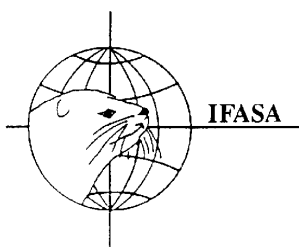
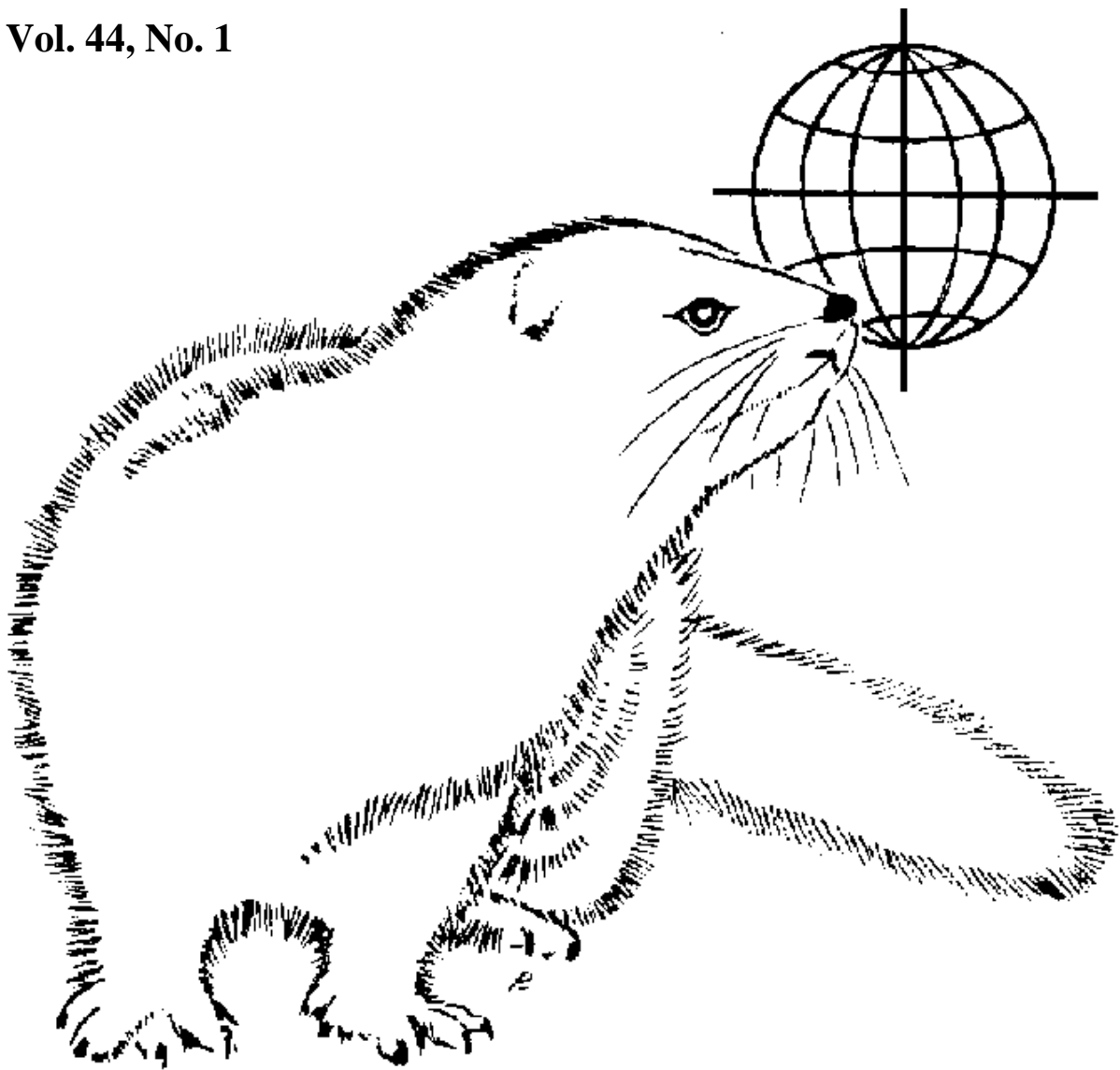


# SCIENTIFUR

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INTERNATIONAL FUR ANIMAL SCIENTIFIC ASSOCIATION

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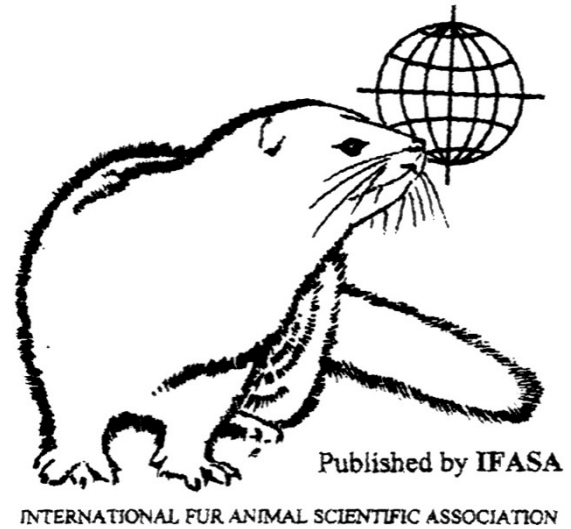
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## Notes from the Editor

Every fourth year, the International Fur Animal Scientific Association (IFASA) in cooperation with institutions and business organisations in countries with important fur animal productions organises an International Scientific Congress in Fur Animal Production. The latest congresses were held in Denmark in 2012 and in Finland in 2016. In 2020, the congress will be held in Warsaw in Poland, in a collaboration between IFASA and the Polish Society of Animal Production.

The IFASA Congress is an important forum for researchers in fur animal production who gather to present and discuss recent research and outline research to address future challenges. I encourage all researchers with interest in fur animal production to participate in this important event. Important topics are health and diseases, breeding, genetics and reproduction, nutrition, feeding and management and behaviour and welfare.

Please, note the following deadlines! Deadline for abstracts is February 2, 2020 and for an early bird registration fee it is February 29, 2020. More information about the IFASA Congress can be found in this issue of Scientifur and on the IFASA website: <http://ifasanet.org/> and the organizer's website: <http://ifasa2020.pl/>

Several abstracts in this issue of Scientifur deal with nutrition. This includes protein and amino acid availability in different feeds for young growing and adult mink. The microbiological quality of the feed is another matter dealt with. With cost of feed being the most important cost in the fur animal production and crucial for the growth and health of the animals, these are important topics. Other abstracts deal with Aleutian disease, which is of particular concern in mink production.

Vivi Hunnicke Nielsen

Editor Scientifur





## The XII International Scientific Congress in Fur Animal Production

August, 25-27, 2020, Warsaw, Poland

### Invitation

Dear Friends,

On behalf of the International Fur Animal Scientific Association (IFASA) and the Polish Society of Animal Production (PSAP) we are very pleased to invite you to the XII International Scientific Congress in Fur Animal Production. The Congress will be held in Warsaw, in August 2020.

Organized every 4 years Congresses are a meeting places for scientists from around the world dealing with all aspects of fur animal breeding. It is an opportunity both to present the results of the latest research and to discuss the future and development of the fur branch.

The Congress will be organized by Polish Society of Animal Production, an organization which since 1922 has been gathering Polish scientists working in the area of animal husbandry. The place of the Congress will be Warsaw, a city that hosted participants of the VI International Scientific Congress in Fur Animal Production in 1996. This is a special challenge for us, because there will be some participants who remember the previous meeting in Warsaw. We want to show you how Warsaw and Poland have changed and developed over this quarter of a century, also in terms of fur animals breeding.

Prof. Roman Niżnikowski  
*President of PSAP*

Prof. Marian Brzozowski  
*Organizing Committee*

Website: [ifasa2020.pl](http://ifasa2020.pl)

## Warsaw - beautiful and surprising destination

Think of a city that offers numerous advantages and interesting experiences. Think of a European metropolis that can bring a smile to the faces of tourists, businessmen and art lovers? You're thinking of Warsaw! No matter whether you come to Warsaw for business or for pleasure, the city has all the attractions you need to make your time in the city a perfect one.



## Congress Venue

Get the celebrity treatment with world-class service at The Westin Warsaw. The hotel is located in the centre of Warsaw, 5 minutes' walking distance from the Palace of Culture and Science, Warsaw Central Railway Station.

## Call for abstracts

Abstracts should be submitted using the online application on website <https://ifasa2020.pl/abstracts>. Abstracts are required in English. The abstract should contain the specific objectives, experimental methods and statistical analyses used, together with a synthesis of the results and conclusions. The title, authors and the abstract must not exceed 2250 characters (including spaces).

**Abstract Deadline: February 2, 2020**

## Registration fees:

	Early bird fee (till February 29, 2020)	Regular fee (after February 29, 2020)
IFASA Delegate	550 €	650 €
Accompanying Person	300 €	300 €

**Congress Secretariat:** Symposium Cracoviense, PCO  
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 Ph +48 12 4227600 Fax +48 12 4213857

**Contact person:** Agnieszka Bryk, [ifasa2020@symposium.pl](mailto:ifasa2020@symposium.pl)

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**BREEDING, GENETICS AND REPRODUCTION****Morphological Characterization and Gene Expression Patterns for Melanin Pigmentation in Rex Rabbit**

Hu S<sup>1</sup>, Zhai P<sup>2</sup>, Chen Y<sup>1</sup>, Zhao B<sup>1</sup>, Yang N<sup>1</sup>, Wang M<sup>1</sup>, Xiao Y<sup>1</sup>, Bao G<sup>3</sup>, Wu X<sup>4</sup>

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Animal melanin has an important role in the formation of animal fur and skin, which is determined by its quantities, character, and distribution. To identify the effect of melanin on the formation of multi-colored Rex rabbits (Black, Chinchilla, Beaver, Protein cyan, Protein yellow, White), the structure of hair follicles and melanin content in multi-colored Rex rabbit skins were observed by Hematoxylin and Eosin (H&E) staining and melanin staining, respectively. The melanin granules were primarily found in the epidermis and hair follicle roots. The melanin content of skin was measured by extracting melanin from skin tissue. The results demonstrated that the melanin content was the highest in the skin of black Rex rabbit. Additionally, we measured the mRNA and protein expression levels of melanin-related key genes (MITF and TYR) in the skin of different hair color by quantitative real-time PCR and Wes assay, respectively. The results revealed that the mRNA expression levels in the skin of black Rex rabbit was highly expressed when as compared with other Rex rabbit skin ( $P < 0.01$ ), and they were the lowest in the skin of white Rex rabbit. Finally, correlation analysis was conducted between melanin content and the expression levels of mRNA and protein. The results indicated a significant correlation between melanin content and the mRNA expression of MITF ( $P < 0.05$ ), but it was not correlated with the mRNA expression of TYR ( $P > 0.05$ ). In summary, melanin deposition has important economic value, and the coat color of fur-bearing animals is partly determined by the melanin-related genes.

