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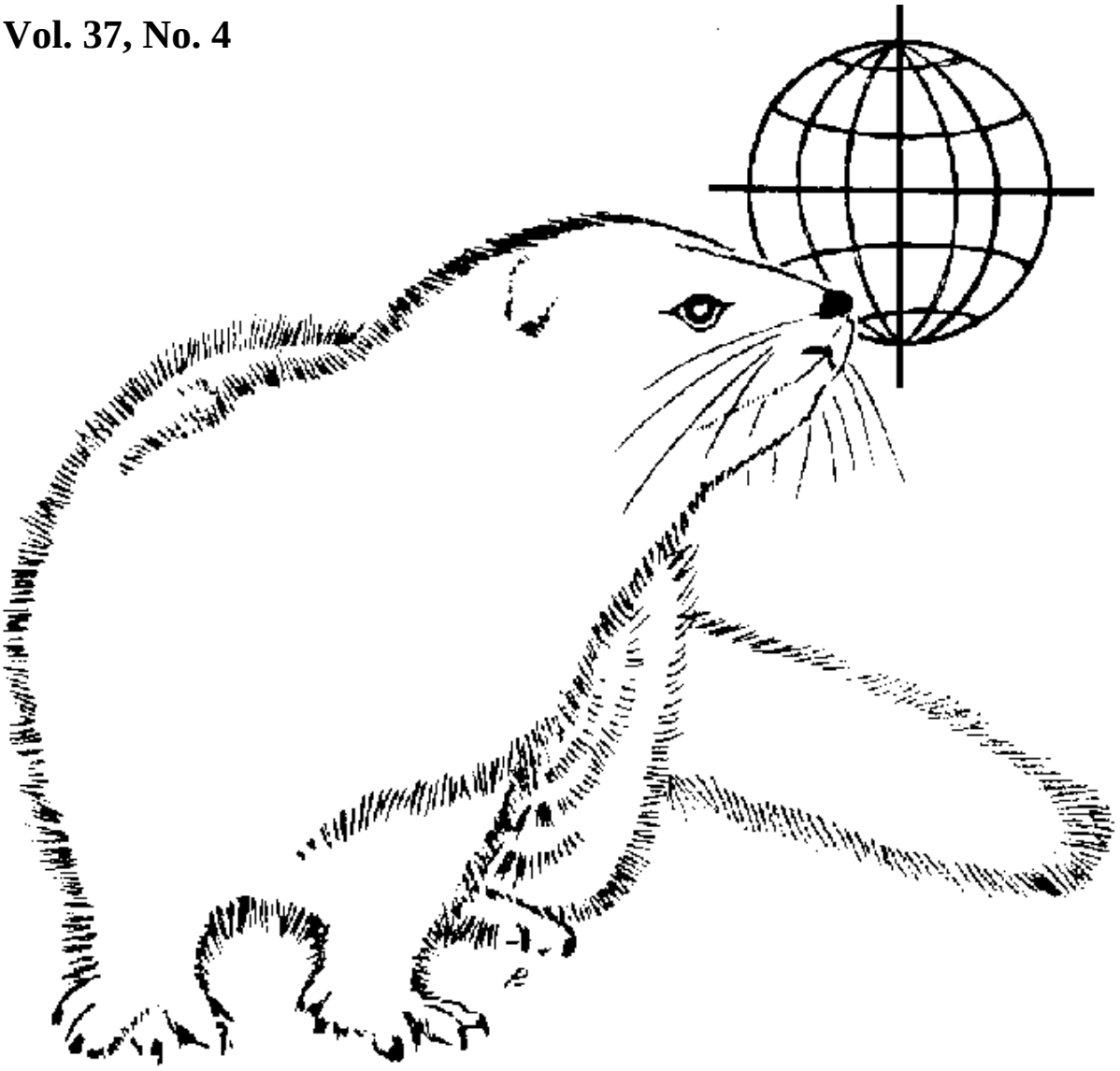

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INTERNATIONAL FUR ANIMAL SCIENTIFIC ASSOCIATION

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Notes from the Editor

Fast transfer of new important research results to farm practice is essential. At the yearly meeting at Aarhus University, Denmark recent results are presented to the fur animal industry including fur animal production advisors. Abstracts from the meeting “Actual Mink Research 2013” are published in this issue of Scientifur.

Fox production is of major importance in Finland and education of new researchers to support the field is crucial. A summary of a PhD thesis defended at University of Helsinki, Finland is given. The study deals with the problem that selection for increased animal size in fur animal production has at the same time seriously affected litter size. The thesis contributes to the understanding of this important issue by studying blue fox populations in Finland.

