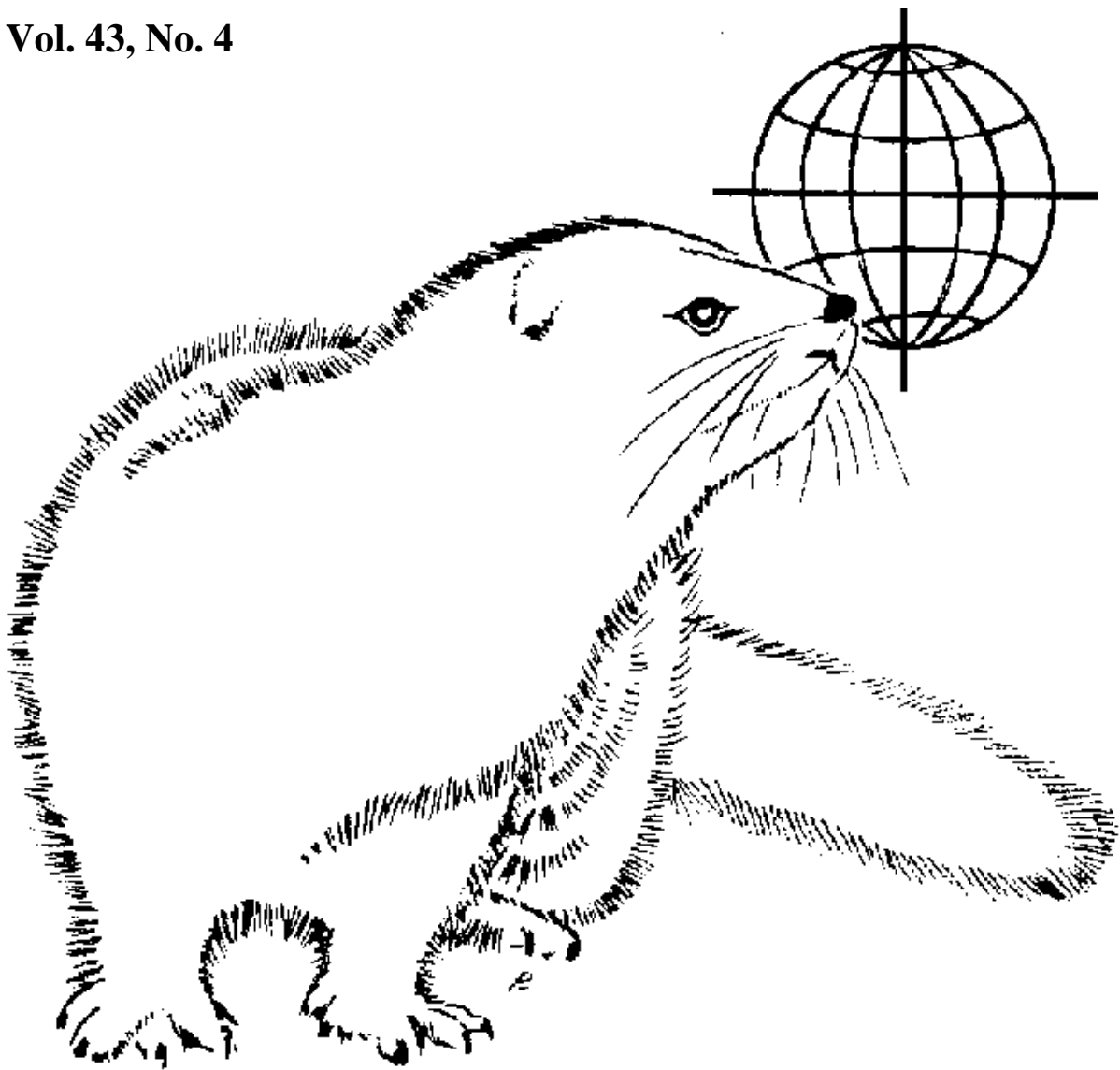


# SCIENTIFUR

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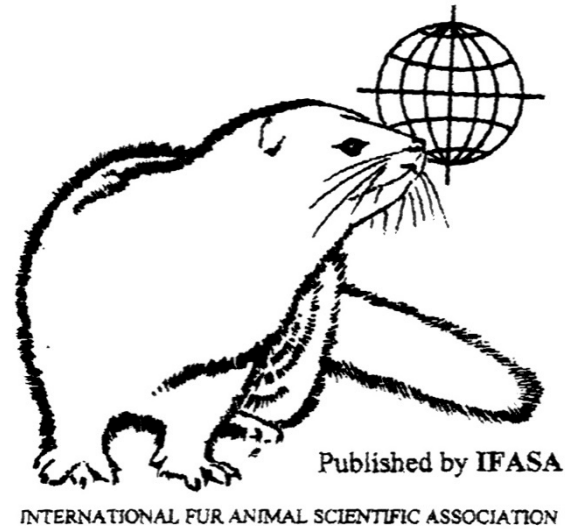
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## Notes from the Editor

The extent of the fur animal production and the demand for and sales and prices of skins vary as experienced over the last years. The favorable prices for mink skins in 2013 led to a subsequent large increase in the production. It was followed by falling prices for skins, which has resulted in a recent adjustment of production. Against this background, there is again an expectation of a future better payment for the skins.

With low prices, it may be a challenge just to cover the production costs. Research is needed to improve resource efficiency for environmental reasons, but just as important for economic reasons. This includes research for improved efficiency, which also implies research for improved litter size and survival of kits as well as health and welfare.

Research referred to in this issue of *Scientifur* points at genotypes influencing female and male fecundity

in foxes with the potential of improvement by selection. Other research points at the option of coping with offspring's fearfulness and stress responses by selecting for low-fear and explorative dams. Good health is crucial and a suggestion is put forward of providing solutions with a synthetic compound to inhibit replication of the Aleutian mink disease virus as well as mitigating the harmful effects of the disease on the fecundity and weight of infected animals. Advice regarding vaccines against astrovirus is given and long-term immunogenicity and efficacy are suggested by using oral rabies virus vaccine.