*Biochem Genet.* 2019 Oct; 57(5):734-744.

Doi: 10.1007/s10528-019-09929-x.

Epub 2019 Jul 13.

**NUTRITION, FEEDING AND MANAGEMENT****Amino acid availability of protein meals of different quality for adult and growing mink (*Neovison vison*)**

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Protein and amino acid (AA) availability of three protein meals of expected different quality were evaluated in young growing and adult mink. Lamb meal (LM), poultry meal (PM) or fishmeal (FM) were used as main protein sources in three extruded diets investigated by determining apparent total tract digestibility (ATTD) and nitrogen balance in 12 growing mink males aged 8-11 weeks in a Latin square design. In adult mink, ATTD of the diets was determined. The diets had lower protein content than recommended for growing mink, protein contributing 23% of total metabolisable energy (ME), to ensure differences in growth response. The LM diet with expected low protein quality revealed lower content of essential AA than the PM and FM diets. The ATTD of major nutrients and essential AA was significantly affected by diet, with the poorest values for LM, intermediate for PM and the highest values for FM. Mink kits revealed lower ATTD values than adults for protein, AA and especially fat, resulting in lower dietary ME content for kits than for adults. The mean difference was greatest for the LM diet with lowest ATTD and smallest for the FM diet with the highest ATTD. Nitrogen retention and growth rate differed significantly among diets and was lowest for diet LM and highest for diet FM, respectively. Different dietary essential AA contents and ATTD, especially of methionine, were the main factors to explain the difference in growth response. Generally, plasma essential AA concentrations did not clearly reflect the different dietary supply and the different

growth response. The study shows that a recommended level of 0.31 g apparent total tract digestible methionine per MJ ME covers the minimum requirement with a safety margin. To obtain optimal growth, the lower digestive capacity in young mink kits should be considered when choosing feed ingredients.

*Arch Anim Nutr.* 2019 Oct 8: 1-15.

Doi: 10.1080/1745039X.2019.1667711.

Epub ahead of print.

### Microbiological quality of mink feed raw materials and feed production area

Lyhs U<sup>1,2</sup>, Frandsen H<sup>3</sup>, Andersen B<sup>4</sup>, Nonnemann B<sup>5</sup>, Hjulsager C<sup>5,6</sup>, Pedersen K<sup>7</sup>, Chriél M<sup>5,8</sup>

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### Background

The quality of mink feed and raw ingredients affect health and growth. The objectives of this study were to examine the microbiological quality of ready-to-eat mink feed and its raw ingredients, screen the plant part of the feed for mycotoxins, and determine the hygiene of the production environment in the feed processing facilities. The results of the study are important for identification of critical steps in the feed production and for formulation of recommendations

for improvements of production processes to obtain better quality feed. Feed and swab samples were taken at three Danish mink feed producers October 2016 and May 2017, respectively. Viable counts, detection of methicillin-resistant *Staphylococcus aureus* (MRSA), influenza virus and filamentous fungi were performed together with qualitative chemical analyses for bioactive fungal metabolites and mycotoxins. Swab samples were analyzed for total viable counts.

### Results

Viable counts varied between  $7.2 \times 10^2$  and  $9.3 \times 10^7$  cfu/g in raw ingredients and between  $10^7$  and  $10^9$  cfu/cm<sup>2</sup> on different surfaces at the feed production facilities. A pork meat product, pork haemoglobin, pork liver and a poultry mix was found positive for MRSA, while monophasic *Salmonella* [4,5,12:i:-] was detected in a pork meat product. Neither MRSA nor *Salmonella* was detected in any ready-to-eat feed. Influenza A virus was not detected in any sample. Filamentous fungi were detected in all analysed samples of ready-to-eat feed while dihydrodemethyl-sterigmatocystin was found in almost 50% of all ready-to-eat feed samples and in 80% of the sugar beet pulp. Fumonisin and other *Fusarium* toxins were found especially in corn gluten meal and extruded barley and wheat.

### Conclusions

Mink feed contained a cocktail of mycotoxins and bacteria, which may not per se cause clinical disease, but may affect organ function and animal performance and well-being.

*Acta Vet Scand.* 2019 Nov 21; 61(1):56.

Doi: 10.1186/s13028-019-0489-6.

### Evaluation of Collagen and Elastin Content in Skin of Multiparous Minks Receiving Feed Contaminated with Deoxynivalenol (DON, Vomitoxin) with or without Bentonite Supplementation

Taszkun I<sup>1</sup>, Tomaszewska E<sup>2</sup>, Dobrowolski P<sup>3</sup>, Żmuda A<sup>4</sup>, Sitkowski W<sup>1</sup>, Muszyński S<sup>5</sup>

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Deoxynivalenol (DON, vomitoxin) is considered one of the most dangerous mycotoxins contaminating cereal products for food and feed. One of the protective methods against the adverse effect of DON on mink health is to use a component such as bentonite as a feed supplement to allow toxins absorption. The aim of this study was to determine the effect of DON, administered alone or with bentonite, on the histological structure of the skin and the content of collagen and elastin. A multiparous minks from control group (not exposed to DON) and a study groups receiving fed with DON-containing wheat for seven months: I: at a concentration of 1.1 mg/kg of feed, II: at a concentration of 3.7 mg/kg; III: DON at a concentration of 3.7 mg/kg and bentonite at a concentration of 0.5 kg/1000 kg of feed (0.05%); and IV: DON at a concentration of 3.7 mg/kg and bentonite at a concentration 2 kg/1000 kg (0.2%). After performing euthanasia and before pelting, skin samples of 2 cm in diameter were drawn from the multiparous minks from the lateral surface of the right anterior limb. Our obtained results clearly indicate that DON administered for a period of seven months at a dose of 1.1 mg/kg significantly changes the thickness of skin of a multiparous mink. It causes an increase in the percentage of elastin from 5.9% to 9.4% and a decrease in immature collagen, which results in a change in the collagen/elastin ratio from 10/1 to 5/1. A dose of 3.7 mg/kg DON in feed without or with 0.05% bentonite causes the absence of immature collagen in the dermis, but the addition of 0.2% bentonite in the feed reveals the presence of immature collagen and increase the percentage of the elastin.

*Animals (Basel).* 2019 Dec 4; 9 (12). pii: E1081.

Doi: 10.3390/ani9121081.

**Relationships between mercury concentrations in fur and stomach contents of river otter (*Lontra canadensis*) and mink (*Neovison vison*) in Northern Alberta Canada and their applications as proxies for environmental factors determining mercury bioavailability**

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**The effect of fish and mealworm larvae meals as alternative dietary protein sources on nutrient digestibility and gastrointestinal function in *Chinchilla lanigera***

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Chinchillas are herbivores, but wild chinchillas may occasionally consume animal-based foods. The aim of this study was to determine the effect of fish meal

(FM) and mealworm meal (MWM) included in complete pelleted diets on nutrient digestibility and gastrointestinal function in chinchillas. The experiment was performed on 24 male, divided into three groups, n=8. Control group (C) was fed a diet containing 10% soybean meal (SBM). In the experimental group FM, chinchillas received a diet containing 3% fish meal, and the diet administered to the experimental group MWM was supplemented with 4% dried mealworm larvae meal. The nutrient digestibility of diets was determined. At the end of the experiment animals were euthanized and their digestive tracts were removed to analyze gut activity. FM group animals were characterized by lower crude fat digestibility, whereas both alternative protein sources improved the digestibility of acid detergent fiber (ADF). A considerable increase in the activity of cecal intracellular and extracellular bacterial enzymes (in particular  $\beta$ -glucosidase,  $\beta$ -galactosidase and  $\beta$ -xylosidase) was noted in the FM group, which however did not increase the concentrations of short-chain fatty acids (SCFA). The inclusion of MWM in chinchilla diets shifted the bacterial fermentation site from the cecum (lowest SCFA pool) to the colon (highest SCFA pool), thus enabling to derive additional energy from less digestible dietary components. In conclusion, chinchilla diets can be supplemented with small amounts of animal protein such as fish meal and dried mealworm larvae meal.

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Doi: 10.1538/expanim.19-0072.

Epub ahead of print.

### **Comparative analysis of the gut microbiota of the blue fox (*Alopex lagopus*) and raccoon dog (*Nyctereutes procyonoides*)**

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The goal of this study is to compare the gut microbiota of domestic blue fox (*Alopex lagopus*) and rac-

coon dog (*Nyctereutes procyonoides*) to provide better understanding of their intestinal gut microbiota. We analyzed the structure of fecal microbes in 40 blue foxes and 40 raccoon dogs that were raised under same conditions, using high-throughput Illumina sequencing targeting the V3-V4 region of the 16S rRNA gene. In total, 295,146 sequence reads were obtained. The average number of operational taxonomical units in the two group samples was 194 to 286. Firmicutes (blue fox 73.40%, raccoon dog 46.90%) and Bacteroidetes (blue fox 21.92%, raccoon dog 44.25%) were the most abundant phyla in the gut of blue fox and raccoon dog. At the genus level, *Prevotella* (blue fox 16.89%, raccoon dog 36.22%), *Blautia* (blue fox 9.02%, raccoon dog 13.72%), and *Peptostreptococcaeae\_incertain\_sedi* (blue fox 22.41%, raccoon dog 2.84%) were commonly presented in the gut of two kinds of animal. Principal coordinates analysis showed that the microbial communities were different between blue fox and raccoon dog. The Firmicutes-to-Bacteroidetes ratio was higher in blue foxes (3:1) than in raccoon dogs (1:1). Moreover, *Peptostreptococcaeae\_incertain\_sedi* and *Prevotella*, were more abundant in the gut of blue fox, whereas the abundance of *Prevotella* and *Blautia* were higher in the gut of raccoon dog. In conclusion, the present study revealed the difference of the gut microbial composition between blue fox and raccoon dog under the same diet conditions.

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Doi: 10.1007/s00203-019-01721-0.

