienic measures between case and control farms were found and there were no differences in drinking water quality, bedding material, composition neither of color types nor in management regarding litter equalization.

Conclusions

Results from this study showed an association between the occurrence of pre-weaning diarrhea on mink farms and parity profile, farm size and feeding intensity in the gestational period. The access of dogs to the farm area was a significant risk factor, but needs further clarification.

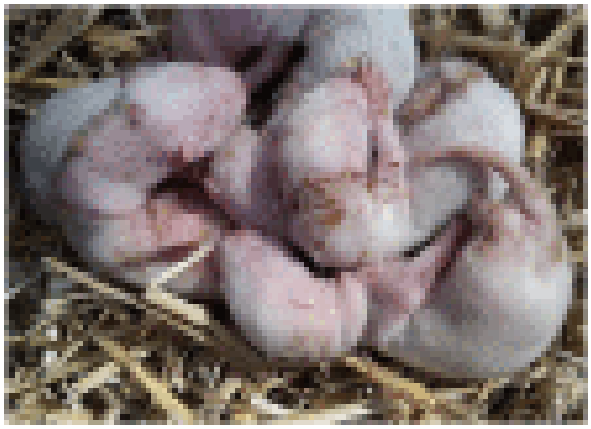

Fig. 1. A mink kit litter affected by pre-weaning diarrhea and a greasy/sticky appearance

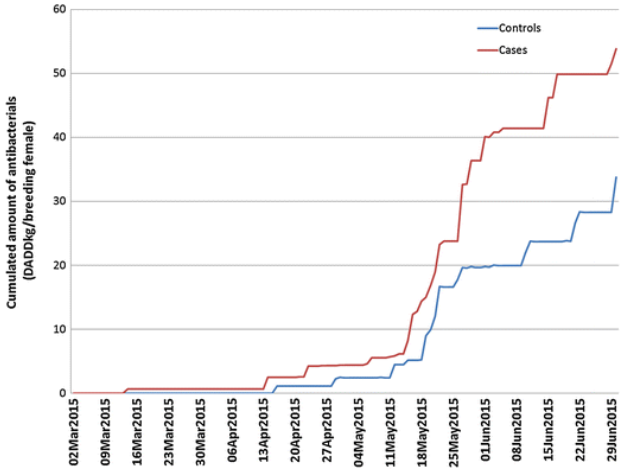

Fig. 2. Cumulated amount of prescribed antibacterials for case and control farms

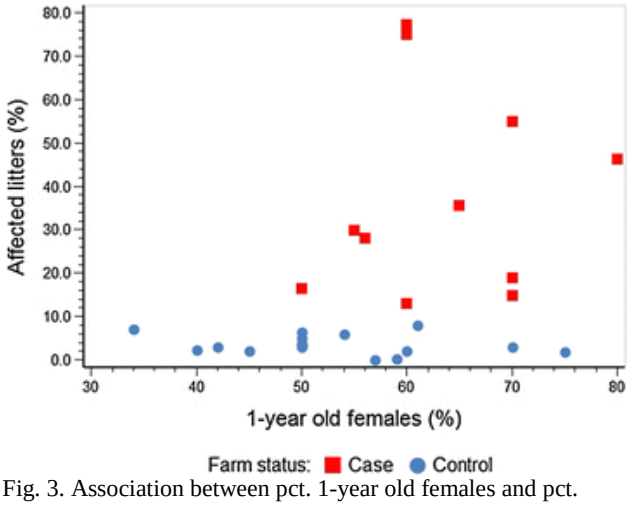

Fig. 3. Association between pct. 1-year old females and pct. affected litters with case control status

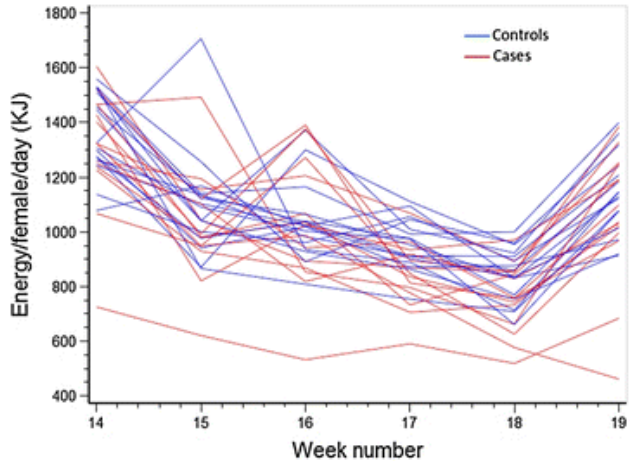

Fig. 4. Energy supply per female in April and May 2015 for case and control farms

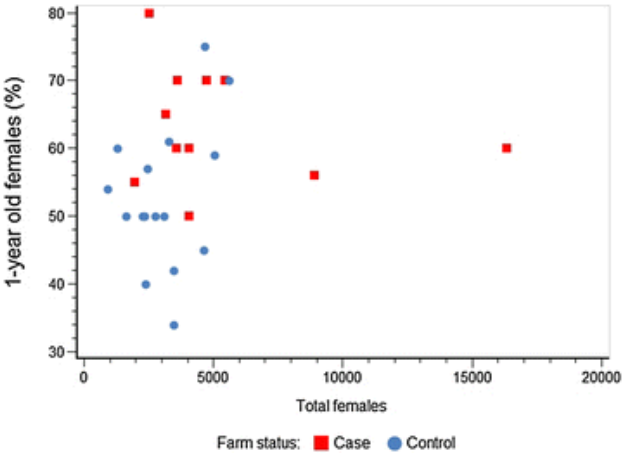

Fig. 5. Association between farm size and pct. 1-year old females with case control status

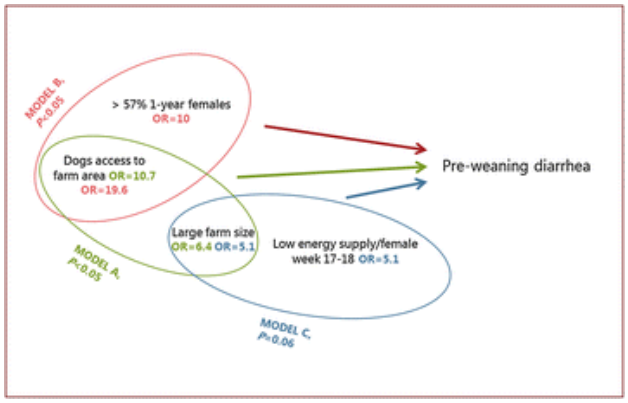

Fig. 6. Multivariable models for risk factors associated with case control status of pre-weaning diarrhea

Acta Vet Scand. 2017 Jun 29; 59(1):43.
Doi: 10.1186/s13028-017-0312-1.