I am glad to announce the XII International Scientific Congress in Fur Animal Production, which will be held 25-27 August 2020 in Warsaw Poland: <http://ifasa2020.pl/> and <http://www.ifasanet.org/index.php>

Vivi Hunnicke Nielsen

Editor *Scientifur*





**BREEDING, GENETICS AND REPRODUCTION****Polymorphisms of four candidate genes and their correlations with growth traits in blue fox (*Alopex lagopus*)**

Yu D.Y.<sup>1</sup>, Wu R.Z.<sup>1</sup>, Zhao Y.<sup>1</sup>, Nie Z.H.<sup>1</sup>, Wei L.<sup>2</sup>, Wang T.Y.<sup>2</sup>, Liu Z.P.<sup>3</sup>

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*Gene*. 2019 Oct 30; 717:143987.

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**Activity and transcriptional regulatory elements of the promoter in Arctic fox (*Vulpes lagopus*)  $\beta$ -defensin103 gene**

Guo M.<sup>1</sup>, Zhao Z.<sup>1</sup>, Wang R.<sup>1</sup>, Zheng X.<sup>2</sup>, Peng Y.<sup>1</sup>, Liu Z.<sup>1</sup>, Li X.<sup>1</sup>, Gong Y.<sup>1</sup>

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The aim of this study was to screen the active regions and transcription factor binding sites in the promoter of the CBD103 gene related to Arctic fox coat color, and to provide a basis for revealing the molecular genetic mechanism of CBD103 gene regulating the coat color formation. The 5'-flanking region fragment 2 123 bp of Arctic fox CBD103 gene was cloned, and 4 truncated promoter reporter vectors of different lengths were constructed. The promoter activity was detected by the dual-luciferase reporter assay system. Point mutations were performed on the 3 predicted specificity protein 1 (Sp1) transcription factor binding sites in the highest promoter active region, and 3 mutant vectors were constructed. The activity was then detected by the dual-luciferase reporter assay system. The results showed that the region 1 656 (-1 604/+51) had the highest activity in the 4 truncated

promoters of different lengths, and the promoter activity of the three mutant vectors constructed in this region were significantly lower than that of the wild type (fragment 1 656). The region of -1 604/+51 was the core promoter region of CBD103 gene in Arctic fox and -1 552/-1 564, -1 439/-1 454 and -329/-339 regions were positive regulatory regions. This study successfully obtained the core promoter region and positive regulation regions of the Arctic fox CBD103 gene, which laid a foundation for further study on the molecular genetic mechanism of this gene regulating Arctic fox coat color.

*Sheng Wu Gong Cheng Xue Bao*. 2019 Aug 25; 35 (8):1469-1477.

Doi: 10.13345/j.cjb.190063.

Article in Chinese; Abstract available in Chinese from the publisher.

**Assessment of chosen semen characteristics of two colour morphs of the Arctic fox *Alopex lagopus* L.**

Stasiak K.<sup>1</sup>, Kondracki S.<sup>2</sup>, Iwanina M.<sup>2</sup>

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*Anim Sci J*. 2019 Sep; 90(9):1120-1126.

Doi: 10.1111/asj.13257. Epub 2019 Jul 16.

© 2019 Japanese Society of Animal Science.

**BEHAVIOUR AND WELFARE****Maternal temperament modulates curiosity and cortisol responses in farmed mink**

Malmkvist J, Hansen S.W.<sup>2</sup>, Damgaard B.M.<sup>2</sup>, Christensen J.W.<sup>2</sup>

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<sup>2</sup>Department of Animal Science, Aarhus University, Denmark.

*Physiol Behav*. 2019 Sep 6:112679.

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Epub ahead of print.

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## Understanding the intricacy of canid 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.

*PLoS One. 2019 Sep 11; 14(9):e0220792.*

*Doi: 10.1371/journal.pone.0220792.*

*eCollection 2019.*

## HEALTH AND DISEASE

### Aleutian Mink Disease Virus in the breeding environment in Poland and its place in the global epidemiology of AMDV

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*Virus Res. 2019 Sep; 270:197665.*

*Doi: 10.1016/j.virusres.2019.197665.*

*Epub 2019 Jul 12.*

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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.

*Arch Virol.* 2019 Aug 19.

Doi: 10.1007/s00705-019-04375-x.

Epub ahead of print.

#### **Endemic Skunk amdoparvovirus in free-ranging striped skunks (*Mephitis mephitis*) in California**

Glueckert E.<sup>1</sup>, Clifford D.L.<sup>1,2</sup>, Brenn-White M.<sup>1</sup>, Ochoa J.<sup>3</sup>, Gabriel M.<sup>4,5</sup>, Wengert G.<sup>4</sup>, Foley J.<sup>1</sup>

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*Transbound Emerg Dis.* 2019 Jun 17.

Doi: 10.1111/tbed.13272. Epub ahead of print.

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#### **Immunogenicity and Efficacy Evaluation of Subunit Astrovirus Vaccines**

Bidokhti M.R.M.<sup>1,2</sup>, Ullman K.<sup>3</sup>, Hammer A.S.<sup>4</sup>, Jensen T.H.<sup>4</sup>, Chriél M.<sup>4</sup>, Byraredy S.N.<sup>5</sup>, Baule C.<sup>3</sup>

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A full understanding of the immune response to astrovirus (AstV) infection is required to treat and control AstV-induced gastroenteritis. Relative contributions of each arm of the immune system in restricting AstV infection remain unknown. In this study, two novel subunit AstV vaccines derived from capsid protein (CP) of mink AstV (MAstV) such as CPΔN (spanning amino acids 161-775) and CPΔC (spanning amino acids 1-621) were evaluated. Their immunogenicity and cytokine production in mice, as well as protective efficacy in mink litters via maternal immunization, were studied. Truncated CPs induced higher levels of serum anti-CP antibodies than CP, with the highest level for CPΔN. No seronegativity was detected after booster immunization with either AstV CP truncates in both mice and mink. All mink moms stayed seropositive during the entire 104-day study. Furthermore, lymphoproliferation responses and Th1/Th2 cytokine induction of mice splenocytes ex vivo re-stimulated by truncated CPs were significantly higher than those by CP, with the highest level for CPΔN. Immunization of mink moms with truncated CPs could suppress virus shedding and clinical signs in their litters during a 51-day study after challenge with a heterogeneous MAstV strain. Collectively, AstV truncated CPs exhibit better parameters for protection than full-length CP.