Molecular genetic tools are increasingly being used in the study of fur animals. An abstract of the first QTL-study in fur animals with identification of QTLs for fur quality traits in mink is presented. An abstract from a study demonstrating the inheritance of the dominant white coat colour of blue fox is also given. Scientifur 37,4 also contains an abstract from a study of the estimation of genetic parameters of pelt character, feed efficiency and size traits in Finnish blue fox.

Attention is drawn to the 65th Annual Meeting of the European Association of Animal Production (EAAP) to be held in Copenhagen 25-29 August 2014. It is the aim to include fur animal research in the various scientific sessions.

Vivi Hunnicke Nielsen
Editor Scientifur

BREEDING, GENETICS AND REPRODUCTION

Identifying QTL and genetic correlations between fur quality traits in mink (*Neovison vison*)

J.P. Thirstrup, R. Anistoroaei, B. Guldbrandtsen, K. Christensen, M. Fredholm, V.H. Nielsen

Mapping of QTL affecting fur quality traits (guard hair length, guard hair thickness, density of wool, surface of the fur and quality) and skin length was performed in a three-generation mink population (F_2 design). In the parental generation, Nordic Brown mink were crossed reciprocally with American Black short nap mink. In all, 1082 mink encompassing three generations were used for the analyses. The mink were genotyped for 104 microsatellites covering all 14 autosomes. The QTL analyses were performed by least-square regression implemented in gridqtl software. Genetic and phenotypic correlations and heritabilities were estimated using the average information-restricted maximum-likelihood method. Evidence was found for QTL affecting fur quality traits on nine autosomes. QTL were detected for guard hair thickness on chromosomes 1, 2, 3, 6 and 13; for guard hair length on chromosomes 2, 3 and 6; for wool density on chromosomes 6 and 13; for surface on chromosomes 7, 12 and 13; for quality on chromosomes 6, 7, 11 and 13; and for skin length on chromosomes 7 and 9. Proximity of locations of QTL for guard hair length, guard hair thickness and for wool density and quality suggests that some of the traits are in part under the influence of the same genes. Traits under the influence of QTL at close or identical positions also were traits that were strongly genotypically correlated. Based on the results of correlation analyses, the most important single traits influencing the quality were found to be density of wool, guard hair thickness and appearance of the surface.

Anim. Genet. 2013: Dec 5. [Epub ahead of print] doi: 10.1111/age.12102

http://www.ncbi.nlm.nih.gov/pubmed/24303917

A base substitution in the donor site of intron 12 of KIT gene is responsible for the dominant white coat colour of blue fox (*Alopex lagopus*)

S.Q. Yan, J.N. Hou, C.Y. Bai, Y. Jiang, X.J. Zhang, H.L. Ren, B.X. Sun, Z.H. Zhao, J.H. Sun

The dominant white coat colour of farmed blue fox is inherited as a monogenic autosomal dominant trait and is suggested to be embryonic lethal in the homozygous state. In this study, the transcripts of KIT were identified by RT-PCR for a dominant white fox and a normal blue fox. Sequence analysis showed that the KIT transcript in normal blue fox contained the full-length coding sequence of 2919 bp (GenBank Acc. No KF530833), but in the dominant white individual, a truncated isoform lacking the entire exon 12 specifically co-expressed with the normal transcript. Genomic DNA sequencing revealed that a single nucleotide polymorphism (c.1867+1G>T) in intron 12 appeared only in the dominant white individuals and a 1-bp ins/del polymorphism in the same intron showed in individuals representing two different coat colours. Genotyping results of the SNP with PCR-RFLP in 185 individuals showed all 90 normal blue foxes were homozygous for the G allele, and all dominant white individuals were heterozygous. Due to the truncated protein with a deletion of 35 amino acids and an amino acid replacement (p.Pro623Ala) located in the conserved ATP binding domain, we propose that the mutant receptor had absent tyrosine kinase activity. These findings reveal that the base substitution at the first nucleotide of intron 12 of KIT gene, resulting in skipping of exon 12, is a causative mutation responsible for the dominant white phenotype of blue fox.

Anim. Genet. 2013: Dec 6. [Epub ahead of print] doi: 10.1111/age.12105

http://www.ncbi.nlm.nih.gov/pubmed/24308634

Genetic parameters of pelt character, feed efficiency and size traits in Finnish blue fox (*Vulpes lagopus*)

R. Kempe, N. Koskinen, I. Strandén

Pelt character traits (size, quality, colour clarity, darkness) are important economic traits in blue fox breeding. Better feed efficiency (FE) is another economically important and new breeding goal for fur animals. The purpose of this study was to determine the correlations between pelt character

traits, FE and size traits and to estimate genetic parameters for pelt character traits. Pelt size (pSIcm) had a high positive genetic correlation with animal grading size (gSI), final body weight (BWFin), body length and daily gain (DG), and a moderate correlation with body condition score (BCS). Animal body length and BCS (describing fatness) were considered as genetically different traits. Genetic correlations between pelt quality and size traits were estimated without precision and did not differ from zero, but colour clarity (pCL) had a low antagonistic genetic correlation with FE. Pelt size and DG had a favourable genetic correlation with FE but a fairly high unfavourable genetic correlation with dry matter feed intake. The current emphasis on selection for larger animal and pelt size improves FE indirectly, but selection for larger pelt size favours fast-growing and fat individuals and simultaneously increases feed intake. The detected genetic connections between FE, size, feed intake and pCL should be taken into account in the Finnish blue fox breeding programme.