A cross-sectional field study on potential associations between feed quality measures and usage of antimicrobials in commercial mink *(Neovison vison)*

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Prev Vet Med. 2017 Aug 1; 143:54-60.
Doi: 10.1016/j.prevetmed.2017.04.012.
Epub 2017 Apr 28.

Mink *(Mustela vison)* Gut Microbial Communities from Northeast China and Its Internal Relationship with Gender and Food Additives

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It is well documented that the microbial interactions and biodiversity play an important role in health and disease in mammalian species. There is a rare study about gut microbiota of Mustelidae family. In this study, 40 male and female minks from Northeast China were divided into three groups and fed until they reached maturity. The V3 region of 16S rRNA genes was amplified and sequenced using NGS. There were 526 OTUs principally concentrated among five bacterial phyla. Two points about mink's body weight gaining were observed: (1) the weight of male individuals increased more rapidly than female individuals; (2) the weight of individuals whose feed was supplemented with Chinese herb additives increased more rapidly than individuals without giving food additives. The differences of microorganism abundance were shown in two points: (1) two genera which had ≥2-fold change difference were found between male and female minks. (2) Ten genera which had a ≥2-fold change difference were found among minks with and without Chinese herb additive. Findings from this study provide new and fundamental knowledge on the gut microbiota composition of minks farmed in Northeast China, which can contribute to the general well-being of minks worldwide.

Curr Microbiol. 2017 Jul 14.
Doi: 10.1007/s00284-017-1301-3.
[Epub ahead of print]

Short-term effect of oral amoxicillin treatment on the gut microbial community composition in farm mink *(Neovison vison)*

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FEMS Microbiol Ecol. 2017 Jul 1; 93(7).
Doi: 10.1093/femsec/fix092.

Effects of Different Sources and Levels of Zinc on Growth Performance, Nutrient Digestibility, and Fur Quality of Growing-Furring Male Mink *(Mustela vison)*

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[6]National Engineering Research Center of Biological Feed, Beijing, China.

The objective of this study was to investigate the effects of different sources and levels of zinc (Zn) on growth performance, nutrient digestibility, serum biochemical parameters, and fur quality in growing-furring male mink. Animals in the control group were fed a basal diet with no Zn supplementation. Mink in the other nine treatments were fed the basal diet supplemented with Zn from either grade Zn sulfate ($ZnSO_4 \cdot 7H_2O$), Zn glycinate (ZnGly), or Zn pectin oligosaccharides (ZnPOS) at concentrations of either 100, 300, or 900 mg Zn/kg dry matter. One hundred and fifty healthy 15-week-old male mink were randomly allocated to ten dietary treatments (n = 15/group) for a 60-day trial from mid-September to pelting in December. Mink in the Zn-POS groups had higher average daily gain than those in the control group ($P < 0.05$). Zn source slightly improved the feed/gain ($P = 0.097$). N retention was increased by Zn addition ($P < 0.05$). Mink supplemented with dietary Zn had higher ($P < 0.05$) pancreas Zn level than the control group. Fur length was greater ($P < 0.05$) in ZnGly and ZnPOS groups compared with the control. In addition, fur length and fur density increased (linear, $P < 0.05$) with Zn supplementation in the diet. In conclusion, our data show that dietary Zn addition improves growth performance by increasing nitrogen retention and fat digestibility in growing-furring mink and Z-POS is equally bioavailable to mink compared to ZnGly.

Biol Trace Elem Res. 2017 Jul 8.
Doi: 10.1007/s12011-017-1081-4.
[Epub ahead of print]

BEHAVIOUR AND WELFARE

Date of assessment affects the WelFur-assessment of mink in the winter- and growth period

Marsbøll A.F.[1], Henriksen B. I. F.[1], Hansen B. K.[2], Møller S. H.[1]

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Proceedings of the 7th International Conference on the Assessment of Animal Welfare at the Farm and Group Lev 2017, Session 05, Poster 47, 147 Doi.org/10.3920/978-90-8686-862-9

Ad libitum feeding of lactating mink or access to additional water for kits did not improve welfare

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[1]Aarhus University, Department of Animal Science, Denmark.

Proceedings of the 7th International Conference on the Assessment of Animal Welfare at the Farm and Group Lev 2017, Session 05, Poster 73, 173 Doi.org/10.3920/978-90-8686-862-9

Full-scale implementation of WelFur-Mink in Europe – only certified pelts will be sold from 2020

Møller S. H.[1], Henriksen B. I. F.[1], Marsbøll A. F.[1]

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Proceedings of the 7th International Conference on the Assessment of Animal Welfare at the Farm and Group Lev 2017, Session 08, Theatre 4, 261 Doi.org/10.3920/978-90-8686-862-9

Margin of error of the WelFur fox good health score in the current semi-random sampling method

Koistinen T.[1], Sepponen J.[1], Korhonen H. T.[1], Ojala E.[2], Mononen J.[1]

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Proceedings of the 7th International Conference on the Assessment of Animal Welfare at the Farm and Group Lev 2017, Session 05, Poster 82, 182 Doi.org/10.3920/978-90-8686-862-9

Correlation between criterion scores of WelFur fox assessment and Qualitative Behaviour Assessment

Mononen J.[1], Ojala E.[2], Koistinen T.[1]

[1]Natural Resources Institute Finland, Green Technology, Finland.

[2]Kannus Research Farm Luova Ltd. Finland.

Proceedings of the 7th International Conference on the Assessment of Animal Welfare at the Farm and Group Lev 2017, Session 05, Poster 85, 185 Doi.org/10.3920/978-90-8686-862-9

HEALTH AND DISEASE

Antimicrobial resistance among pathogenic bacteria from mink *(Neovison vison)* in Denmark

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Background
For proper treatment of bacterial infections in mink, knowledge of the causative agents and their antimicrobial susceptibility patterns is crucial. The used antimicrobials are in general not registered for mink, i.e. most usage is "off-label". In this study, we report the patterns of antimicrobial resistance among pathogenic bacteria isolated from Danish mink during the period 2014-2016. The aim of this investigation was to provide data on antimicrobial resistance and consumption, to serve as background knowledge for new veterinary guidelines for prudent and optimal antimicrobial usage in mink.

Results
A total number of 308 Escherichia coli isolates, 41 Pseudomonas aeruginosa, 36 Streptococcus canis, 30 Streptococcus dysgalactiae, 55 Staphylococcus delphini, 9 Staphylococcus aureus, and 20 Staphylococcus schleiferi were included in this study. Among E. coli, resistance was observed more frequently among the hemolytic isolates than among the non-hemolytic ones. The highest frequency of resistance was found to ampicillin, 82.3% and 48.0% of the hemolytic of the non-hemolytic isolates, respectively. The majority of the P. aeruginosa isolates were only sensitive to ciprofloxacin and gentamicin. Among the Staphylococcus spp., the highest occurrence of resistance was found for tetracycline. Regarding the nine S. aureus, one isolate

was resistant to cefoxitin indicating it was a methicillin-resistant Staphylococcus aureus. Both β-hemolytic Streptococcus species showed high levels of resistance to tetracycline and erythromycin. The antimicrobial consumption increased significantly during 2007-2012, and fluctuated at a high level during 2012-2016, except for a temporary drop in 2013-2014. The majority of the prescribed antimicrobials were aminopenicillins followed by tetracyclines and macrolides.