*Vaccines (Basel).* 2019 Aug 2; 7(3). pii: E79.

Doi: 10.3390/vaccines7030079.

### **Archaea and Bacteria Exposure in Danish Livestock Farmers**

Bønløkke J.H.<sup>1</sup>, Duchaine C.<sup>2</sup>, Schlünssen V.<sup>3,4</sup>, Sigsgaard T.<sup>3</sup>, Veillette M.<sup>2</sup>, Basinas I.<sup>5</sup>

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*Ann Work Expo Health*. 2019 Aug 28. pii: wxz058. Doi: 10.1093/annweh/wxz058. [Epub ahead of print] © The Author(s) 2019. Published by Oxford University Press on behalf of the British Occupational Hygiene Society.

### **Comparing the treatment effect of narrow spectrum antimicrobial, probiotic and fluid with amoxicillin in mink kits (Neovison vison) with pre-weaning diarrhea**

Birch J.M.<sup>1</sup>, Agger J.F.<sup>2</sup>, Leijon M.<sup>3</sup>, Ullman K.<sup>3</sup>, Struve T.<sup>4</sup>, Jensen H.E.<sup>2</sup>

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<sup>4</sup>Kopenhagen Fur Diagnostics, Kopenhagen Fur, Glostrup, Denmark.

*Res Vet Sci*. 2019 Aug; 125: 121-129. Doi: 10.1016/j.rvsc.2019.05.021. Epub 2019 Jun 3. Copyright © 2019 Elsevier Ltd. All rights reserved.

### **Mink Enteritis Virus Infection Induces Mitochondrion-mediated Apoptosis by the Viral Nonstructural Protein 1**

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 Sep 4. pii: JVI.01249-19. Doi: 10.1128/JVI.01249-19. Epub ahead of print. Copyright © 2019 American Society for Microbiology.

### **Molecular and Phenotypic Characteristics of *Escherichia coli* Isolates from Farmed Minks in Zhucheng, China**

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In this study, the prevalence, phenotypes, and clonal relationships of *Escherichia coli* (*E. coli*) strains isolated from minks were investigated. In July 2017, a total of 62 fresh faecal swab samples were randomly collected from one large-scale mink farm in

Zhucheng, Shandong Province, China. In all the samples, 50 *E. coli* strains were isolated and then assigned to serotyping, antimicrobial susceptibility test, detection of antimicrobial resistance genes and the Class 1 integrons, and multilocus sequence typing (MLST). Four pathogenic serotypes were identified among all the isolates, while the most common serotype was enterohemorrhagic *E. coli* O104:H4 (6.0 %). Antimicrobial sensitivity testing revealed that most isolates were susceptible to cefoxitin (96.0 %) and amikacin (82.0 %), while most isolates were resistant to ampicillin (92.0 %) and tetracycline (90.0 %). An analysis of the nucleotide sequences revealed that 7 isolates (14.0%) carried 4 types of Class 1 integron cassette, including *dfrA27+aadA2+qnrA* (57.1%), *dfrA17+aadA5* (14.3%), *dfrA12+aadA2* (14.3%), and *dfrA1+aadA1* (14.3%). PCR screening showed that 14 antibiotic resistance genes were presented in 50 isolates, while the most prevalent resistance gene was *qnrS*, which was detected in 60.0 % of isolates, followed by *sul2* (40.0%) and *oqxA* (38.0%). MLST analysis showed that 32 sequence types (STs) were identified, while ST46 was the predominant genotype among all isolates. Clonal complex 3 (CC3) was dominant. Compared with 340 human *E. coli* STs reported in China, the ST10 clonal complex, known as the largest human clonal complex, was also found in the 50 mink *E. coli* isolates. Meanwhile, mink-derived strain ST206 formed a new clonal complex, CC206, which was different from human ST strains. Our results showed that farmed minks could be reservoirs of antimicrobial-resistant *E. coli* with Class 1 integron cassettes and resistance genes, which were likely to pose a threat to public health. Therefore, continuous inspections and monitoring of *E. coli* in minks are essential for detecting and controlling emerging *E. coli* with different serovars as well as antibiotic resistance.

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Doi: 10.1155/2019/3917841. eCollection 2019.

### Semiaquatic mammals might be intermediate hosts to spread avian influenza viruses from avian to human

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Avian influenza A viruses (AIVs) can occasionally transmit to mammals and lead to the development of human pandemic. A species of mammal is considered as a mixing vessel in the process of host adaptation. So far, pigs are considered as a plausible intermediate host for the generation of human pandemic strains, and are labelled 'mixing vessels'. In this study, through the analysis of two professional databases, the Influenza Virus Resource of NCBI and the Global Initiative on Sharing Avian Influenza Data (GISAID), we found that the species of mink (*Neovison vison*) can be infected by more subtypes of influenza A viruses with considerably higher  $\alpha$ -diversity related indices. It suggested that the semiaquatic mammals (riverside mammals), rather than pigs, might be the intermediate host to spread AIVs and serve as a potential mixing vessel for the interspecies transmission among birds, mammals and human. In epidemic areas, minks, possibly some other semia-

quatic mammals as well, could be an important sentinel species for influenza surveillance and early warning.