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### **Methods for the identification of farm escapees in feral mink (*Neovison vison*) populations**

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In Denmark, American mink (*Neovison vison*) have been bred for their fur since the mid-1920s. Mink escaping from farms may supply the feral population. Often, it is of biological and management interest to separate the population of feral mink (i.e. mink caught in the wild) in two groups: 1) mink born on farms i.e., escapees, and 2) mink born in the wild. In this study, two methods were used for separating feral mink into the two groups: a) Comparison of body length of farmed mink and feral mink, and b) Presence of a biomarker (tetracycline: an oral antibiotic used on mink farms). A total of 367 wild caught mink (from the mainland of Denmark and the island of Bornholm), and 147 mink from farms, collected during the period 2014–2018, were used for the analysis of body length. For the testing of tetracycline (TC) as a biomarker, 78 mink from farms where there was knowledge about TC treatment (with or without) were examined for fluorescent markings in the canine teeth. Results from both univariate analyses and Gaussian mixture model analysis demonstrated clear divisions between the mean body length (mean  $\pm$  S.E., range) of farmed males (52.1 cm  $\pm$  0.4, 48–68) and farmed females (mean 44.0  $\pm$  0.2, 40–50), and between farmed mink and wild caught mink. Mixture analysis identified two groups within each sex of the wild caught mink, one assigned to farmed mink (born in captivity) and another group of smaller mink suspected of being born in the wild. On Bornholm, the mean ( $\pm$ SD, range) length of males born in the wild was 43.7cm ( $\pm$  0.3, 36–57) and for females 37.5cm ( $\pm$  0.3, 32–45). The mean length ( $\pm$ SD, range) of males born in the wild in the mainland of Denmark was 42.5cm ( $\pm$  2.3, 36–46) and for females 36.1cm ( $\pm$  1.0, 34–37). Among the feral mink from mainland Denmark, 28.4% of males and 21.6% of females were identified as escapees, while 0% of the males and 1% of the females were identified as escapees among the wild caught mink on Bornholm. Eight percent of mink from farms using tetracycline were false negatives, while no false positives were found among mink from farms not using TC. TC fluorescence was found in five of 217 mink caught in the wild equivalent to 22% escapees in mainland Denmark. No TC markings were found in mink caught in the wild on Bornholm. In conclusion, both methods a) the body length of mink, and b) fluorescent biomarkers in canine teeth are considered as useful tools to identifying mink that have escaped from farms.

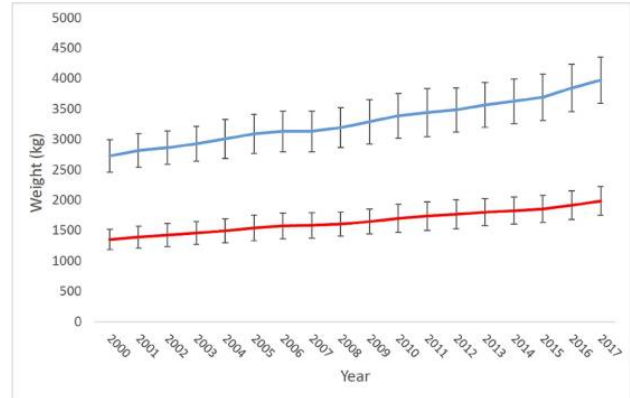


Fig. 1. Increase in weight of breeding farm mink in Denmark from 2000 to 2017.

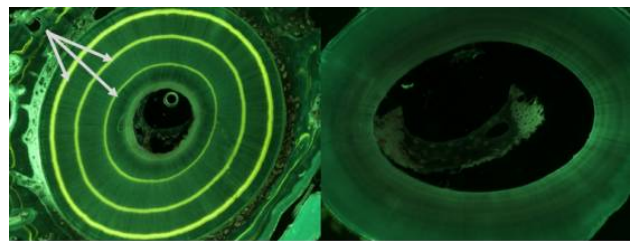


Fig. 2. Tooth root apex from mink with tetracycline (TC)(left) and without TC (right). Thin slices (70–100  $\mu$ m) of the tooth root apex from mink under a microscope, left photo from a mink treated at least three times with tetracycline (TC) and right photo from an untreated mink. TC can be seen as bright yellow bands in the tooth cementum (arrows).

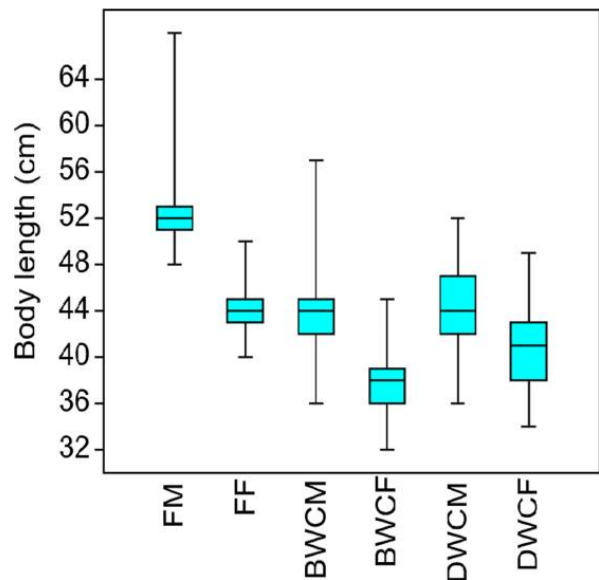


Fig. 3. Box plot of the mink body length. Length excluding the tails of farm males (FM), farmed females (FF), Bornholm wild caught males (BWCM) and females (BWCF), from samples collected from 2014–2018. Denmark mainland wild caught males (DWCM) and females

(DWCF). The rectangles represent the 95% confidence intervals.

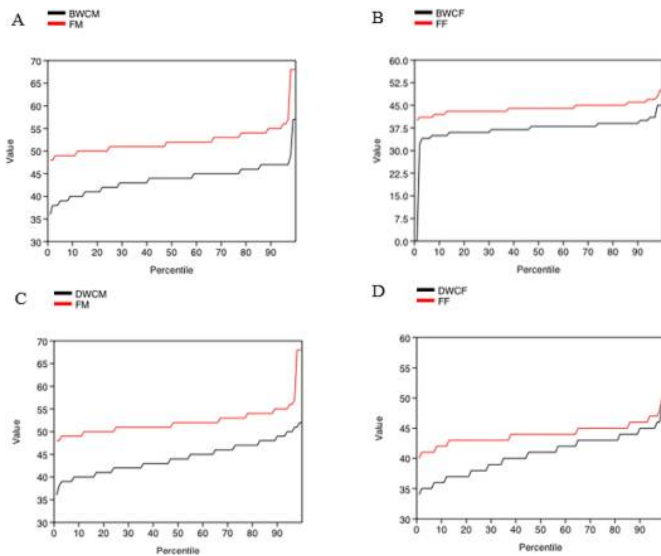


Fig 4. a-d. Cumulative curves of body length of farm mink and mink caught in the wild in Denmark from 2014–2018.

*PLoS One*. 2019 Nov 11; 14(11):e0224559.  
Doi: 10.1371/journal.pone.0224559.  
eCollection 2019.

### Features of the Femoral Proximocaudal Joint Capsule Insertion Among Canids

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### BEHAVIOUR AND WELFARE

#### The History of Farm Foxes Undermines the Animal Domestication Syndrome

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#### Hypothalamic transcriptome of tame and aggressive silver foxes (*Vulpes vulpes*) identifies gene expression differences shared across brain regions

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## **Understanding the social systems: Structure and temporal stability of red fox (*Vulpes vulpes*) groups**

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Red foxes have a highly flexible social system. Despite numerous studies worldwide, our understanding

of the pattern and stability of fox social relationships remains limited. We applied social network analysis to camera trap data collected at high-quality foraging patches to examine the social structure of a population of urban red foxes. Foxes encountered a conspecific on 13% of patch visits, and had significant preferred and avoided companionships in all seasons. They also associated in communities that matched territorial space use, confirming that territories can be analysed separately to increase power without excluding too many social partners. Foxes maintained stable, long-term relationships with other territory residents, but the average longevity of relationships varied seasonally, suggesting that social connectivity, particularly between foxes from different social groups, is influenced by their annual life cycle. The probability of re-association after a given time lag was highest in spring and summer, during cub birth and rearing, and lowest in the winter mating season, when mean relationship duration was shorter. 33% of fox relationships lasted for four consecutive seasons and were probably between territory residents. 14% lasted for around 20 days and were probably between residents and visitors from adjacent territories. The majority (53%) lasted less than one day, particularly during dispersal and mating, and were probably between foxes from non-adjacent social groups. Social structure varied between groups; in one group the death of the dominant male caused significant social disruption for two seasons. This is the first application of social network analysis to multiple red fox social groups. However, our analyses were based on interactions at high quality food patches; social connections may differ when foxes are resting, travelling and foraging elsewhere in their territory. Our results will inform management practices, particularly for disease spread and population control.

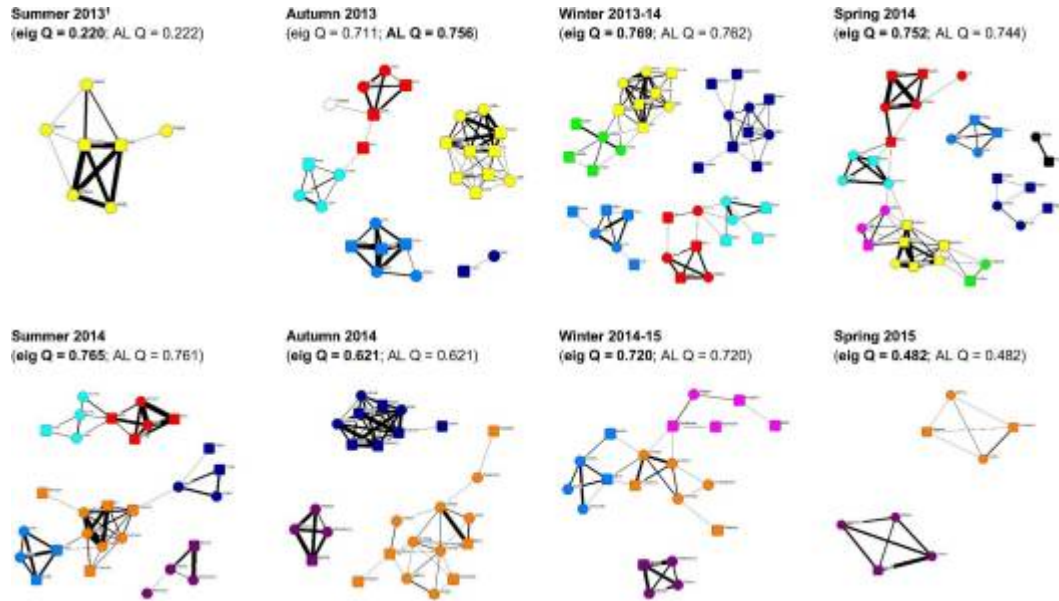


Fig 1. Consistency of communities in each season and year. Edge thickness is proportional to the simple ratio index. Node shapes represent males (■) and females (●). Eig Q = maximum modularity from eigenvector community detection, AL Q = maximum modularity from average-linkage hierarchical clustering. The communities presented are from the method in bold, based on the highest modularity or the eigenvector method when modularity was the same for both methods. <sup>1</sup> Q < 0.3 indicated the network could not be divided into communities so the full network is presented. The arrow indicates a male that switched communities between seasons.