Conclusions

The study showed that antimicrobial resistance was common in most pathogenic bacteria from mink, in particular hemolytic E. coli. There is a need of guidelines for prudent use of antimicrobials for mink.

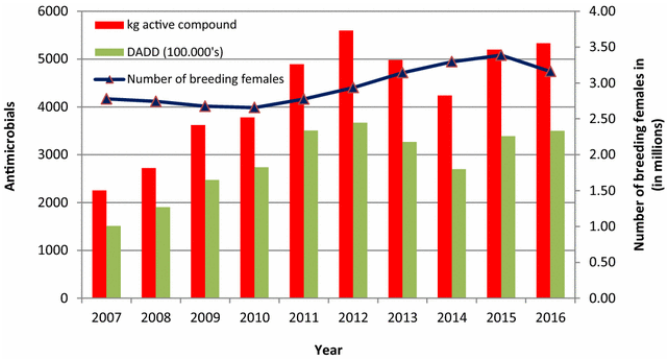

Fig. 1. Antimicrobial prescriptions in Danish mink production (2007–2016). The prescription of antimicrobials given in kg active compound and DADD per year, and the curve indicating number of breeding females (in millions). DADD: defined animal daily dose is the assumed average maintenance dose needed to treat one kg animal

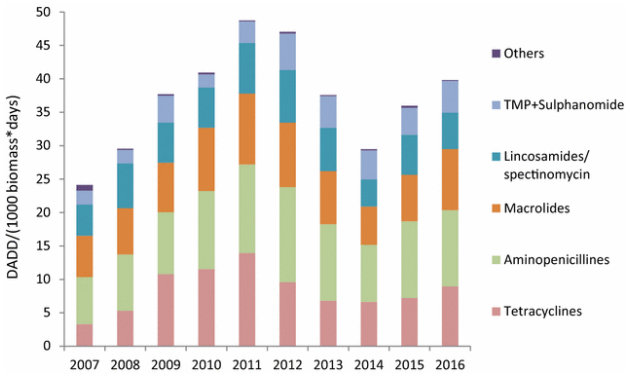

Fig. 2. Antimicrobial prescriptions in the Danish mink production (2007–2016) by antimicrobial class. *DADD* defined animal daily dose is the assumed average maintenance dose needed to treat one kg animal. Others: Pleuromutilins, amphenicols, aminoglycosides, cephalosporins, colistin, fluoroquinolones, penicillin. TMP + sulphonamide: trimethoprim with sulphonamide

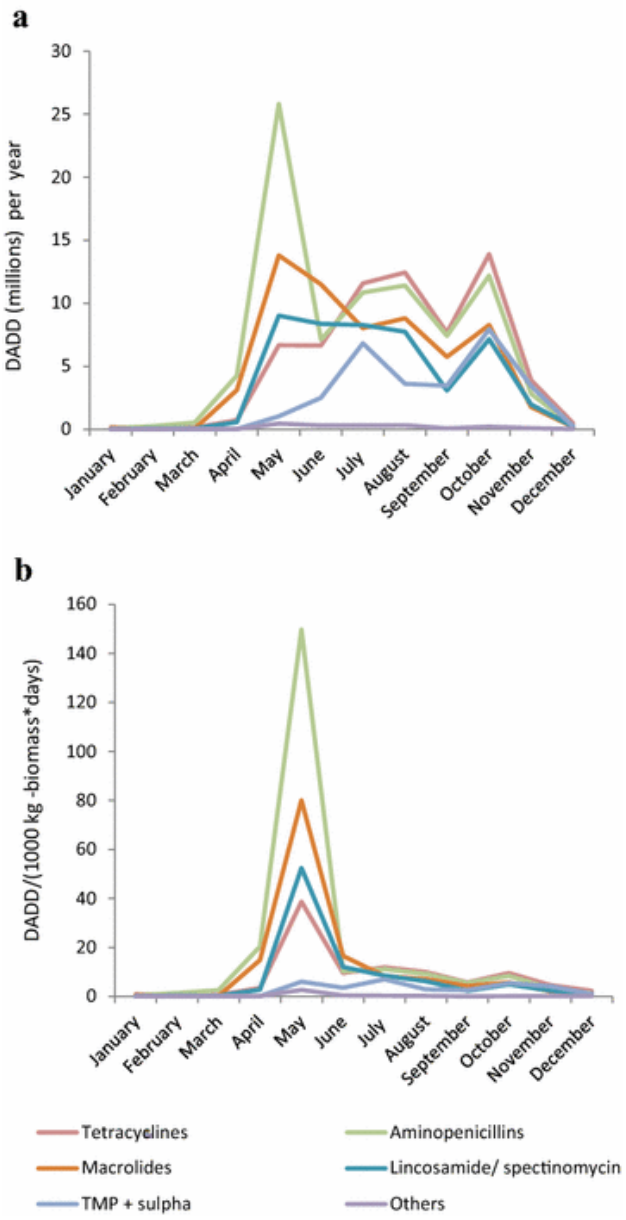

Fig. 3. Seasonal patterns in antimicrobial prescriptions by antimicrobial class in the Danish mink production (2007–2016). **a** The graph is a monthly average from the time period 2007–2016, and illustrates the seasonal pattern in antimicrobial consumption. *DADD* defined animal daily dose is the assumed average maintenance dose needed to treat one kg animal. **b** The graph is a monthly average from the time period 2007–2016, and illustrates the seasonal pattern in antimicrobial consumption relative to the size of Danish mink production (monthly average, 2007–2016).
DADD/(1000 kg – biomass * day) = number of DADD's used within a given period per tonnes live biomass multiplied by number of days at risk within the time period (month), the unit describes the prescribed antimicrobials relative to the biomass on the farm, i.e. the decrease during autumn as the kits grow and the biomass increases. Others: Pleuromutilins, amphenicols, aminoglycosides, cephalosporins, colistin, fluoroquinolones, penicillin. TMP + sulpha: trimethoprim with sulphonamide

Acta Vet Scand. 2017 Sep 13; 59(1):60.
Doi: 10.1186/s13028-017-0328-6.