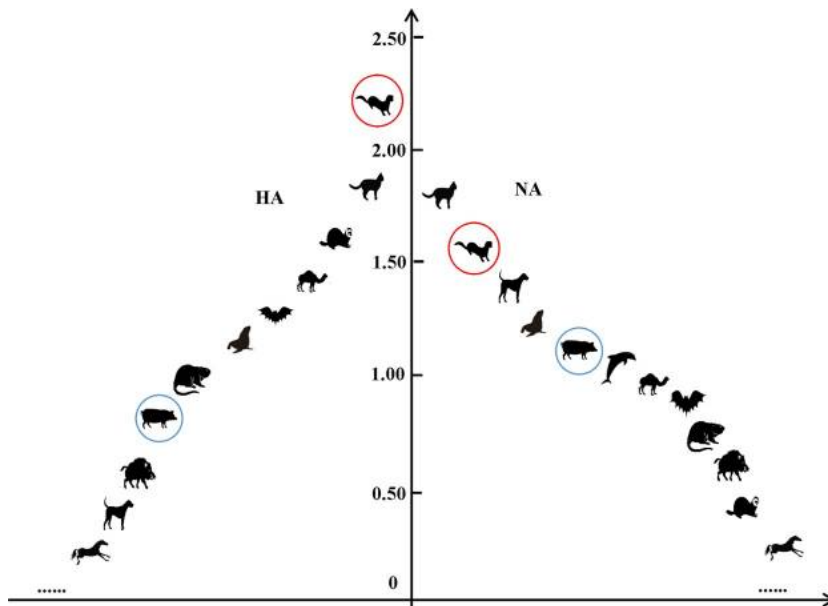
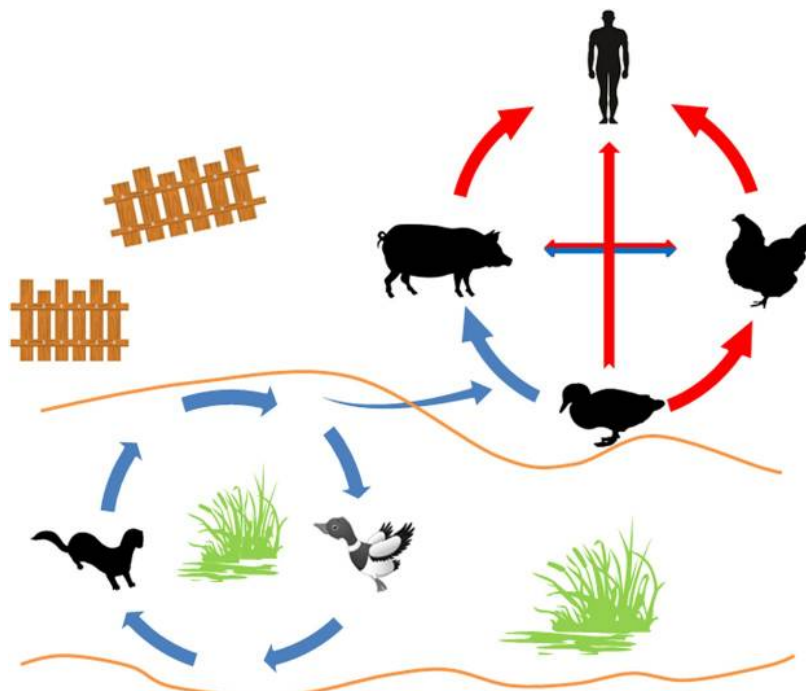


Fig. 1. Shannon-wiener index of IAVs' HA and NA derived from different mammals\*. \*Only those are greater than zero are shown. As for HA (left side), from high to low are mink, cat, ferret, camel, bat, seal, muskrat, swine, boar, canine, equine, in turn; as for NA (right side), they are cat, mink, canine, seal, swine, whale, camel, bat, muskrat, boar, ferret, equine, respectively.

Fig. 2. The illustration of adaptation and transmission of Human AIVs. An adaptation from AIVs to human AIVs includes two circulations, the aquatic habitat circulation and the land habitat circulation. In the aquatic habitat circulation, AIVs are transmitting, mutating, and adapting between aquatic birds and minks (as well as other semiaquatic mammals). This adaptation may or may not change their infectivity to avian, but can significantly increase the infectivity to human and terrestrial mammals. Poultry such as duck, goose can be infected through contacting with epidemic water. In a free stall barn system, usually in some areas of South Asia, Southeast Asia, Southern and Eastern China, it will inevitably lead to a land habitat circulation including human beings. The blue pathway is transmitted by faecal-oral route, while the red one is transmitted by intra-tracheal inoculation. The conception for this scene is partly based on the observation of daily lives; e.g., in rural areas of South Asia, Southeast Asia, Southern and Eastern China, pigs and poultry, in particular chick, are often observed to eat each other's feces. Pigs also eat duck feces, but ducks seldom eat pig feces; and partly based on the available reports, e.g., human infected by a human-adapted AIV from the live poultry market was often reported in China.



Sci Rep. 2019 Aug 12; 9(1): 11641.  
 Doi: 10.1038/s41598-019-48255-5.

**A Protein E-PilA Fusion Protein Shows Vaccine Potential against Nontypeable Haemophilus influenzae in Mice and Chinchillas**

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**Isolation and identification of tiger parvovirus in captive Siberian tigers and phylogenetic analysis of VP2 gene**

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**Origins of the arctic fox variant rabies viruses responsible for recent cases of the disease in southern Ontario**

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A subpopulation of the arctic fox lineage of rabies virus has circulated extensively in red fox populations of Ontario, Canada, between the 1960s and 1990s.