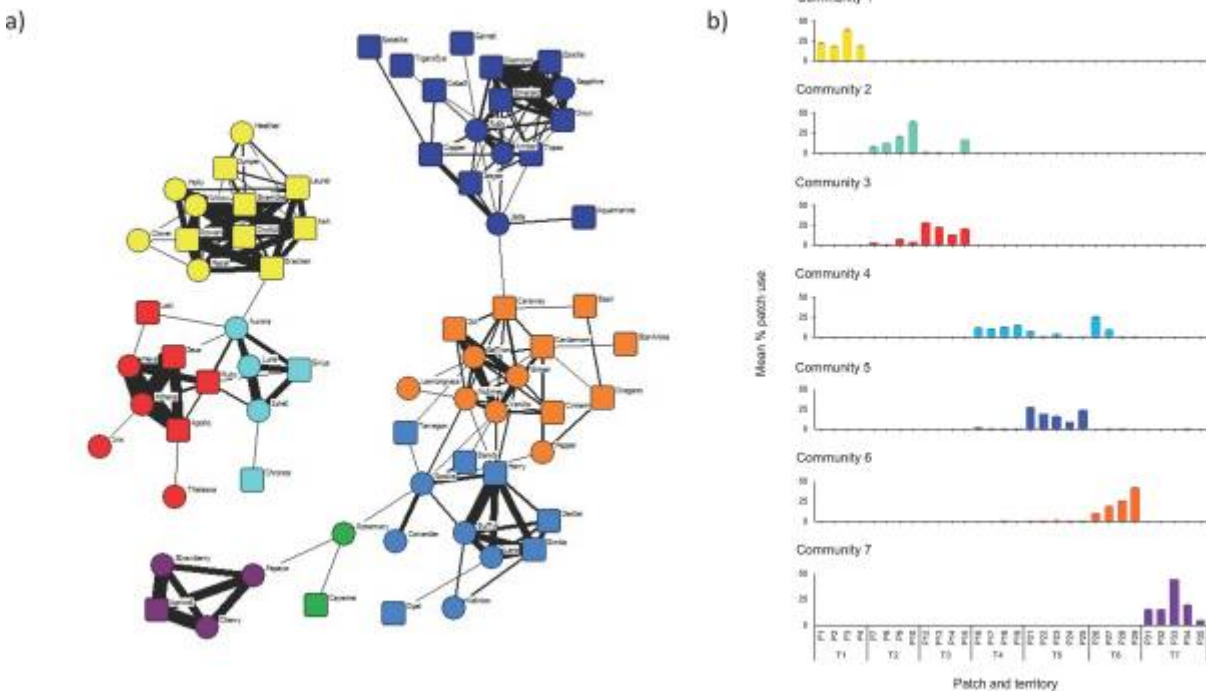


Fig 2. (a) Communities 1–8 in the fox social network, excluding isolates. Node shapes represent males (■) and females (●). Line thickness is proportional to the simple ratio index (SRI). (b) Spatial profiles of communities 1–7. Colours correspond to communities in (a) and error bars indicate standard deviation.

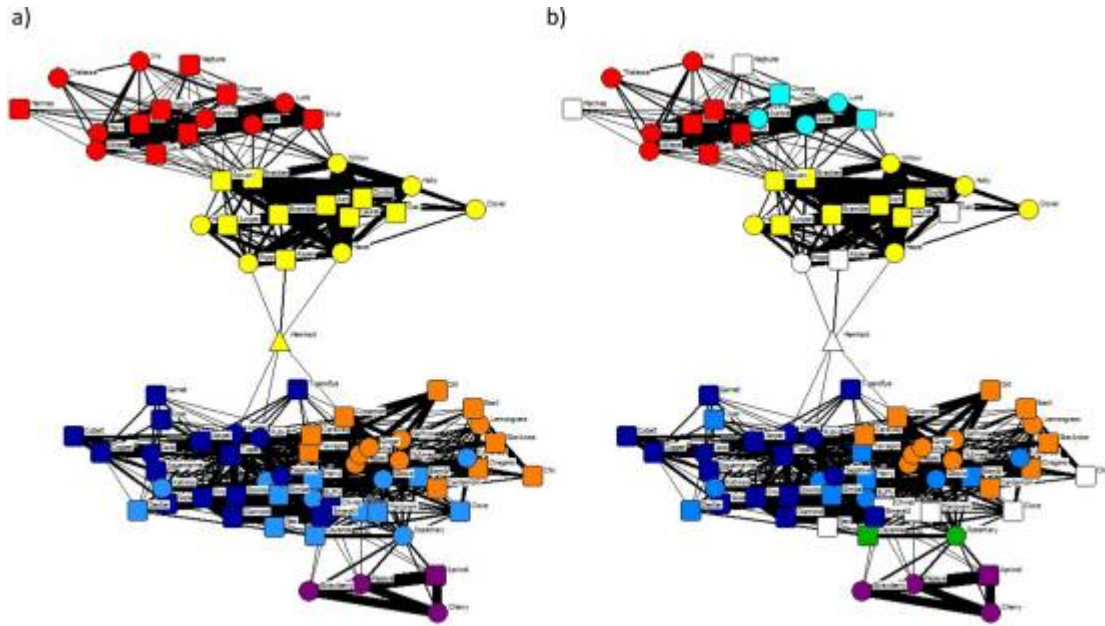


Fig 3. Space use network with (a) colours representing communities based on daily space use overlap and (b) colours representing communities based on spatiotemporal associations, for comparison. Line thickness is proportional to the simple ratio index (SRI) based on the number of days when dyads visited the same patches. Node shapes represent males (■), females (●) and unknown sex (▲).

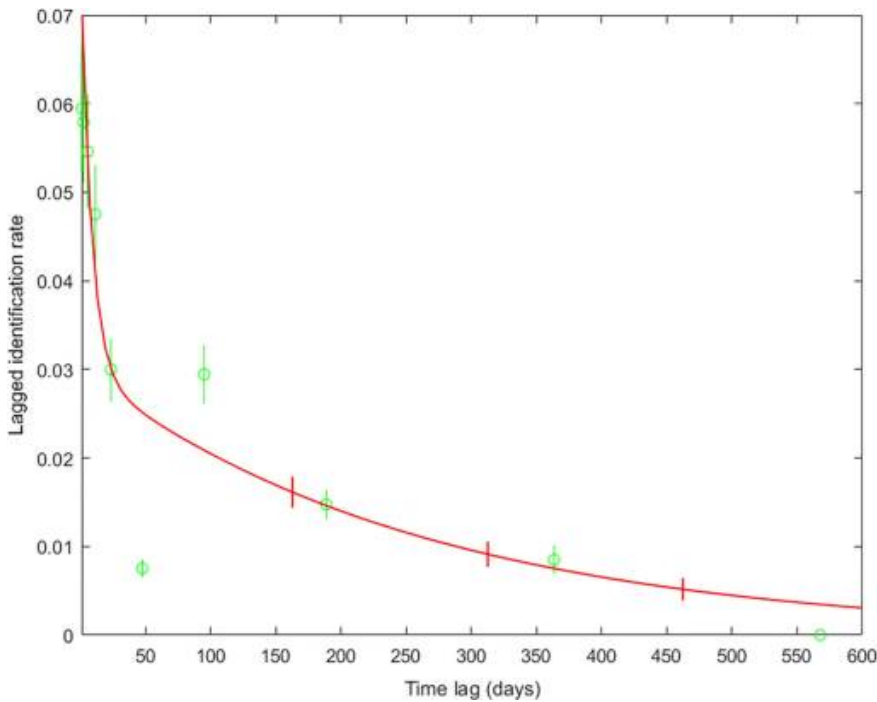


Fig 4. The probability that a fox identified on a given day would be the same as a randomly chosen individual at a later time (lagged identification rate, LIR) across the whole study (green circles) and the best-fitting model (red line). Error bars show bootstrap standard errors calculated over 100 replicates.

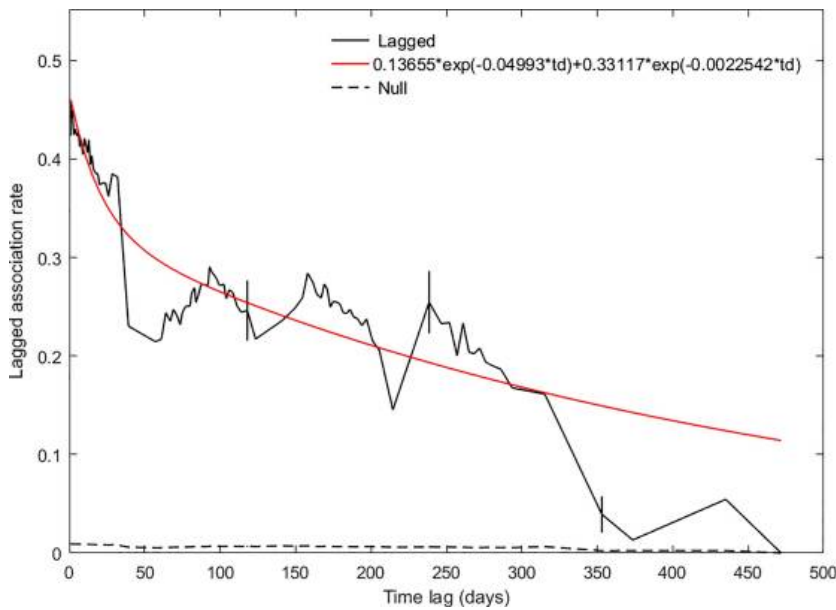
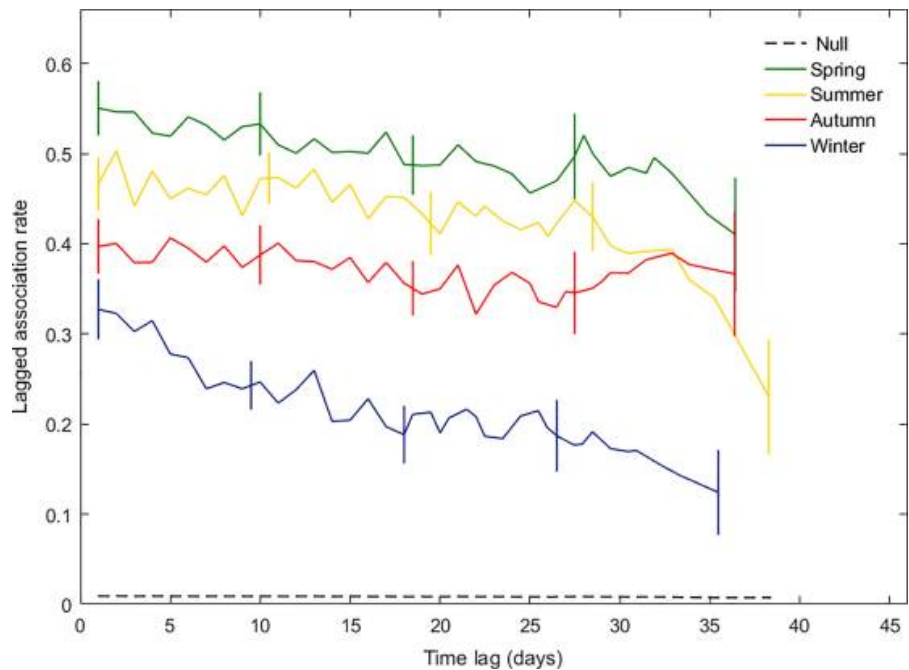