Outbreak tracking of Aleutian mink disease virus (AMDV) using partial NS1 gene sequencing

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[2]Kemitorvet Bygning 204, Rum 255. 2800 Kongens Lyngby, Denmark.
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Background
Aleutian Mink Disease (AMD) is an infectious disease of mink (Neovison vison) and globally a major cause of economic losses in mink farming. The disease is caused by Aleutian Mink Disease Virus (AMDV) that belongs to the genus Amdoparvovirus within the Parvoviridae family. Several strains have been described with varying virulence and the severity of infection also depends on the host's genotype and immune status. Clinical signs include respiratory distress in kits and unthriftiness and low quality of the pelts. The infection can also be subclinical. Systematic control of AMDV in Danish mink farms was voluntarily initiated in 1976. Over recent decades the disease was mainly restricted to the very northern part of the country (Northern Jutland), with only sporadic outbreaks outside this region. Most of the viruses from this region have remained very closely related at the nucleotide level for decades. However, in 2015, several outbreaks of AMDV occurred at mink farms throughout Denmark, and the sources of these outbreaks were not known.

Methods
Partial NS1 gene sequencing, phylogenetic analyses data were utilized along with epidemiological to determine the origin of the outbreaks.

Results
The phylogenetic analyses of partial NS1 gene sequences revealed that the outbreaks were caused by two different clusters of viruses that were clearly different from the strains found in Northern Jutland. These clusters had restricted geographical distribution, and the variation within the clusters was remarkably low. The outbreaks on Zealand were epidemiologically linked and a close sequence match was found to two virus sequences from Sweden. The other cluster of outbreaks restricted to Jutland and Funen were linked to three feed producers (FP) but secondary transmissions between farms in the same geographical area could not be excluded.

Conclusion
This study confirmed that partial NS1 sequencing can be used in outbreak tracking to determine major viral clusters of AMDV. Using this method, two new distinct AMDV clusters with low intra-cluster sequence diversity were identified, and epidemiological data helped to reveal possible ways of viral introduction into the affected herds.

Virol J. 2017 Jun 21; 14(1):119.
Doi: 10.1186/s12985-017-0786-5.

Construction and Immunogenicity Analysis of Whole-Gene Mutation DNA Vaccine of Aleutian Mink Virus Isolated Virulent Strain

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Aleutian mink disease (AD) is a chronic viral infection that causes autoimmune disorders in minks and presents a significant economic burden on mink farming. Despite the substantial challenges presented by AD, no effective vaccine is available and only partial protection has been achieved. We constructed a whole-gene nucleic acid vaccine from an isolated virulent Aleutian mink disease virus (ADV) strain

(pcDNA3.1-ADV). Based on this whole-gene nucleic acid vaccine, we generated truncated mutant constructs by removing portions of the ADV VP2 gene using overlap extension polymerase chain reaction. pcDNA3.1-ADV-428 lacks nucleotides encoding VP2 amino acid residues 428-466, and pcDNA3.1-ADV-428-487 harbors additional deletion of nucleotides coding for VP2 amino acid residues 487-501. We also generated nucleic acid vaccines for the ADV NS1 gene, truncated ADV NS1 gene, ADV VS2 gene, and truncated ADV VS2 gene: pcDNA3.1-NS1, pcDNA3.1-NS1-D, pcDNA3.1-VP2, and pcDNA3.1-VP2-D, respectively. The immunogenicity of the seven DNA vaccines was confirmed by immunofluorescent evaluation. Sixty female minks were divided into 10 groups: seven groups were immunized with the DNA vaccines, one control group was injected with phosphate-buffered saline, one group was immunized with pcDNA3.1 empty vector, and one group was immunized with inactivated ADV-G virus. ADV antibody levels, percentage of $CD8^+$ cells in blood, and levels of γ-globulin and circulating immune complexes in the serum were evaluated longitudinally over 36 weeks after ADV challenge. Minks that were immunized with the pcDNA3.1-ADV-428-487 nucleic acid vaccine produced ADV antibodies. After ADV challenge, the minks immunized with pcDNA3.1-ADV-428-487 nucleic acid vaccine had lower γ-globulin content and lower CIC in serum compared to other immunization groups. Although the pcDNA3.1-ADV-428-487 nucleic acid vaccine did not demonstrate complete protection against ADV, it demonstrated marked efficacy and could potentially be used as a vaccine to prevent losses in mink populations due to ADV. Discovery of effective means to vaccinate mink against ADV will not only improve overall health of mink populations but will also reduce the economic impact of ADV.

Viral Immunol. 2017 Aug 22.
Doi: 10.1089/vim.2017.0044. [Epub ahead of print]

Generation of an infectious clone of AMDV and identification of capsid residues essential for infectivity in cell culture

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Virus Res. 2017 Sep 15. pii: S0168-1702 (17) 30362-3.
Doi: 10.1016/j.virusres.2017.09.011.
[Epub ahead of print]

Abortion and mortality in farm mink *(Neovison vison)* associated with feed-born Clostridium limosum

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Vet Microbiol. 2017 May; 203:229-233.
Doi: 10.1016/j.vetmic.2017.03.017.
Epub 2017 Mar 18.

Scrapie, CWD, and Transmissible Mink Encephalopathy

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Prog Mol Biol Transl Sci. 2017; 150:267-292.
Doi: 10.1016/bs.pmbts.2017.07.009.
Epub 2017 Aug 10.

Intraspecies and interspecies transmission of mink H9N2 influenza virus

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H9N2 influenza A virus (IAV) causes low pathogenic respiratory disease and infects a wide range of hosts. In this study, six IAVs were isolated from mink and identified as H9N2 IAV. Sequence analysis revealed that the six isolates continued to evolve, and their PB2 genes shared high nucleotide sequence identity with H7N9 IAV. The six isolates contained an amino acid motif PSRSSR↓GL at the hemagglutinin cleavage site, which is a characteristic of low pathogenic influenza viruses. A serosurvey demonstrated that H9N2 IAV had spread widely in mink and was prevalent in foxes and raccoon dogs. Transmission experiments showed that close contact between H9N2-infected mink and naive mink, foxes and raccoon dogs resulted in spread of the virus to the contact animals. Furthermore, H9N2 challenge experiments in foxes and raccoon dogs showed that H9N2 IAV could infect these hosts. Virological and epidemiological surveillance of H9N2 IAV should be strengthened for the fur animal industry.

Figure 1
Phylogenetic trees of all eight segments of H9N2 IAVs isolated from the mink. Phylogenetic trees were constructed using MEGA 6.0, and the reliability of the tree was evaluated by the bootstrap method with 1,000 replications. The black bold sequences represented the H9N2 IAVs isolated from the mink, the red sequences represented the reference strains. (**A**), HA; (**B**), NA; (**C**), PB2; (**D**), PB1; (**E**), PA; (**F**), NP; (**G**), M; (**H**), NS.