An intensive wildlife rabies control program, in which field operations were initiated in 1989, resulted in elimination of the disease in eastern Ontario. However in southwestern Ontario, as numbers of rabid foxes declined the proportion of skunks confirmed to be infected with this rabies virus variant increased and concerted control efforts targeting this species were employed to eliminate the disease. Since 2012 no cases due to this viral variant were reported in southwestern Ontario until 2015 when a single case of rabies due to the arctic fox variant was reported in a bovine. Several additional cases have been documented subsequently. Since routine antigenic typing cannot discriminate between the variants which previously circulated in Ontario and those from northern Canada it was unknown whether these recent cases were the result of a new introduction of this variant or a continuation of the previous enzootic. To explore the origins of this new outbreak whole genome sequences of a collection of 128 rabies viruses recovered from Ontario between the 1990s to the present were compared with those representative of variants circulating in the Canadian north. Phylogenetic analysis shows that the variant responsible for current cases in southwestern Ontario has evolved from those variants known to circulate in Ontario previously and is not due to a new introduction from northern regions. Thus despite ongoing passive surveillance the persistence of wildlife rabies went undetected in the study area for almost three years. The apparent adaptation of this rabies virus variant to the skunk host provided the opportunity to explore coding changes in the viral genome which might be associated with this host shift. Several such changes were identified including a subset for which the operation of positive selection was supported. The location of a small number of these amino acid substitutions in or close to protein motifs of functional importance suggests that some of them may have played a role in this host shift.

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**Long-Term Immunogenicity and Efficacy of the Oral Rabies Virus Vaccine Strain SPBN GASGAS in Foxes**

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To evaluate the long-term immunogenicity of the live-attenuated, oral rabies vaccine SPBN GASGAS in a full good clinical practice (GCP) compliant study, forty-six (46) healthy, seronegative red foxes (*Vulpes vulpes*) were allocated to two treatment groups: group 1 ( $n = 31$ ) received a vaccine bait containing 1.7 ml of the vaccine of minimum potency ( $10^{6.6}$  FFU/mL) and group 2 ( $n = 15$ ) received a placebo-bait. In total, 29 animals of group 1 and 14 animals of group 2 were challenged at 12 months post-vaccination with a fox rabies virus isolate ( $10^{3.0}$  MICLD<sub>50</sub>/mL). While 90% of the animals offered a vaccine bait resisted the challenge, only one animal (7%) of the controls survived. All animals that had seroconverted following vaccination survived the challenge infection at 12 months post-vaccination. Rabies specific antibodies could be detected as early as 14 days post-vaccination. Based on the kinetics of the antibody response to SPBN GASGAS as measured in ELISA and RFFIT, the animals maintained stable antibody titres during the 12-month pre-challenge observation period at a high level. The results indicate that successful vaccination using the oral route with this new rabies virus vaccine strain confers long-term duration of immunity beyond one year, meeting the same requirements as for licensure as laid down by the European Pharmacopoeia.

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Doi: 10.3390/v11090790.

### Zoonotic Pathogens in the American Mink in Its Southernmost Distribution

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The American mink, *Neovison vison*, is an invasive species in Chile. Its impact on native fauna and public health has not been studied in depth in the country. In this study, we searched for gastrointestinal parasites, including helminths and zoonotic *Cryptosporidium* sp., the presence of *Trichinella* sp. in muscle, and the renal carriage of pathogenic *Leptospira* sp. in minks caught on Navarino Island, "Magallanes y la Antártica Chilena" Region, and Maullín and Ancud, "Los Lagos" Region, Chile. A total of 58, 15, and 21 minks from Navarino Island, Maullín, and Ancud, respectively, were examined for *Trichinella* sp. (artificial digestion of muscle). A total of 36, 11, and 17 minks from Navarino Island, Maullín, and Ancud, respectively, were examined for pathogenic *Leptospira* species (molecular detection of LipL32 gen fragment in renal tissue) infection. Finally, 45, 11, and 17 minks from Navarino Island, Maullín, and Ancud, respectively, were analyzed to detect gastrointestinal parasites (by optical inspection of the digestive tract for helminths, and by both Ziehl-Neelsen stain and molecular detection of small subunit-ribosomal DNA for *Cryptosporidium* species). *Trichinella* larvae were not observed. Pathogenic *Leptospira* sp. was detected in 22 samples: 15 from Navarino Island, 3 from Maullín, and 4 from Ancud. Two nematodes, belonging to Ascaridinae (subfamily) and *Pterygodermatites* (*Paucipectines*) sp., were found in samples of two minks from Navarino Island. Oocysts and DNA of *Cryptosporidium* sp. were detected in three fecal samples from Navarino Island. Further studies could determine the zoonotic potential of *Cryptosporidium* sp., as well as the potential impact of the zoonotic *Leptospira* sp. on the human population of the Navarino Island, Maullín, and Ancud districts. The enemy release theory could explain the low helminth species richness in the minks. In addition, we did not find evidence of parasite transmission from native fauna.

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Volume XX, Number XX, July 2019

<sup>a</sup>Mary Ann Liebert, Inc.

DOI: 10.1089/vbz.2019.2445



Symposiums and congresses etc.

**Actual Mink Research 2019**  
**Meeting at Research Centre Foulum**  
**Faculty of Science and Technology**  
**Aarhus University, Denmark**  
**17 September 2019**