Fig 5. The probability that pairs of foxes that associated on a given day would re-associate at a later time (lagged association rate, LAR), the best-fitting exponential model and the expected association rate if associations were random (null association rate, NAR) for the whole dataset.. From: Understanding the intricacy of canid social systems: Structure and temporal stability of red fox (*Vulpes vulpes*) groups. Vertical lines show jack-knife standard errors.

Fig 6. The probability that pairs of foxes that associated on a given day would re-associate at a later time (lagged association rate, LAR) within seasons (maximum lag = 40 days) and the expected association rate if associations were random (null association rate, NAR) calculated across all data.. From: Understanding the intricacy of canid social systems: Structure and temporal stability of red fox (*Vulpes vulpes*) groups. Vertical lines show jack-knife standard errors.



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 Doi: 10.1371/journal.pone.0220792.  
 eCollection 2019.

**HEALTH AND DISEASE**

**Development and validation of nucleic acid tests to diagnose Aleutian mink disease virus**

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**Mink Aleutian disease seroprevalence in China during 1981-2017: A systematic review and meta-analysis**

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**Development of an EvaGreen-based real-time PCR assay for detection of Aleutian mink disease virus**

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**Breeding parameters on a mink farm infected with Aleutian mink disease virus following the use of methisoprinol**

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Aleutian mink disease virus is one of the greatest threats to modern mink farming. The disease reduces fecundity and causes high mortality among kits. The aim of this study was to evaluate the effectiveness of methisoprinol in counteracting the effects of Aleutian disease, both by inhibiting replication of the virus and by mitigating the harmful effects of the disease on the fecundity and weight of infected animals. The study included 300 individuals with confirmed infection,

divided according to antibody titres into three experimental groups, which received a 20% methisoprinol solution, and three control groups, which did not receive the immunostimulant. In the mink from the experimental groups, the number of copies of the genetic material of the virus in the spleens and lymph nodes was one order of magnitude lower than in the case of the control groups. Mink receiving the supplement also showed higher fecundity (on average

5.83 in the experimental groups and 4.83 in the control groups), and the weight of their offspring before slaughter was over 200 g higher. Given the lack of effective methods for immunoprophylaxis and treatment, methisoprinol supplementation can be an effective means of counteracting the effects of AMDV on persistently infected farms.

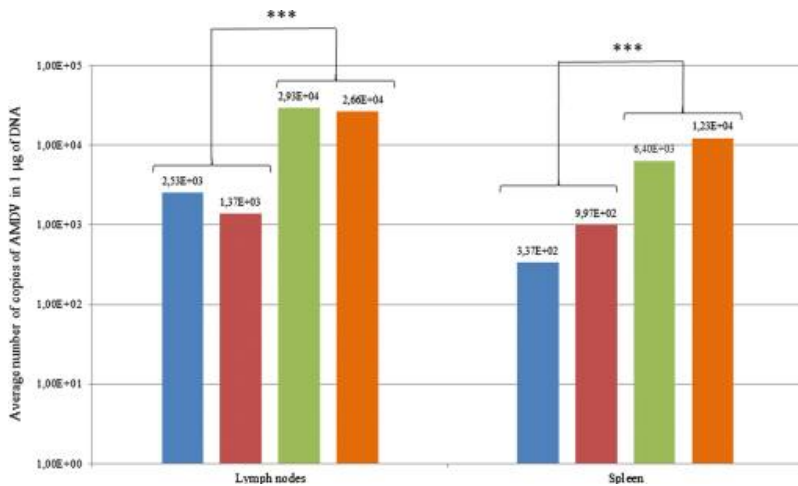
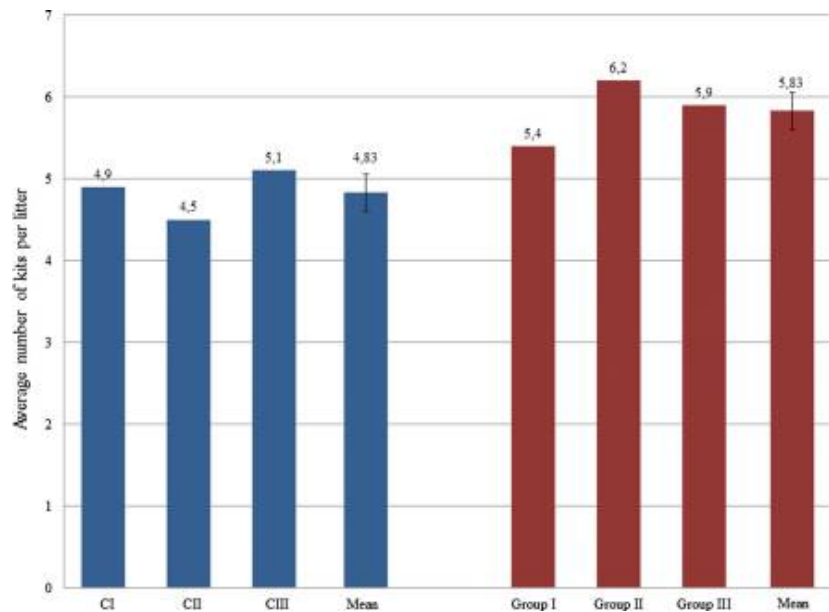


Fig. 1. Average number of copies of AMDV DNA in the spleens and lymph nodes of mink in the experimental and control groups in 1 µg of DNA. Blue, experimental group, young female offspring; red, experimental group, adult females from foundation stock; green, control, young female offspring; orange, control, adult females from foundation stock; \*\*\*, statistically significant difference

Fig. 2. Average number of kits per litter 10 days after whelping; blue, control group; red, experimental group (C1 and group 1 – control and experimental animals with antibody titre designated as +, C2 and group 2 – control and experimental animals with antibody titre designated as ++, C3 and group 3 – control and experimental animals with antibody titre designated as +++)



Arch Virol. 2019 Nov; 164 (11): 2691-2698.  
 Doi: 10.1007/s00705-019-04375-x.  
 Epub 2019 Aug 19.

### Development and evaluation of a direct TaqMan qPCR assay for the rapid detection of diverse carnivore and parvoviruses

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### Phylogenetic analysis of two amino acid substitutions in the hemagglutinin protein of canine distemper virus strains detected in fur-bearing animals in China

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Canine distemper virus (CDV) causes a highly contagious disease in a wide range of carnivores. The hemagglutinin (H) protein of viruses shows the highest variability and plays an important role in modulation of viral antigenicity, virulence, and receptor recognition. Since 2012, canine distemper (CD) outbreaks in

fur-bearing animals (minks, foxes, raccoon dogs) caused by CDV variants with I542N and Y549H substitutions in the H protein have been frequently reported in China. To characterize the molecular evolutionary dynamics and epidemiological dynamics of CDV, 235 H gene sequences of CDV wild-type strains collected from 22 countries between 1975 and 2015, including 44 strains predominant in fur-bearing animals in China, were analyzed. The phylogenetic relationships and evolutionary rates of the CDV strains were determined by Bayesian phylogenetics. The CDV strains clustered into distinct geographic genotypes, irrespective of the species of isolation. All the variant strains formed a distinct monophyletic cluster and belonged to the F sub-genotype within the Asia-1 genotype—currently the predominant sub-genotype in fur-bearing animals in China. Evolutionary analysis suggested that the variant strains originated in 2006. Furthermore, the selection pressure analysis revealed that the Y549H substitution was under positive selection pressure for adaptation toward the fur-bearing animals. The residue at position 549 also showed structural interaction with the V domain of the mink signaling lymphocyte-activation molecule (SLAM) receptor based on the homology modeling of the H-SLAM complex. Our results suggested that the Y549H substitution contributed to the molecular adaptation of CDV variants in the fur-bearing animals during the viral evolutionary phase in China.

*Virus Genes.* 2019 Dec 4.  
Doi: 10.1007/s11262-019-01720-9.  
Epub ahead of print.

### Viral Nonstructural Protein 1 Induces Mitochondrion-Mediated Apoptosis in Mink Enteritis Virus Infection

Lin P<sup>1,2,3</sup>, Cheng Y<sup>1</sup>, Song S<sup>1</sup>, Qiu J<sup>4</sup>, Yi L<sup>1</sup>, Cao Z<sup>1</sup>, Li J<sup>2,3</sup>, Cheng S<sup>1</sup>, Wang J<sup>5</sup>

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*J Virol.* 2019 Oct 29; 93 (22). pii: e01249-19.

Doi: 10.1128/JVI.01249-19.

Print 2019 Nov 15.

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### Occurrence and Genomic Characterization of Two MCR-1-Producing *Escherichia coli* Isolates from the Same Mink Farmer

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<sup>#</sup>Contributed equally

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Doi: 10.1128/mSphere.00602-19.

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### Helminths of Mustelids with Overlapping Ecological Niches: Eurasian Otter *Lutra lutra* (Linnaeus, 1758), American Mink *Neovison vison* Schreber, 1777, and European Polecat *Mustela putorius* Linnaeus, 1758

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*Helminthologia.* 2019 Mar 6; 56 (1): 66-74.

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eCollection 2019 Mar.