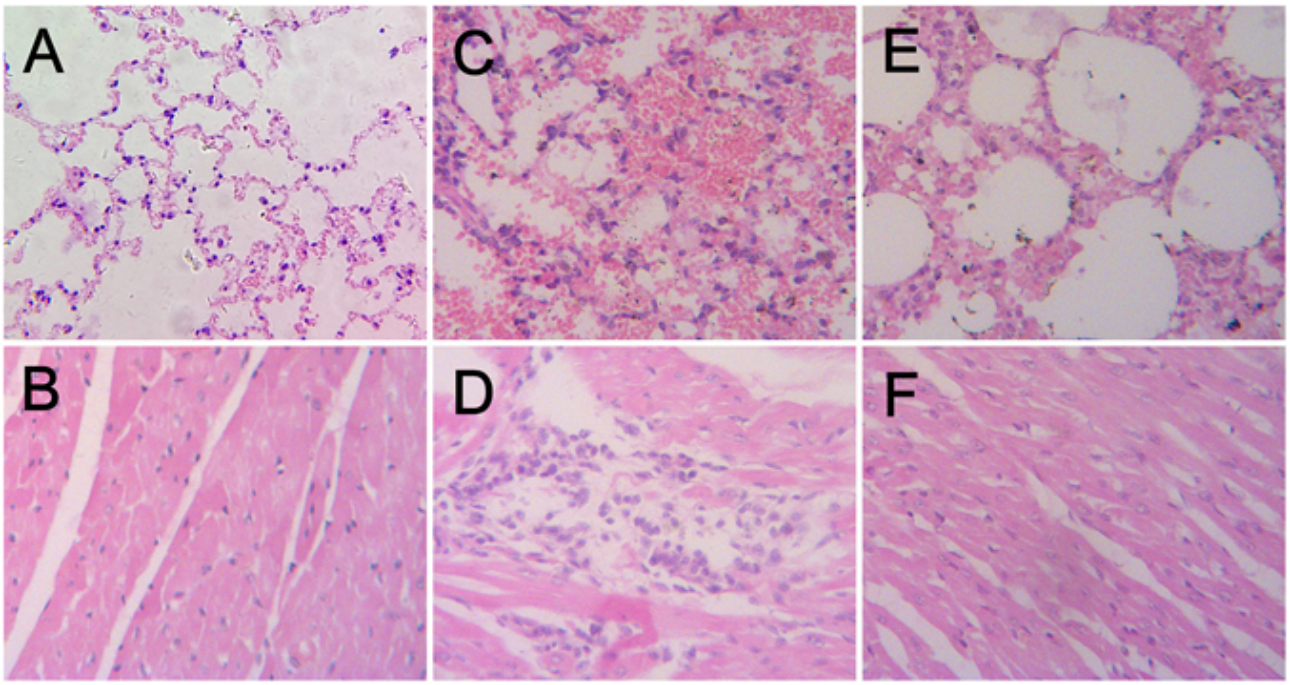

Figure 2
Histopathologic appearance of tissues of the mink. (**A**) Lung tissue taken from a control mink on day 6 p.i. (**B**) Heart tissue taken from a control mink on day 6 p.i. (**C**) Lung tissue taken from a inoculated mink on day 6 p.i., characterized by large area of bleeding, thickening of the alveolar septa. (**D**) Heart tissue taken from a inoculated mink on day 6 p.i., characterized by infiltration of inflammatory cells. (**E**) Lung tissue taken from an exposure mink on day 6 p.i., characterized by slight thickening of the alveolar septa. (**F**) Heart tissue taken from an exposure mink on day 6 p.i., no obvious histologic lesions were found. HE stain. Original magnification was ×200 for all images.

Sci Rep. 2017 Aug 7; 7(1):7429.
Doi: 10.1038/s41598-017-07879-1.

Molecular characterization of feline panleukopenia virus isolated from mink and its pathogenesis in mink

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Vet Microbiol. 2017 Jun; 205:92-98.
Doi: 10.1016/j.vetmic.2017.05.017.
Epub 2017 May 22.

Questionnaire survey of detrimental fur animal epidemic necrotic pyoderma in Finland

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Background

In 2007, a previously unrecorded disease, fur animal epidemic necrotic pyoderma (FENP), was detected in farmed mink (Neovision vision), foxes (Vulpes lagopus) and Finnraccoons (Nyctereutes procyonoides) in Finland. Symptoms included severe pyoderma with increased mortality, causing both animal welfare problems and economic losses. In 2011, an epidemiologic questionnaire was mailed to all members of the Finnish Fur Breeders' Association to assess the occurrence of FENP from 2009 through the first 6 months of 2011. The aim was to describe the geographical distribution and detailed clinical signs of FENP, as well as sources of infection and potential risk factors for the disease.

Results

A total of 239 farmers (25%) returned the questionnaire. Clinical signs of FENP were observed in 40% (95% CI 34-46%) of the study farms. In addition, the survey clarified the specific clinical signs for different animal species. The presence of disease was associated with the importation of mink, especially from Denmark (OR 9.3, 95% CI 2.6-33.0). The transmission route between Finnish farms was associated with fur animal purchases. Some risk factors such as the farm type were also indicated. As such, FENP was detected more commonly on farms with more than one species of fur animal in comparison to farms with, for example, only foxes (OR 4.6, 95% CI 2.4-8.6), and the incidence was higher on farms with over 750 breeder mink compared to smaller farms (OR 3.8, 95% CI 1.6-9.0). Contact between fur animals and birds and other wildlife increased the risk of FENP on farms. Responses also indicated that blocking the entry of wildlife to the animal premises protected against FENP.

Conclusions

FENP was most likely introduced to Finland by imported mink and spread further within the country via domestically purchased fur animals. Some potential risk factors, such as the type and size of the farm and contact with wildlife, contributed to the spread of FENP. Escape-proof shelter buildings block the entry of wildlife, thus protecting fur animals against FENP.

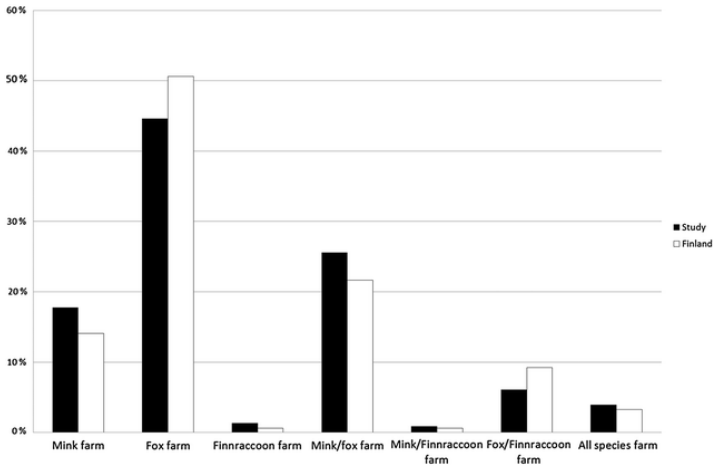

Fig. 1. Characteristics of the fur farms included in the study and all Finnish fur farms (2010). Farms in the study compared with all farms in Finland according to the fur animal species farmed. The information for Finnish fur farms was obtained from the Finnish Fur Breeders' Association (FFBA)