**BILAG**

**TEMADAG OM**  
**AKTUEL MINKFORSKNING**

**17. september 2019**



## Methionine for mink during the growing and furring period

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The objective of the study was to investigate the effect of feeding different methionine levels from mid-July to pelting on the growth and skin parameters of the mink kits, when the methionine content was constant throughout the period or reduced from September 22 to pelting, and furthermore to investigate whether mink are able to utilize crystalline L-methionine. The study comprised nine groups of 137-140 brown males provided the following methionine levels (g digestible met/100 kcal ME) from mid-July to September 21 and from September 22 to pelting, respectively: 0.12/0.12, 0.13/0.13, 0.14/0.14, 0.14/0.12, 0.15/0.15, 0.16/0.16, 0.16/0.14, 0.16/0.12, 0.18/0.18. The methionine levels were achieved by adding crystalline L-methionine “on top” to a basal diet containing 0.12 g digestible met/100 kcal ME and consisting of about 50% raw poultry (Øland). Feeding 0.12 and up to 0.18 g digestible met/100 kcal ME resulted in the same growth from mid-July to September 18. In contrast, feeding 0.12 g digestible met/100 Kcal ME from 22 September to pelting resulted in a significant lower growth compared to 0.14 and up to 0.18 g digestible met/100 Kcal ME. For the entire experimental period from mid-July to pelting, no difference in growth was found by feeding 0.14 and up to 0.18 g digestible met/100 Kcal OE. On the other hand, increasing methionine from 0.12 and up to 0.18 g digestible met/100 Kcal OE resulted in a significant positive linear increase in the skin quality. This indicates that the methionine requirement might be higher to maximize skin quality than to maximize growth, but in general the results confirmed that the current recommendation of 0.16 g digestible met/100 kcal ME fits quite well. However, the economical weighting of skin results and feed costs indicated that there may be an economic potential in reducing to 0.14 g digestible met/100 kcal ME. In addition, the study showed that mink utilize crystalline L-methionine added to the feed. Over the past few years, the price of crystalline L-methionine has fallen, so it may be an economic advantage to use low-methionine feed ingredients and then add crystalline L-methionine to obtain the desired methionine level in the feed.

*Meeting at Research Centre Foulum, Faculty of Science and Technology, Aarhus University, Denmark. September 2019 (in Danish) p. 1-9. Author's abstract.*

## Vitamins for mink during the growing period – an experiment in commercial farms

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Through experiments performed at Kopenhagen Fur Farm during the past years, evidence has accumulated that mink during the growing period are supplemented with higher amounts of vitamins than needed. A surplus of vitamins is only an extra cost to the feed. The experiments has been performed with feed composed of high quality ingredients. To ensure that the results can be transferred to practical conditions an experiment was performed at commercial farms receiving feed from three different feed kitchens with the aim evaluate the excretion of B-vitamins in September and October and to determine the  $\alpha$ -tocopherol ( $\alpha$ -TOC, vitamin E) and vitamin A status in male mink. Initially, the feed kitchens added the same amount of vitamins and minerals to the feed, but in September one of the feed kitchens reduced the addition of riboflavin (vitamin B2) and  $\alpha$ -TOC and omitted addition of retinol (vitamin A), thiamin (vitamin B1), and vitamin D. Urine samples from two farms receiving feed from this feed kitchen were collected before the reduction and samples from the other two farms were collected after the reduction. Applying non-targeted LC-MS metabolomics to the urine samples and extracting the data concerning B-vitamins and metabolites thereof showed that riboflavin, niacin, pantothenic acid, and pyridoxine is excreted in high amounts providing evidence that the addition of these vitamins to the feed is unnecessary. In urine samples from farms receiving feed from the feed kitchen that reduced the addition of riboflavin it was evident that the excretion was lower after the reduction, but an excretion could still be seen confirming that the amount of riboflavin naturally occurring in the feed covers the need of the mink. The  $\alpha$ -TOC status was determined in 10 mink from each farm at pelting. A blood samples was collected from the animals and samples of liver, fat, lung, and heart was taken. The average  $\alpha$ -TOC concentration was above 10  $\mu$ g/ml, which is the preferred minimum level, in mink from all feed kitchens. However, 25 % of the mink from farms receiving feed from the kitchen that reduced the addition of  $\alpha$ -TOC had  $\alpha$ -TOC concentration below 10  $\mu$ g/ml. In the body,  $\alpha$ -TOC is stored in the liver (short-term) and in abdominal fat (long-term). Making a correlation between the  $\alpha$ -TOC concentration in plasma and liver showed that the mink with low plasma level of  $\alpha$ -TOC also had a low concentration in the liver. This means that their  $\alpha$ -TOC status is low. One feed kitchen had a high content of swine offal in the feed this resulted in a high

concentration of vitamin A in the liver. Based on the present results it is suggested that the addition of riboflavin, niacin, pantothenic acid, and pyridoxine to the diet can be omitted. Regarding  $\alpha$ -TOC supplementation with either 40 mg synthetic  $\alpha$ -TOC or 20 mg natural  $\alpha$ -TOC per kg feed is recommended. Addition of vitamin A can be omitted from September and it is highly recommended to omit addition when the feed contains swine offal.

*Meeting at Research Centre Foulum, Faculty of Science and Technology, Aarhus University, Denmark. September 2019 (in Danish) p. 10-18. Author's abstract.*

### **An effect study on antimicrobial treatment of cystitis/uroolithiasis in mink kits**

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On a Danish mink farm with acute rise in mortality caused by cystitis/uroolithiasis an effect study on antimicrobial treatment of cystitis in mink kits was implemented. Two groups of mink kits of 1920 kits in each were formed. The treatment group received 5 days treatment with sulfadiazine/trimethoprim in contrast to the control group there did not received any treatment. Dead mink kits in the two groups were collected from the day the treatment was initiated and for nearly 3 months hereafter. By macroscopic pathological investigation all the collected mink kits were examined for urinary tract disease to measure treatment effect. The final results and conclusions are still under evaluation and are to be published on a later date.

*Meeting at Research Centre Foulum, Faculty of Science and Technology, Aarhus University, Denmark. September 2019 (in Danish) p. 19-22. Author's abstract.*

### **Potential effect of Fur Animal Necrotic Pyoderma (FENP) on reproduction results**

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During the mating season 2019 a field study was performed on five mink farms, with the purpose of investigating the potential effect of Fur Animal Necrotic Pyoderma (FENP) on reproduction results. The study is part of a PhD project conducted in corporation between Copenhagen University and Kopenhagen Fur. On the five farms a total of 249 males (48-51 males pr. farm) were selected. All females introduced to the males in the study group were registered and followed. Relevant data from the animals were recorded (including number of introduction to males, number of kits, diseases etc.). Two farms were excluded because none of the males in the study group developed FENP symptoms. Females (n= 10) with other diagnoses than FENP or females found dead were excluded. In total 698 females remained in the study. Among these 698 females, 106 were introduced one or more times to a male diagnosed with FENP. Preliminary results indicate that contact with FENP males have a negative effect on production results of the females on the farms included in this study. Currently further data analysis is in progress in order to evaluate the significance of the results.