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### *Acholeplasma equirhinis* sp. nov. isolated from respiratory tract of horse (*Equus caballus*) and *Mycoplasma procyoni* sp. nov. isolated from oral cavity of raccoon (*Procyon lotor*)

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We describe two novel species of *Acholeplasma* sp. strain N93 and *Mycoplasma* sp. strain LR5794 which were isolated from the nasopharynx of a horse from the United Kingdom and from the oral cavity of a North American raccoon from Canada, respectively. These strains were phenotypically and genetically characterized and compared to other established *Mycoplasma* and *Acholeplasma* species. Both strains are facultative anaerobes, resistant to penicillin, and produce acid from glucose but do not hydrolyze arginine

and urea. Both strains grew well in microaerophilic and anaerobic atmospheric conditions at 35-37 °C using PPLO (pleuropneumonia-like organisms) medium. *Acholeplasma* sp. N93 does not require serum for growth. Colonies of both strains showed a typical fried-egg appearance and transmission electron microscopy of bacterial cells revealed a typical mycoplasma cellular morphology. Molecular characterization included assessment of several genetic loci. The genetic analysis indicated that *Acholeplasma* sp. N93 and *Mycoplasma* sp. LR5794 were most closely related to *A. hippikon* and *A. equifetale*, and *M. molare* and *M. lagogenitalium*, respectively. However, both novel strains were genetically unique in comparison to other well-known *Mycoplasma* and *Acholeplasma* species. Based on the isolation source history, phenotypic, genotypic, and phylogenetic characteristics of these novel strains, we propose the name *Acholeplasma equirhinis* sp. nov. for *Acholeplasma* sp. isolated from the nasopharynx of a horse [the type strain is N93<sup>T</sup> (= DSM 106692<sup>T</sup> = ATCC TSD-139<sup>T</sup> = NCTC 14351<sup>T</sup>)], and the name *Mycoplasma procyoni* sp. nov. for the *Mycoplasma* sp. isolated from the oral cavity of a North American raccoon [the type strain is LR5794<sup>T</sup> (= DSM 106703<sup>T</sup> = ATCC TSD-141<sup>T</sup> = NCTC 14309<sup>T</sup>)].

*Arch Microbiol.* 2019 Dec 11.

Doi: 10.1007/s00203-019-01786-x.

Epub ahead of print.

### **Serotypes and virulence genes of *Pseudomonas aeruginosa* isolated from mink and its pathogenicity in mink**

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*Microb Pathog.* 2019 Dec 1; 139: 103904.

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Epub ahead of print.

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### **Prevalence and Genotyping of *Toxoplasma gondii* Infection in Raccoon Dogs (*Nyctereutes procyonoides*) in Northern China**

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*Toxoplasma gondii* is one of protozoan parasites resulting in zoonosis, which can infect nearly all of warm-blooded hosts, including humans and raccoon dogs (*Nyctereutes procyonoides*). However, related reports on prevalence and genetic characterization of *T. gondii* strains in raccoon dogs were few in China. The aim of this study was to survey the prevalence and genetic characterization of *T. gondii* strains in domestic raccoon dogs from Jilin, Liaoning, and Hebei provinces, northern China. During April 2016 to November 2017, a total of 337 tissue samples collected from domestic raccoon dogs were detected with B1 gene using a nested PCR. And the positive samples were genotyped at 11 genetic markers (SAG1, 5'- and 3'-SAG2, alternative SAG2, SAG3, BTUB, GRA6, L358, PK1, c22-8, c29-2, and Apico) using multilocus PCR-restriction fragment length polymorphism technology. Sixteen out of 337 sika deer (4.75%) were positive with B1 gene by nest

PCR. Furthermore, four positive DNA samples were completely typed through further being genotyped, in which three samples were identified as ToxoDB Genotype #9, and one sample was confirmed as ToxoDB Genotype #10. The results of molecular detection not only revealed the existence of *T. gondii* in domestic raccoon dogs in Jilin, Liaoning, and Hebei for the first time, but also provided the information of genetic diversity. This study also indicated that ToxoDB Genotype #9 as a kind of potential reservoir for *T. gondii* transmission, may be main genotype in domestic raccoon dogs in China, posing a risk of infection in human health.

*Vector Borne Zoonotic Dis.* 2019 Oct 7.

*Doi: 10.1089/vbz.2019.2512. Epub ahead of print.*



Malmö 2018

**NJF SEMINAR 505  
AUTUMN MEETING IN  
FUR ANIMAL RESEARCH 2018**

**Scandic Trianglen Hotel in Malmö  
3 – 5 October 2018**



## BEHAVIOUR AND WELFARE SESSION

### Scientific review of mink welfare in Sweden

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The Scientific Council for Animal Protection has been commissioned by the Swedish Board of Agriculture, which has been commissioned by the Government, to evaluate the animal welfare of mink in Swedish fur production and assess whether production, as it is today, means that the animals are given the opportunity to behave naturally. This means that the animals are kept and maintained in a good animal environment so that their welfare is promoted and that they can perform such behaviours that they are strongly motivated for and which are important to their well-being and that behavioural disorders are prevented.

Mink raised for fur production in Sweden must be kept and managed in accordance with a constitution (SJVFS 2012: 14), which entered into force on 1 July 2012 and a regulation for the holding of mink (SJVFS 2013: 16 Issue No L 103), which was adopted on June 5 2013 and meant that changes would be made immediately or until January 1 2017. These regulations were developed after careful analysis of the scientific literature and after contact with external researchers. This report to the Swedish Board of Agriculture compiles the most relevant research, both older and newer, and attempts to link knowledge about the natural behaviour of mink, its domestication and breeding, how the mink are kept, managed and fed, and their health and diseases to the welfare of mink. In addition to complying with animal welfare rules, the industry itself has developed a welfare program (most of which is linked to the Swedish farms), and in the EU, these farms also undergo welfare checks through the "FurEurope" program (WelFur). Everyone working with mink in Sweden must have completed a course of at least 30 hours followed by a test, and in order to be responsible for the killing of mink, further education and examination are required.

The compilation of international research and the description of how minks are kept and managed in Sweden today, after the new rules have been introduced, indicate that the production is managed so that the animals are given good opportunities to behave naturally. Mink are generally kept in a good animal environment so that their well-being is promoted and the mink is rel-

atively healthy. Mink can, through the new rules, perform such behaviours as they are strongly motivated for and which are important to their well-being. Behavioural disorders are prevented by giving mink ad libitum access to feed, keeping them in climbing cages with two shelves, providing them straw for nest building, feeding and occupation, and giving them at least two enrichments which are replaced regularly. In Sweden mink has always had ad libitum access to a nest, which is one of the most important resources. Drinking water is given ad libitum in frost-free drinking nipples, but the industry might consider to also providing water outside the nest for kits and the female from 3-4 weeks after the kits are born. Water in a larger bath is considered a powerful enrichment, but not a behavioural need, and health of the mink may be compromised. There are some areas where the management of the mink could be improved, for example avoid breeding on larger size of the mink, which may cause housing and management problems in the future. More knowledge is therefore required in several areas.

### Cross fostering in mink: Time after birth influence maternal behaviour and offspring growth

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Only few systematic studies focus on cross fostering of mink offspring and levelling of litters early in life. Methods: 408 transponder marked kits were transferred from large litters (9-14 kits) to foster mothers (N=408, 4-7 kit per litter) on either Day 2 (N = 201) or Day 6 (N=207) relative to the day of birth (Day 0). Besides timing of transfer, the foster mother age class (young: 1.st parity, old: 2<sup>nd</sup>-3<sup>rd</sup> parity) was a factor in the study. The transferred kits were 50% male and 50% female. Results: Mink mothers retrieved the novel kit quicker to the nest at Day 2 than at Day 6. The offspring body-weight (Day 56) was higher after transfer at Day 2 than at Day 6. Young and old dams displayed an equal acceptance of the foster kit, but the growth of kits was significantly better in litters nursed by the experienced, older dams. Foster kits had a higher risk of dying (15.8 % vs. 11.4 % for the biological kits in the receiving litter) until Day 56. The mortality of foster kits was not different from that in a group of intact control litters with 8-14 kits. There was a strong influence of offspring sex on the amount of damages observed around Day 49. Out of the 2516 examined kits in receiver litters, 6.8% of the males and 46.1% of the females, had some sort of a damage (primarily scrust/wounds on the

side of the neck), scored in different intensities from 1-5. Litters of young dams receiving a novel kit Day 2 scored significantly worse on total damage in the litter, than the young dams receiving a novel kit Day 6 and the older dams. Conclusion: It is recommended to transfer mink kits early (within the first days) after birth and to choose old rather than young dams as receiver of foster kits.

### **Searching for optimal wintering conditions for young Finnraccoon females**

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<sup>2</sup>University of Eastern Finland, Department of Biology and Environmental Sciences.

The present study has been published in Applied Animal Behaviour Science in 2018: Koistinen T., Raatikainen S., Sepponen J., Korhonen H.T. 2018. Resting preferences and welfare of Finnraccoon (*Nyctereutes procyonoides ussuriensis*) females housed in various housing conditions in winter. (doi: 10.1016/j.applanim.2018.06.006).

The aim of the present study was to document the wintering behaviour of young Finnraccoon females (*Nyctereutes procyonoides*). Females were raised alone in two different size cages, alone in the larger cage with access to a winter nest and in pair in the larger cage through their first winter. The results show that the housing conditions affect the resting behaviour; the females having access to a winter nest rest almost solely inside the nest, while the females housed in pair allo-huddle. The females without these resting options rest on the cage floor and to a lesser extent on the ordinary platform. The Finnraccoons with access to a winter nest are less active than others, but do not show true superficial hibernation. The level of stereotypic behaviour remains low throughout the winter. Based on the present results young Finnraccoons are recommended to be raised in social housing units or with access to nest box in winter, in order to secure comfort resting behaviour.

### **Extra water for kits and ad-libitum feed for mink dams also benefit mink on private farms, but effects differ from research**

Steen H. Møller<sup>1</sup>, Britt I.F. Henriksen<sup>1</sup>

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Research at Aarhus University's mink farm has shown a better development of mammary gland tissue in mink dams if they are fed ad libitum after birth, rather than more restricted, although the effects differ somewhat between first year dams (Pinkalski & Møller, 2014) and older dams (Møller et al., 2015).

For many years it has been known that mink kits as well as dams benefit from easier access to the standard drinking water supply, and that it helps the kits to drink earlier which reduce saliva licking and makes them grow faster (Møller & Lohi, 1989; Møller, 1991). Recently it has been shown that additional water for mink kits close to the next box helps the kits to drink up to eleven days earlier which increases the positive effects on growth, wounds and weight development (e.g. Hansen et al., 2015; Jespersen et al., 2014; Malmkvist et al., 2016; Clausen & Larsen 2013).