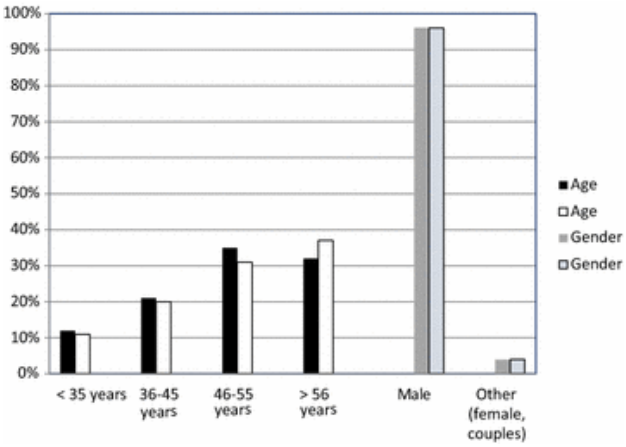

Fig. 2. Characteristics of fur farmers included in the study and all Finnish fur farmers (2010). The age and gender of the fur farmers in the study compared to fur farmers in Finland. The information for Finnish fur farmers was obtained from the Finnish Fur Breeders' Association (FFBA)

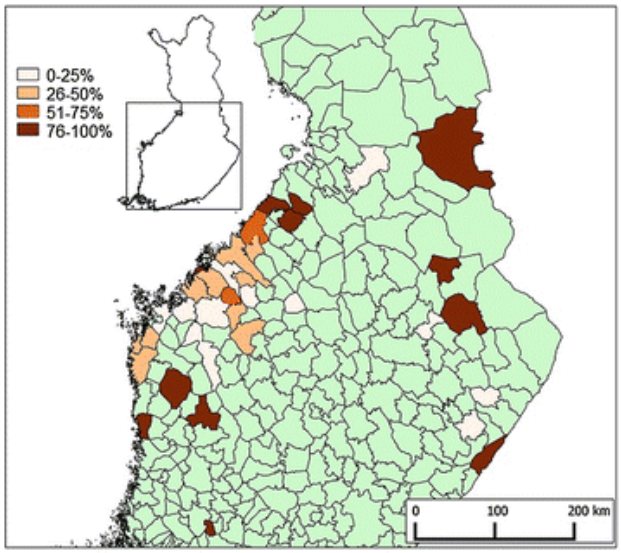

Fig. 3. Fur animal epidemic necrotic pyoderma (FENP) on participating farms. The geographic distribution of the farms and percentage of farms reporting FENP during the period from 2009 through 2011. Areas in *green*: no participants

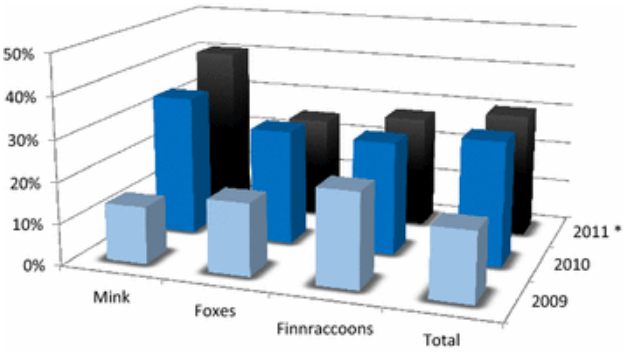

Fig. 4.Occurrence of fur animal epidemic necrotic pyoderma (FENP) on Finnish fur farms. Occurrence of FENP in mink, fox, Finnraccoon and all study farms during the period from 2009 through 2011. *Asterisks* first 6 months of 2011

Acta Vet Scand. 2017 Aug 3; 59(1):54.
Doi: 10.1186/s13028-017-0322-z.

Livestock-associated methicillin-resistant Staphylococcus aureus is widespread in farmed mink *(Neovison vison)*

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Vet Microbiol. 2017 Aug; 207:44-49.
Doi: 10.1016/j.vetmic.2017.05.027.
Epub 2017 Jun 1.

Severe Fever with Thrombocytopenia Syndrome Virus Infection in Minks in China

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We analyzed the seroprevalence of tick-borne severe fever with thrombocytopenia syndrome virus (SFTSV) in farm-raised minks using double antigen ELISA (enzyme-linked immunosorbent assay) kit and indicated that 8.4% (15/178) of the minks had antibodies to the nucleoprotein of SFTSV and 72.7% (8/11) of mink farms had minks positive to SFTSV. The ELISA results were further confirmed by presence of neutralization to SFTSV in the mink sera. Our results suggested that minks were widely infected with SFTSV in China.

Vector Borne Zoonotic Dis. 2017 Aug; 17(8):596-598.
Doi: 10.1089/vbz.2017.2115. Epub 2017 Jun 27.

Serology and protein electrophoresis for evidence of exposure to 12 mink pathogens in free-ranging American mink *(Neovison vison)* in Argentina

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Background
Basic pathologic characteristics for farmed minks were previously reported worldwide. However, its status in the wild has not been studied in detail.

Objective
Serology and electrophoresis were carried out for evidence of exposure to 12 mink pathogens on two different locations.

Animals and methods
Serology was done in 87 wild minks by reference techniques against Toxoplasma gondii, Encephalitozoon cuniculi, Neospora caninum, Brucella abortus, Mycobacterium bovis, Leptospira interrogans, canine distemper virus (CDV), canine adenovirus (CAV), canine parvovirus (CPV), rabies virus (RV), Influenza A virus (FLUAV) and Aleutian disease virus (ADV). Hypergammaglobulinemia, the ADV main clinical feature, was determined by conventional electrophoresis.

Results
Seventy-one percent of the 87 sera had antibodies against one or more pathogens. ADV accounted for the highest seroprevalence (29%), followed by T. gondii (26%), L. interrogans (14%), M. bovis (12%), B. abortus (9%), N. caninum (3%), CPV (3%) and CDV (2%). Seroprevalence was influenced by location but not sex or age. Additionally, 16% of the seropositive samples for ADV had gammaglobulin levels >40.0 g/L. Antibody titers for CDV and CPV were low and difficult to interpret as almost all these cases had borderline concentrations.

Conclusion
A cautious interpretation of the results is urged as the epidemiological role of the wild mink is largely unexplored for most of these agents. Nevertheless, the information may be clinically relevant.