*Meeting at Research Centre Foulum, Faculty of Science and Technology, Aarhus University, Denmark. September 2019 (in Danish) p. 24-27. Author's abstract.*

### **Selection for feed efficiency without negative consequences on body weight and litter size**

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Feed efficiency, body weight and litter size are economically important traits in mink breeding. Breeding for feed efficiency mink can reduce the production cost per pelt, by reducing feed costs. Meanwhile, breeding for heavier mink can increase the price per pelt, since heavier animals tend to have larger pelts. Furthermore, increasing litter size increases the number of pelts produced per breeding female. To maximize profit breed-

ing should include feed efficiency, body weight and litter size as breeding criteria. Due to the large sexual dimorphism in mink, traits like feed efficiency, feed intake and body weight are expected to have different genetic parameters in males and females. The aim of this study, was 1) obtain sex specific genetic parameters of feed efficiency, feed intake and body weight, along with genetic parameters of litter size; 2) examine the consequences of single trait selection on litter size and each of the sex specific breeding values of feed efficiency, feed intake and body weight; 3) investigate the possibility of selection on an 'average' breeding value for feed efficiency, based on the sex specific breeding values, in place of said sex specific breeding values. Foulum Research Farm provided group recorded feed intake (cage-level with a male and a female in each cage) and individually recorded bodyweight in males, body weight in females and litter size at day 21. Data included 16782 males and 18375 females. The pedigree included 35131 animals and dated back to 1998. A multivariate animal model including four traits were used to analyze feed intake, body weight in males, body weight in females and litter size at day 21 after whelping. The model separated the genetic variance of feed intake into male and female, and yielded therefore five breeding values: feed intake in males, feed intake in females, body weight in females and litter size at day 21 after whelping. Breeding values for feed efficiency, defined as residual feed intake (within sex adjustment of feed intake breeding values for body weight breeding values) were obtained post-analysis for males and females. 'Average' breeding values were constructed for feed efficiency based on the sex specific breeding values of feed efficiency. Results showed that there were sufficient genetic variance and reasonable heritabilities of all traits to allow genetic progress through selection. Results also showed that selection for feed efficiency, defined as residual feed intake, in either sex reduces feed intake in either sex and does not have negative consequences for bodyweight in either sex or litter size at day 21 after whelping. Furthermore, it was shown that selection on 'average' breeding values yielded selection responses falling between the selection responses obtained when selecting on the sex specific breeding values. In conclusion, feed efficiency, in the form of residual feed intake, should be included in the selection decisions in mink.

*Meeting at Research Centre Foulum, Faculty of Science and Technology, Aarhus University, Denmark. September 2019 (in Danish) p. 28-31.*

*Author's abstract.*

### **Correlation between skin length and alternative measures for mink size, and the potential of early selection of breeding animals.**

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The aim of this project was to explore possibilities for early selection of mink, to optimize welfare and fertility for the breeding animals. The fat deposition in the growing-furring period where mink are fed ad libitum results in high November weight. Mink selected for breeding based on sorting in November needs to be slimmed down before mating in the spring, to obtain the preferred BCS to optimize reproductive performance. The slimming results in hungry mink that express more stereotypic behavior. We investigated, if we can select future breeding animals before fat deposition in the fall increase. With an early selection, we can restrict the feed intake in the fall, and avoid a tough diet over the winter for the breeding animals. We used 1261 white mink born in 2018 (627 females, 634 males) from Kopenhagen Fur Farm, Denmark, to investigate the heritability ( $h^2$ ) of different measures of size: circumference in September and October, body weight and length in September, October and at pelting in November. We also estimated the genetic correlation to skin size. We found  $h^2$  between 0.07 (SE~0.09) and 0.72 (SE~0.12), lowest for circumference (in October), highest for weight (at pelting). In general, we found higher  $h^2$  for females than for males. We also found high genetic correlations ( $\sigma_a^2$ ) between weight and skin size. For females, September weight was just as good an indicator for skin size as weight in November ( $\sigma_a^2=0.91$ , SE=0.04). For males,  $\sigma_a^2$  was 0.80 (SE=0.09) for November weight, and 0.65 (SE=0.09) for September weight. In September, we have same information about (mothers) fertility and size of females as we do in November. We can use this information to select females in September. However, we cannot measure quality of the winter fur in September. To compensate for the lack of quality measure in September, we suggest a two-step selection strategy for females. First step: Select females based on mother's fertility and own bodyweight in September, select a surplus for second round sorting. Second step: Females from first round are finally selected based on pelt quality. Same strategy can be used for males. With this strategy, the tough slimming down will be unnecessary in the winter period.