In order to test if the effects would be the same in practice, we applied ad libitum feeding compared to more restricted feeding after birth, and an additional water nipple just outside the nest box in large scale on 4 private farms. We hereby present the results, that was primarily expected in the period from 28 days to weaning. The main purpose was to test to what degree results from research farms, can be found under the very varying management routines found on private farms.

Science-based animal welfare in the European fur sector

Jyrki Sura - Head of Welfur, Fur Europe

**One Tool, Many Purpose**

WELFUR™

**Background**

- Welfur is based on the scientific methodology of the European Commission's Welfare Quality® project (2004)
- The Welfare Quality® project aimed at accommodating societal concerns and market demands based on a reliable on-farm monitoring system
- Backed by the European fur auction houses, Welfur was initiated by the European Fur Breeders Association in 2009

**Building Welfur**

All existing scientific literature is reviewed. This forms basis of the Welfur protocols

European universities are involved in the development of Welfur

On-farm testing of Welfur and calibration of scoring system

Implementation of Welfur on 4.000 European mink and fox farms

2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020

**Animal Welfare Based on Science**

- 30 years of scientific research underlies the animal welfare assessment in Welfur
- External reviewers have conserved the quality of the scientific work
- The measurements in Welfur have been chosen for their validity, reliability and feasibility

**One Tool, Many Purpose**

- RELIABLE ANIMAL WELFARE ASSESSMENT
- ANIMAL WELFARE IMPROVEMENTS
- CONSUMER TRANSPARENCY
- BUILDING POLITICAL ACCEPTANCE LICENCE TO OPERATE

**Professional Animal Welfare Assessment**

- Welfur combines different approaches to animal welfare in one and the same system
- The animals' experience of a good life is the focus of Welfur. Increase the animals' positive emotions and eliminate the negative
- Welfur favours animal indicators, i.e. prefers to measure directly on the animal rather than the housing system

**Welfare in Practice**

22/25 measurements  
12 criteria  
4 Principles  
1 overall score

6-8 hours  
120 mink cages  
80 fox cages  
3<sup>rd</sup> party assessor

Period 1 (winter) | Period 2 (summer) | Period 3 (spring)

3 x ASSESSMENTS (1 per period)  
Methodological computer evaluation of data

Welfare Certification | FARM SCORE+ Industry Standards | No Certification (prevented from selling at international auction houses)

Objective documentation of animal welfare standards | Consumer transparency | Tool to improve animal welfare

**European Consumer Behavior**

- 59% are willing to pay more for products stemming from animal productions with high animal welfare
- 52% look for animal welfare certificates when buying products
- 47% find the selection of animal welfare-friendly products in retail stores and super markets inadequate – up 9% since 2006

*Eurobarometer 2016*

**Fashion Houses Drive Sustainability Forward**

- Global fashion brands are increasingly concerned about the origin of their raw materials
- Top fashion houses have shown interest in Welfare from the beginning
- The European fur sector is in dialogue with these brands through a Luxury Round Table

**Traceability Trends**

- Certification and traceability is going to grow as a sales parameter in the future
- Some consumers will buy fur only because it will be possible to buy from certified farms
- It is quite possible that Welfare directly will expand the number of potential fur buyers

**Welfare Status 2018**

- 96% of European mink and fox farmers have signed up for the programme
- Also farms in North America are signing in
- First European farms will be Welfare certified in December 2018,
- The European Commission has highlighted Welfare as a best practice example of animal welfare assessment
- Several European countries have shown interest in including Welfare in national animal welfare legislation

**Thank you!**

**WELFUR™**

## NUTRITION AND MANAGEMENT SESSION

### Iron supplementation to mink kits at day three after birth

Karoline Blaabjerg<sup>1</sup>, Tove N. Clausen<sup>1</sup>, Rikke Brødsgaard Kjærup<sup>2</sup>, Ida Bylov Steensgaard<sup>2</sup> & Peter Foged Larsen<sup>1</sup>

<sup>1</sup>Kopenhagen Fur Research, <sup>2</sup> Department of Animal Science, Aarhus University.

Iron (Fe) plays an important role in growth and hemoglobin formation. After birth and until mink kits begin to ingest solid feed, the hemoglobin level diminishes indicating that mink kits in this period are likely to suffer from iron deficiency (anemia). Therefore, the purpose of this experiment was to investigate the effect of injecting mink kits with iron day 3 after birth on hemoglobin and hematocrit levels and content of iron in the liver as well as growth. The experiment showed that injection with 2 mg iron day 3 after birth resulted in a significant increase in hemoglobin and hematocrit day 18 but not day 39 and 58 after birth. Injection with iron also caused an increase in the iron content of the liver day 18 but had no effect on growth day 18, 39 and 58. The injected iron dose corresponded to the dose per gram of body weight used as a standard for suckling pigs day 3 after birth to prevent anemia. However, mink kits have a relatively higher growth rate compared with suckling pigs. Consequently, the used iron dose per gram of growth was considerably less for the mink kits compared with suckling pigs. This probably explains the lack of effect of iron on growth and hemoglobin and hematocrit day 39 and 58. However, further experiments with higher iron doses are required to confirm this. If future experiments with a higher iron dose show similar positive effects on growth and survival of mink kits, as the right iron dose has been shown to have in suckling pigs, it will contribute to increased productivity and thereby improve the competitiveness of the mink breeders.

### The need of vitamin supplementation in female mink during the winter period

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This investigation showed that the reserves of the fat soluble vitamins in general was high enough to counteract the lower intake caused by the change in body

condition management during the winter period. For the water soluble vitamins the investigation showed that riboflavin, niacin, pantothenic acid and pyridoxal can be reduced in the winter period, whereas low excretion of these vitamins from the kits during the lactation period indicate that supplementation most likely is needed.

### Weight data collected on Danish farms in 2015-2017, from early winter to the females giving birth, in order to find the optimal weight development curve for maximal number of kits born

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The purpose of this project was to find a recommended weight curve in mink from early December to end of April to ensure a high reproductive result, based on weight data from Danish farms. Furthermore, the aim of the project was to give Danish advisors and veterinarians more knowledge on weight loss during winter and the effects on reproductive results, and thereby the possibility to offer a validated and correct advise to the farmers. Before this project was started, a number of Danish farmers already weighed minks throughout the year, but no systematized collection and sharing of these data existed, and therefore nor farmers, advisors or veterinarians had the benefits of knowledge being shared. This project was started in the Danish knowledge exchange groups, where requirement to participate was the willingness to weigh mink at certain intervals and share the data with the group and the advisors in an online excel-based system made specifically to this project. Females and males were weighed every fortnight from December to April 1<sup>st</sup> and weekly from April 1<sup>st</sup> to end of April in two years - season 2015/2016 and 2016/2017. The resulting recommended weight development curve for females showed, that the females should loose approximately 40 % of their bodyweight from pelting to ultimo February, and be maintained at that weight until flushing commenced. Regardless of weight loss recommendations, no females should be thinner than body condition score 2 at any given moment, so weight can never be the only assessment method on the farms. For males the recommended weight loss was approximately 35 % ultimo January, and maintained until mid-February where feed and body condition then should be increased in order to get them ready for the mating season. No males should be thinner than body condition score 2 at any given moment. In the future the recommended weight development curve produced in this project will be refined and further validated, through

weight data collected in the new Furapps, increasing the knowledge and quality of the recommended weight loss during winter and weight gain until parturition.

### **Effect of feed energy and protein level on performance in blue fox (*Vulpes lagopus*) in late growing-furring period.**

Vappu Ylinen<sup>1</sup>, Maarit Mohaibes<sup>2</sup>, Jussi Peura<sup>3</sup>, Tor Mikael Lassén<sup>4</sup>, Jarmo Valaja<sup>1</sup>

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Effect of feed energy and protein level on growth and pelt characteristics was studied with 60 blue fox males in late growing-furring period from mid-October until pelting. Experimental groups were “high energy—high protein” (HE-HP), “high energy—low protein” (HE-LP), “low energy—high protein” (LE-HP) and “low energy—low protein” (LE-LP). Feed intake, body weight and weight gain, body condition score (BCS), body mass index (BMI), pelt size, pelt quality and incidence of watery faeces were observed as performance indicators. Blue foxes fed with high-energy feeds had higher body weight ( $p=0.0002$ ), ADG ( $p<0.0001$ ) and BMI ( $p=0.002$ ) at pelting. Pelt size, pelt quality, feed intake and BCS were not affected by the treatments. Watery faeces and reduced voluntary feed intake (loss of appetite, unwillingness to eat) were not found.

### **Effect of tetradecylthioacetic acid (TTA) on body fat deposition in silver foxes (*Vulpes vulpes*)**

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Tetradecylthioacetic acid (TTA) is an artificially produced fatty acid with a sulphur atom replacing the third methyl group from the carboxyl end. In animal studies, TTA has increased mitochondrial  $\beta$ -oxidation and reduced body weight gain and body fat deposition in rats.

In foxes, dietary TTA supplementation might be beneficial for reducing body fat as preparation for the reproduction period.

The study were carried with silver fox males cubs in the autumn period (Sept-Dec) applying 0 (control), 1.2g TTA and 4.8 g TTA/kg feed with seven animals in each group. The TTA levels were based on a feed intake of approximately 250 g dry matter/animal/day, corresponding to 50 mg and 200 mg/ kg body weight per day with a six kg animal for the 1.2 g and 4.8 g TTA group, respectively.

The study showed that the two levels of dietary tetradecylthioacetic acid (TTA) supplementation did not produce clear effects on body fat deposition in growing silver foxes. The 4.8 g/kg level reduced feed consumption, which produced significant reduced body weight gain. There was no significant difference in kidney fat with the 1.2 g TTA level compared to control group, but the highly significant correlation between body weight and kidney fat suggested that, reduced ME intake was the main factor causing reduced kidney fat, irrespective of TTA supplementation. TTA did not reduce fat digestibility.

### **The effect of biochar-peat mixture on the odour from mink manure**

Maarit Hellstedt<sup>1</sup>

<sup>1</sup>Natural Resources Institute Finland.

Gaseous emissions from fur manure cause local nuisance as well as leakage in the nutrient cycles of agriculture. Cover materials can be used during the storage of manure to reduce both the odour problem and to tighten the nutrient cycles. The use of biochar-peat mixtures to reduce odour was tested in a small-scale laboratory study.

The results show that a biochar-peat covering of at least 3 cm is able to considerably reduce the odour from the fur manure. New covering material should be spread every week to keep the effect on an acceptable level. During cold periods as the temperature of the manure is near zero the odour level is quite low and no covering is needed.