Actual Mink Research 2017

Meeting at Research Centre Foulum

Faculty of Science and Technology

Aarhus University, Denmark

19 September 2017

Comparison of expected and determined apparent total tract digestibility coefficients of nutrients in Danish mink feed

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The purpose of this study is to compare expected and determined apparent total tract digestibility coefficients (ATTDC) of protein, fat, and carbohydrate in four complete diets produced by three Danish feed kitchens, to test if the assumption used during feed optimization of additivity of nutrient digestibility of single feed items holds. Further a case is described where ATTDC of protein in two different complete diets produced by the same feed kitchen both were significantly lower than expected, and which initiatives feed manufacturer did to identify the primary cause to the low ATTDC of protein. Results generally support the assumption of additivity of ATTDC of protein and carbohydrate for single feed items for diets from two out of three feed kitchens. ATTDC for these diets were on average 1.5 percent units and 0.7 percent units lower than expected for protein and carbohydrate, respectively. For two different diets produced by the third feed kitchen ATTDC of protein was on average 6.3 percent units lower than expected, and ATTDC of carbohydrate was 6.1 percent units higher than expected. Common for all the complete diets were that the determined ATTDC of fat was higher than expected, on average 3 percent units. The feed kitchen, for which the ATTDC of protein in the complete diets was lower than expected, initiated an investigation, where they used *in vivo* and *in vitro* methods to test different feed items and process techniques. It was showed that a blood meal which had an expected ATTDC of protein on 83 % was the main source of the problem, as the determined ATTDC by *in vivo* and *in vitro* methods was significantly lower.

Meeting at Research Centre Foulum, Faculty of Science and Technology, Aarhus University, Denmark. DCA report no. 103, September 2017 (in Danish) p. 6-10. Author's abstract.

Minerals and immune parameters in mink

Rikke Brødsgaard Kjærup[1], Tove N. Clausen[2] & Peter Foged Larsen[2]

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The feed provided to mink is supplemented with minerals to ensure optimal growth and development. Minerals are also known to have great influence on the immune system. The aim of this study was to examine how the feed content of the minerals zinc, cobber and selenium influenced selected immune parameters at pelting in November.

The same standard feed was given to all groups, and the only difference between the groups was the vitamin and mineral mixtures. The control group was given a standard vitamin and mineral mixture, one group was given standard mixture without zinc, another group without cobber, a fourth group without selenium, and the fifth group was given no extra vitamins or minerals. None of the groups was given extra iron in the feed. The experiment started at the end of June, and 16 mink from each group were selected at pelting for liver and blood sampling.
Even though minerals were left out of the feed, the analysis of the feed showed that the level of the minerals in the feed was above the recommended value, with the exception of zinc in the group without addition of zinc and the group with no vitamins and minerals. The level of minerals was measured in the liver, and differences were found between the groups for the level of cobber and zinc. However, there was no correlation of the level of the same mineral in the feed. Differences were also observed between the groups regarding the amount of white blood cells and lymphocytes. However, the differences were uncorrelated to the measured level of minerals in the feed, and no differences were observed between the groups provided with standard vitamin and mineral mixture or no vitamins or minerals. The other immune parameters measured were red blood cells, neutrophils, hematocrit count, the amount of haemoglobin, haptoglobin and IgG as well as the gene expression in the liver of the genes for mannose-binding lectin and superoxide dismutase 1. For these parameters, no negative effect was observed between groups. Based on these results, it has to be considered whether it is necessary to add extra minerals to the feed during the autumn since no negative effect was observed when not adding cobber, zinc, selenium or iron to the feed.

Meeting at Research Centre Foulum, Faculty of Science and Technology, Aarhus University, Denmark. DCA report no. 103, September 2017 (in Danish) p11-17. Author's abstract.

Mink without addition of vitamin B to the feed – consequences in blood and urine

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The present investigation showed that it is possible to feed male mink without addition of vitamins and minerals during the growing period. In an experiment, mink were fed a diet with either the recommended additions of vitamins and minerals (CONT) or no addition of vitamins and minerals (-VIT). There was no difference in the weight of the male mink in July, August and September but the animals fed -VIT had a significantly higher growth from September to pelting than the animals fed CONT. Blood and urine samples were collected from 15 animals per group in September and November (pelting). The samples were analyzed with HPLC-mass spectrometry and the results showed that the mink excreted riboflavin, niacin, pantothenic acid and pyridoxal even when they were fed -VIT. The male mink fed CONT had a higher excretion of amino acid metabolites in the urine. This may relate to the higher growth observed in -VIT as a lower metabolism of amino acids leaves more for deposition/growth. However, this aspect requires further investigation. Overall, the results of the present investigation confirms the results presented last year and they show that it is relevant to study further a reduction or elimination of the addition of vitamin B to mink feed.

Meeting at Research Centre Foulum, Faculty of Science and Technology, Aarhus University, Denmark. DCA report no. 103, September 2017 (in Danish) p. 18-25. Author's abstract.

Fat digestibility, energy intake and growth in male mink kits from 6 to 11 weeks of age

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The digestive tract and enzyme activity is not fully developed in mink kits and this may affect the digestibility of nutrients. Previous studies have shown that high contents of fat in the diet to mink kits may decrease the overall fat digestibility and thereby the metabolizable energy (ME) content in the diet. Our objectives were to investigate fat and fatty acid digestibility of diets with different fatty acid compositions fed to mink kits from 6 to 11 weeks of age, with a calculated distribution of ME from protein fat and carbohydrates of 35, 50 and 15%, respectively. Furthermore, to investigate the effect of dietary fatty acid composition on ME intake, growth and organ development. Eighty mink kits, divided into 4 dietary treatment groups, were studied from 6 to 11 weeks of age in order to determine fat and fatty acid digestibility of four different fat sources. Ninety percent of the dietary fat consisted of soy oil (mainly C18:1n-9, C18:2n-6), sunflower oil (mainly C18:1n-9, C18:2n-6), coconut oil (mainly C8:0-C12:0) and Lipitec® (mainly C16:0, C18:0) in groups 1, 2, 3 and 4 respectively. It can be concluded that diets based on fat sources with a high proportion of unsaturated fatty acids have higher digestibility than such with a high content of saturated fatty acids and that especially the content of C18:0 is determining for the overall fat digestibility. Diets with low content of ME resulted in higher feed intake which shows that the feed intake in male kits aged 6 to 11 weeks is mainly regulated to a similar ME intake. In addition, the intestine weight in relation to body weight and length was also affected by dietary fatty acid composition where high dietary content of saturated fatty acids resulted in a longer and heavier intestine than kits fed diets with high content of unsaturated fatty acids.

Meeting at Research Centre Foulum, Faculty of Science and Technology, Aarhus University, Denmark. DCA report no. 103, September 2017 (in Danish) p. 26-31. Author's abstract.

Genes in mapped genome regions affect size, quality and reproduction in mink

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In a genome-wide association study in mink (GWAS) we detected many significant SNP-markers and genome regions that affected body weight and skin length in mink. We found that genes affecting body weight and skin length positively often had a negative effect on quality- and reproduction traits. We detected many regions in the genome with

a significant effect on fertility traits, such as barren, this opens for possible improvements in the genetic evaluation of the low heritable fertility traits.

Meeting at Research Centre Foulum, Faculty of Science and Technology, Aarhus University, Denmark. DCA report no. 103, September 2017 (in Danish) p. 32-40. Author's abstract.