*Meeting at Research Centre Foulum, Faculty of Science and Technology, Aarhus University, Denmark. September 2019 (in Danish) p. 32-40. Author's abstract.*

### **Adjusting female mink body condition without compromising their welfare**

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Restrictive feeding with risk of prolonged hunger and stereotypy is one of the main welfare challenges for farmed mink in the winter period. Female mink should not be too fat to respond to flushing, and the project wanted to evaluate different strategies for body condition adjustment. It was hypothesized that adjusting the mink's body condition from score 4 or 5 in early December to 2 in February 20<sup>th</sup> compared with January 31<sup>st</sup> will reduce the number of stereotypic female mink and result in less amount of stress hormones measured as fecal cortisol metabolites. It was also hypothesized that the electronic weighing devices WheighLog, formed as a tube hanging in the middle of the mink's cages, can be a tool to identify risk of stereotypic behaviour in breeding female mink. We evaluated the effect of two different feeding strategies for first year breeding females on different welfare measures. One group was slimmed from body condition score 4 or 5 in early December to score 2 on February 20<sup>th</sup> and the other group was to slimmed to score 2 on January 31<sup>st</sup>. There were 200 animals in each of the two groups. The welfare measures were body condition score, stereotypic behaviour, and fecal cortisol metabolites. The activity in the electronic weighing devices were examined by video recordings and data from the devices. There were significantly lower prevalence of stereotypic behaviour and lower amount of fecal cortisol metabolites in the group that were slimmed to body condition 2 in February compared with January. It was difficult to find any clear picture of changes in the patterns of output data from the WheighLog devices, that could indicate animals with stereotypic behaviour. We therefore reject our hypothesis of using WheighLog to identify risk of stereotypic behaviour. We accept our first two hypothesis and conclude that adjusting mink to body condition 2 in February 20<sup>th</sup> is less stressful for first year breeding female mink than adjusting to body condition 2 in January 31<sup>st</sup>. Even so, there are welfare challenges with both feeding strategies. One important question is if it is necessary to adjust the body condition down to 2 in order to enable female mink to respond to flushing.

*Meeting at Research Centre Foulum, Faculty of Science and Technology, Aarhus University, Denmark. September 2019 (in Danish) p. 41-48. Author's abstract.*

### **Kit transfer between mink litters: The early lactation period may be prolonged for the benefit of small kits**

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Only few systematic studies focus on cross fostering of mink offspring and levelling of litters early in life. Methods: Brown mink was used, and 386 transponder marked kits were transferred from large litters (9-14 kits) to 386 foster mothers with smaller litters focusing on: (1) different recipient litter size (small, 1-3 kits vs. medium, 4-7 kits) transferred Day 4, D4, after birth, and (2) prolonging the early lactation period by kit transfer to 0-4 days younger litters. The foster mother age class (young: 1.st parity, old: 2<sup>nd</sup>-3<sup>rd</sup> parity) was included in the analysis. The majority of transferred kits were female (70.2%) – as in average smaller and prone to damages later in life – and an additional group of 186 transponder marked female kits stayed with their biological large-litter mother after the reduction to 8 kits. Results: Foster kits moved to a younger litter with fewer kits gained more weight during the first 56 days of life, i.e.  $4 > 2 > 0$  days prolonged early lactation period. Mink mothers retrieved an older novel kit quicker to the nest D2 than D4. Small litters (1-3 kits) resulted in significant higher kit growth until D56 and reduced the amount of damages at 7 weeks after birth. Further, the results confirmed 2018-findings that (i) transfer of kits from D2 favour growth, but have no significant effect on kit survival, and (ii) experienced dams result in heavier kits. Conclusion: The early lactation period of mink can be prolonged with 2-4 days, leading to heavier kits at weaning without negative consequences, with a better acceptance of the older kit by newly-delivering dams (D2). Small litters may be good as recipients, however, some data analysis on risk factors are still ongoing.

*Meeting at Research Centre Foulum, Faculty of Science and Technology, Aarhus University, Denmark. September 2019 (in Danish) p. 49-60. Author's abstract.*

### **Correct WelFur-Mink-assessment of partial weaning of large litters at 42 days**

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In WelFur-Mink we assess the effect of partial weaning in the same way as weaning of the full litter and it will therefore get a score of 18 out of 100 for the measurement "Age and procedures at weaning". If this should change we need a scientific background for a different interpretation of partial weaning than of full weaning of all kits in the litter. We therefore conducted an experiment comparing the partial weaning procedure of litters of 6 or more kits 42 days pp. as described in the Danish 'Branchekoden' to normal weaning of the full full litter at 56 days. The first years experiment showed that both the dam and the kits reacts shortly to the weaning at 42 days, but also to the weaning of the remaining kits at 56 days. The long term effects are small and often in favour of partial weaning. In total this indicates that there will be a scientific background for a different interpretation of partial weaning at 42 days.

*Meeting at Research Centre Foulum, Faculty of Science and Technology, Aarhus University, Denmark. September 2019 (in Danish) p. 61-69.  
Author's abstract.*

### **Mink in the Danish nature – how can that be avoided?**

*Sussie Pagh<sup>1</sup>, Cino Pertoldi<sup>1</sup>, Heidi Huus Petersen<sup>2</sup>, Trine Hammer Jensen<sup>1</sup>, Mette Sif Hansen<sup>1</sup>, Mariann Chriél.<sup>2</sup>*

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It has been debated whether or not there is a true feral population in Denmark and if farms in Denmark act as a source for the feral population, despite preventative laws regarding fencing and traps on the farm area. The feral mink population consists of two groups of animals, namely mink that are born in nature and more or less adapted to a living in nature, and mink born on mink farms and have recently escaped into nature.

The population size of feral mink in the Danish nature is unknown. However, the game bag records of mink have decreased during the past two decades. Around

year 2000 the number of mink bagged was around 8000, and today less than 2000 mink are bagged (trapped and/or shot) annually.

The purpose of this project was: 1) to give a conservative estimate of the proportion of mink that originate from farms and have recently escaped into nature out of the total number of bagged mink. 2) to investigate the reproduction and mortality of mink caught in the Danish nature. 3) to test tetracycline as a biomarker for mink escaped from farms

The study has demonstrated that farmed mink escape from the Danish mink farms, and that the proportion of escaped mink differs geographically. Mink escaped from farms constitute up to 3 % of the sampled feral mink at Bornholm and was estimated to be around 30% in the remaining part of Denmark. Based on the estimated turnover of feral mink, the population seem stable to slightly declining under the current conditions. However, escapees from farms may have a negative effect on the chance to control the population. Therefore, control of the fence around the farms to prevent escapes from the premises preferably combined with increased hunting pressure on feral mink will reduce escapees and the feral mink population.

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Author's abstract.*

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