## BREEDING AND GENETICS SESSION

### Implementation of body mass index (BMI) for Finnish blue fox

Jussi Peura<sup>1</sup>

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This article is a case report on the development and implementation of body mass index (BMI) for the Finnish blue fox certification system. BMI has been shown to be an objective and effective measurement to evaluate the level of fatness of blue foxes during autumn before pelting. BMI was developed as part of a residual feed intake project during autumn-spring 2017-2018 and it was tested during autumn 2017. At the beginning of summer 2018 Profur implemented it into the Finnish fur certification system and first certification auditions will start in autumn 2018.

## VETERINARY AND PATHOLOGY SESSION

### Parvoviruses of mink and fox – molecular epidemiology and prevention

Tarja Sironen<sup>1,2</sup>, Anna-Maria Moisander-Jylhi<sup>2</sup>, Jenni Virtanen<sup>1</sup>, Kirsi Aaltonen<sup>2</sup>, Olli Vapalahti<sup>1,2</sup>

<sup>1</sup>*University of Helsinki, Medicum, Department of Virology.*

<sup>2</sup>*University of Helsinki, Department of Veterinary Biosciences.*

Many mustelid and other carnivore species harbor closely related parvoviruses, some of which cause severe disease in the host species. Parvovirus infections of production animals are the most significant cause of enteritis leading both to animal welfare problems and economic losses. To prevent these infections, vaccines have been developed and are in use, however, the vaccines are not always up to date and the vaccination schedules and dosage may be unoptimized. Mink (*Neovison vison*), foxes (*Vulpes lagopus*) and finnraccoons (*Nyctereutes procyonoides*) can all be vaccinated using a mink enteritis virus - vaccine, however, the level of protection is not the same for the different animal species. The recent discovery of new parvoviruses calls for re-assessment of the current vaccination schemes.

We studied the molecular epidemiology of parvoviruses infecting Finnish fur animals. Samples obtained

from mink and foxes revealed the presence of similar, yet not identical parvovirus variants. Based on these observations, a novel vaccine candidate was developed specifically for fox parvovirus. Antibody responses elicited by the candidate vaccine, and the currently used MEY-vaccine were compared, and the results support the continued development and testing of the candidate fox parvovirus vaccine. The technique for vaccine production used in this study will also enable vaccine producers to easily update the vaccine, if new strains or variants are detected in the animal population. We have further studied the presence and titers of maternal antibodies relative to age of the pups and hope to have new recommendations on the vaccination scheme to maximize the effectiveness of the vaccine.

### Preliminary results of clinical and gross pathological studies of cystitis and urolithiasis in farm mink (*Neovison vison*)

Karin Mundbjerg<sup>1,2</sup>, Tove Clausen<sup>3</sup>, Oliver Lykke Honoré<sup>2</sup>, Morten Thorstensen<sup>2</sup>, Caroline Berner<sup>2</sup>, Ida Sebbelov<sup>4</sup> and Anne Sofie Hammer<sup>2</sup>

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<sup>3</sup>*Kopenhagen Farm, Denmark.*

<sup>4</sup>*Department of Mathematical Sciences, University of Copenhagen, Universitetsparken 5, 2100 København Ø, Denmark.*

The objective of this study was to evaluate urine sample analysis and specific blood parameters as predictors of gross lesions in the urinary tract of farm mink kits with cystitis and urolithiasis. Urine samples (n=240) were collected by spontaneous micturition. Based on urine analysis data two case groups (n=18/14) and one control group (n=12) of animals were selected. The case and control animals were euthanized and examined by necropsy. Lesions associated with cystitis and urolithiasis were recorded. Gross pathological findings were recorded in 7 animals. 6 of these were case animals identified by presence of struvite crystals in combination with erythrocytes, pH > 6.6, discolored urine and/or positive nitrite. No gross pathological findings were found in the control animals. In conclusion, urine analysis appeared to be a useful method for the identification of mink kits with gross lesions in the urinary tract. The results indicate that urine color, nitrite, pH and the presence of struvite crystals should be evaluated in combination.

## POSTER SESSION

### Is fur-chewing associated with ‘coping style’ and reproductive performance in blue fox vixens?

Jaakko Mononen<sup>1</sup> and Tarja Koistinen<sup>1</sup>

<sup>1</sup>Natural Resources Institute Finland (Luke), Production systems.

The prevalence of fur-chewing in farmed blue foxes peaks in winter, ranging then on Finnish farms from 0 to 30% of the animals. However, there are few studies on fur-chewing in blue foxes. In our pilot study, we examined the relationships between fur-chewing, behaviour in three behavioural tests reflecting foxes’ ‘coping style’ and reproductive performance. The study population was 551 blue fox vixens (271 primiparous and 280 multiparous) of one commercial Finnish fur farm. The fur-chewing status was assessed and behavioural tests were carried out in early March 2017. The prevalence of fur-chewing was 36%. The reproductive performance data were collected in June-July 2017. The age class of the vixen was as a confounding factor in all the statistical models (Logistic Regression and Poisson Regression). Fur-chewing was more frequent in the blue foxes with a proactive ‘coping style’: eating in the presence of a man in the Feeding Test (only multiparous foxes), being explorative in the Stick Test, and approaching the assessor and showing no fear reactions in Subjective Evaluation of Human-animal relationship. There was no statistically significant association between fur-chewing and whether a vixen succeeded to reproduce or not. Instead, vixens with a proactive ‘coping style’ and fur-chewing tended to have larger litters than vixens with only one or none of these features. Our preliminary results indicate that fur-chewing is probably a part of a proactive coping mechanism in blue foxes. This does not necessarily invalidate fur chewing as an indicator of insufficient housing environment, since there may be individuals who do not have the disposition to develop this abnormal but putatively stress relieving behaviour. Altogether, further studies on several farms are needed to clarify the causation and mechanisms of development of fur-chewing in blue foxes, as well as its relationship to the welfare of the animals.

### How to improve the outcome of the animal protection inspections on Finnish fur farms?

Tarja Koistinen<sup>1</sup>, Hannu T. Korhonen<sup>2</sup>, Petra Tuunanen<sup>1</sup>, Jaakko Mononen<sup>1</sup>, Sari Salminen<sup>3</sup>

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<sup>2</sup>Kokkola.

<sup>3</sup>Finnish Food Safety Authority (Evira) Helsinki.

Regional State Administrative Agencies carry out the annual animal protection inspections on fox, mink and Finn raccoon farms selected by Finnish Food Safety Authority (Evira). Most of the inspected farms are selected by targeted criteria and about one fourth of them randomly. The aim of our project is to clarify the main violations of the regulations on Finnish fur farms and, together with the industry, find out solutions how to improve the inspection outcomes. The annual animal welfare reports of Evira and detailed inspection reports by the veterinarians from the years 2010 to 2016 were carefully examined for recognizing the challenges with national and European regulations. During this period, a total of 236 inspections were done. Violations were not found in 108 cases, and violations were found in 128 cases. However, a total of 378 separate violations were registered, because there were typically several violations in one farm. Only in one case urgent measures were required. The violations were mostly related to outworn or broken cages, lack of enrichments (e.g. activity object, platform, bedding material) and indifferent attitude towards medication, euthanasia and mortality records. Typically, there were no challenges with feeding and watering. No violations were found in the general conditions of the farm, such as lightning and noise. Various ways of further educating the farmers and facilitating management of the farm have been implemented in the project, including giving lectures, spreading information through various channels, making education videos and developing processes. However, the challenge seems to be how to reach the multi-problematic and indifferent farmers, instead of the already active and responsible farmers. We are still looking for ideas, also from the neighboring countries, how to better educate and motivate the farmers to follow the national and European regulations accurately and improve animal welfare in other ways.

### **Detection of the Heat-related Odors in Blue Fox Vixens by Trained Dog – a Pilot Study**

*Ojala, Eeva<sup>1</sup>*

<sup>1</sup>*Kannus Research Farm Luova Ltd.*

One crossbred dog was trained to detect and respond to heat odors of blue fox vixens. The performance of the dog was tested on insemination season during 13 testing days between 19<sup>th</sup> March and 11<sup>th</sup> April 2018. The dog was able to detect an average of 76.1% of the vixens that were on heat on testing days. The results of the experiment indicate that a specific odor is associated with the heat of blue fox vixens and a trained dog is able to detect the odor.

### **Additional water for mink kits and a netting insert in the nest box can reduce kit loss in the nursing period**

*Britt I.F. Henriksen<sup>1</sup>, Jens Malmkvist<sup>1</sup> and Steen H. Møller<sup>1</sup>*

<sup>1</sup>*Aarhus University, Dept. of Animal Science, Tjele, Denmark*

We tested the hypotheses that: 1) the product Easy-strø complete (Easy-AgriCare) will reduce kit mortality compared with straw as bedding material in the nest box, 2) a netting insert will reduce kit mortality in nest boxes of plywood, and 3) an additional water nipple (Hedensted-Gruppen) for mink kits positioned at the nest box entry will decrease the prevalence of kits with injuries, 4) an additional water nipple will mask positive effect of early partial weaning of litters with more than five kits. The different management procedures and products (easy-strø complete, netting insert, additional water for kits, partial weaning of litters of 6 or more kits at six weeks) were tested on two private mink farms in the nursing period, to evaluate their effect on kit mortality and welfare. The odds of kit mortality from day 1 to 28 were higher in nest boxes with a netting insert and with easy-strø complete as bedding material, compared to netting insert with straw. Nest of straw were also scored thicker and higher compared with easy-strø complete. With straw as bedding material, a netting insert reduced the odds of kit mortality from day 1 to 28, compared with no netting insert, while a netting insert, independent of bedding material, reduced the odds of injuries at day 49 on one of the farms. The odds of kit mortality from day 28 to weaning in litters with more than five kits were lower with additional water for kits near the nest box opening. We

conclude that providing access to a water nipple close to the kits nests, and a netting insert together with straw as bedding material in nest boxes of plywood, is positive for the mink kits welfare, with reduced kit loss and less injuries.

### **Characterization of *Escherichia coli* isolates from healthy and diseased mink**

*J. de Rond<sup>1</sup>, J. Wiegel<sup>1</sup>, R.J. Molenaar<sup>1</sup>*

<sup>1</sup>*GD Animal Health, P.O. Box 9, 7400 AA Deventer.*

*Escherichia coli*-related disease problems are of major economic concern for the mink industry (Tibbetts, White et al. 2003) but there is a notable lack of information about the characteristics of the strains that cause disease in mink. In this study, *E. coli* isolates from diseased mink are tested for the presence of gene sequences associated with virulence, resistance or other properties and compared to *E. coli*, isolated from gut contents of healthy mink (commensal). As mink are often fed with uncooked meat products originating from poultry, the disease-associated *E. coli* are also compared to disease-associated *E. coli* from contents of chickens.

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