Year-round use of straw in farm mink

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The knowledge of straw use and function in mink throughout the full yearly production cycle – besides the maternal nest building before parturition – is limited. We focused in this study on several aspects of straw use in adult female mink and their offspring during a year of production, from January to November. This included straw used for (1) eating during the period of slimming before mating, (2) an occupational resource (enrichment) reducing abnormal behaviour, (3) building nests outside the reproductive period, (4) maternal nest-building in delivering dams and influence on reproductive success, and (5) coverage of the wired nest box lid, creating a dark hideout. We created four experimental groups of each 80 cages; group N: straw covered the wired nest box lid for mink to pull down, group C-: straw provided in the cage only, no coverage of nest box lid, group C+: Straw in the cage, the nest box covered by a wooden plate, group NC: straw provided both on the nest box lid and in the cage. We found that adult mink females create a nest inside the nest box throughout the year, in case they had access to straw in the cage (groups C-, C+, NC). The nest score indicative of maternal nest building increased around April 11 in all groups. In the autumn, juveniles had a lower nest score compared to adult females. Access to straw on the nest box lid only (group N) limited the mean nest score in adult mink. Mated NC dams used the nest box more, indicating that the value of the nest box may increase by access to straw both in the cage and on the nest box lid. The NC treatment had positive effects for reproductive output in particularly for first parity dams. Besides building nests using straw, adult mink females ate straw in particularly in periods with feed restriction, no significant different between treatment groups. Easier access to straw (in the cage) did not reduce the concentration of faecal cortisol metabolites or the occurrence of abnormal behaviour, peaking in breeding dams during winter restricted feeding. A layer of straw on the nest box lid reduced stereotypic behaviour in breeding dams in September, in comparison to no coverage (C) or a wooden plate (C+). However, the amount of abnormal behaviour was very low during this time of year. Generally older dams performed more stereotypic behaviour and spent more time in the nest box than the young breeding dams, while tail-chewing and activity out in the cage were more frequent in the younger 1st parity dams. Thus, we believe it is important to consider the age class of mink in studies of effects of resources/enrichment, reproduction, behaviour and welfare.

Meeting at Research Centre Foulum, Faculty of Science and Technology, Aarhus University, Denmark. DCA report no. 103, September 2017 (in Danish) p. 41-48. Author's abstract.

How can the evaluation of stereotypic behaviour in the winter period be standardised in WelFur-Mink?

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For practical reasons it is not always possible to observe stereotypic behaviour before feeding, as described in the WelFur-Mink protocol. A practical solution was, therefore, to standardise the observation to take place either before feeding OR before sunset – thereby risking that there may be a difference in the prevalence of stereotypic behaviour at the two observation times. To ensure that all farms are evaluated the same way, independent of the time of observation of stereotypic behaviour, a potential correction factor must be well-founded.

Meeting at Research Centre Foulum, Faculty of Science and Technology, Aarhus University, Denmark. DCA report no. 103, September 2017 (in Danish) p. 49-54. Author's abstract.

How to ensure that stick tests measure mink temperament only?

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A shelf formed as a bunk in the front part of the cage may function as a place of refuge, with the mink reacting less timid and with more confidence if they do not have to leave this refuge during the test situation. The size of the wooden stick influences the mink's reaction in the test, indicating that the mink pay less attention to a thin stick compared with a tongue spatula. When performing a stick test it is therefore important to keep a distance between a refuge and the stick during the test, and to use the standardized wooden tongue spatula to be able to compare results between farms or tests.

Meeting at Research Centre Foulum, Faculty of Science and Technology, Aarhus University, Denmark. DCA report no. 103, September 2017 (in Danish) p. 55-59. Author's abstract.

Status of implementation of WelFur-Mink in practice

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Fur Europe began to implement WelFur on European mink and fox farms from January 2017. The assessment is conducted by assessors from a private audit company, who have been trained by the researchers that developed the WelFur protocols. The implementation of such a comprehensive protocol requires training and accommodation at all levels before the new tasks become routine. It also requires that workflows, tools and programs are refined to the task. WelFur has come well from the start, but the feedback to farmers has to be improved so that the new knowledge can benefit the mink and thereby the farmers, as soon as possible. When the results of the certification are available, trained consultants are ready to assist the farmers in all countries.

Meeting at Research Centre Foulum, Faculty of Science and Technology, Aarhus University, Denmark. DCA report no. 103, September 2017 (in Danish) p. 60-66. Author's abstract.

New flea control strategy in mink farms

Kim Søholt Larsen[1] *& Martin Sciuto*[1]

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Through several years fleas have been a problem on the farms. This is partly due to resistance towards one of the insecticides used but also due to fact that the way that the farmers are using the nest boxes have changed. This study is presenting the study of two new insecticides and are presenting a suggestion for the use of these products and for using physical control of the fleas and thus to get this management method integrated much more on the farm than today.

Meeting at Research Centre Foulum, Faculty of Science and Technology, Aarhus University, Denmark. DCA report no. 103, September 2017 (in Danish) p. 67-69. Author's abstract.

Success in control of Aleutian disease in mink depend on many factors

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Several factors are known to influence the risk of (re-) infection with Aleutian disease mink virus (AMDV). The most important factors are the purchase of infected animals; flaws in cleaning of previous infection premises; purchases of second-hand farm equipment, halls or machines originating from an infected farm; and infection via feed. This study has evaluated the impact of the detected AMDV strains on the risk for re-infection the following year. Test data for the period January 2015 to January 2017 and sequencing data for the period February 2013 to November 2016 was included in the study.
The results indicate that the Saeby strain causes more frequently re-infections than the other strains, if more than one AMDV-antibody positive was detected in the farm. It is not possible from this study to know why, but the Saeby strain probably survives better in the environment, despite thorough cleaning and disinfection of the premises.

Meeting at Research Centre Foulum, Faculty of Science and Technology, Aarhus University, Denmark. DCA report no. 103, September 2017 (in Danish) p. 70-73. Author's abstract.

Current investigations of Fur Animal necrotizing Pyoderma (FENP) in Danish farm mink (*Neovison vison*)

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[1]Department of Veterinary and Animal Sciences, University of Copenhagen.

Mink from 14 Danish Mink Farms was diagnosed with the disease called Fur Animal necrotizing Pyoderma (FENP) during the first 8 months of 2017. The disease outbreaks on these farms were characterized by increased prevalence of unusual wounds in the head, shoulder and feet region. In some of these farms there were also increased prevalence of pleural empyemas. There is stil no documented effective treatment or way of preventing FENP outbreaks on the mink farms. Current reseach activities at the University of Copenhagen focus on the development of diagnostic methods that would enable screening of large numbers of animals for infectious agents associated with FENP. These investigations includes attempts to develop serological methods for detection of antibodies in serum. Finally current studies includes evaluation of the effect of autovaccine on infected farms.

Meeting at Research Centre Foulum, Faculty of Science and Technology, Aarhus University, Denmark. DCA report no. 103, September 2017 (in Danish) p. 74-77. Author's abstract.

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