J. Anim. Breed. Genet. 2013: 130(6): 445-455

http://www.ncbi.nlm.nih.gov/pubmed/24236607

Polymorphism of cytogenetic markers in wild and farm red fox (*Vulpes vulpes*) populations

M. Bugno-Poniewierska, P. Sołek, L. Potocki, K. Pawlina, M. Wnuk, G. Jezewska-Witkowska, E. Słota

Analysis of the origin of domestic animals is of wide interest and has many practical applications in areas such as agriculture and evolutionary biology. Identification of an ancestor and comparison with the domesticated form allows for an analysis of genetic, physiological, morphological and behavioral effects of domestication. Because fox breeding has been an ongoing process for over a century, differences are expected between farm and wild populations at the chromosomal level. The aim of this work was to analyse polymorphisms at the chromosomal level in foxes raised on farms and those living in the wild. Blood samples and lung tissue served as the experimental material and were obtained after slaughter of 35 foxes, including 28 breeding animals and 7 wild animals. The classical cytogenetic method was used including AgNOR technique, as well as molecular methods such as fluorescence in situ hybridization (FISH), and primed in situ labeling (PRINS). Analysis of the number of B chromosomes showed the presence of polymorphisms in foxes from both studied populations, but there was no correlation between the number of B chromosomes and the origin and gender of particular animals. An analysis ofactive nucleolar organizers showed the presence of a large number of polymorphisms and a tendency towards reduction of the number of NORs in the captive-raised population.

Folia. Biol. (Krakow). 2013: 61(3-4): 1551-63

http://www.ncbi.nlm.nih.gov/pubmed/24279163

The polymorphism of cytogenetic markers in the farm and wild-living raccoon dog (*Nyctereutes proyonoides)*

M. Bugno-Poniewierska, M. Wroński, L. Potocki, K. Pawlina, M. Wnuk, G. Jeżewska-Witkowska, E. Slota

The raccoon dog (*Nyctereutes procyonoides*) is a mammalian species that belongs to canidae family, order carnivora. This species represents both animals living in the wild and farm animals used in the fur industry. raccoon dogs have the most 'primitive' karyotype among canidae family. The chinese raccoon dog (*Nyctereutes procyonoides procyonoides*) is characterised by a variable number of chromosomes (2n = 54 + 0–4 B). B chromosomes are supernumerary chromosomes occurring in addition to the basic set of a chromosomes in the cells of many organisms. The func- tion and origin of these additional chromosomes is not clear. The aim of this work was to deter- mine possible karyotypic differences between wild-living and farm populations, using methods of classical and molecular cytogenetics. The most useful cytogenetic markers to analyse karyo- type polymorphism of canine are the number of B chromosomes and nucleolar organizer regions. A variation was identified in the number of B chromosomes and nucleolar organizer regions (NORs) in cells between wild-living and breeding populations.

Ann. Anim. Sci. 2013: 13(4): 701–713
http://www.degruyter.com/view/j/aoas.2013.13.issue-4/issue-files/aoas.2013.13.issue-4.xml

Changes in testicular weight and volume of American mink (*Neovison vison*) before and during mating season

B. Lasota, A. Jarczyńska, L. Felska-Błaszczyk, M. Laszczyńska, B. Seremak, A. Skuratko

The aim of this study was to compare the size of testes in male mink of two color varieties, before and during the breeding season, with an intention of a possible application of any existing differences as one of the criteria for selection of males for mating. Weight and volume measurements were performed on 246 testes collected from 123 males of two color types: Mahogany and Standard Black (Black Velvet). Testes were collected before the breeding season (December 8) and just on the end of the season (March 31). Comparison of weight and volume of testes collected in December and March showed a considerable and statistically significant increase in both parameters. Testicular weight increased by about 1.87-fold in Mahogany and 1.47-fold in Black Velvet (from 1.94 to 3.64 g and from 2.36 to 3.48 g, respectively), while the increase in volume was over 12-fold in Mahogany and 9-fold in Black Velvet (from 0.27 to 3.48 cm^3 and from 0.34 to 3.07 cm^3, respectively). Before the season the weight of about 57% of testes remained in the range 1.5–2.0 g, and during the season about 63% of samples were in the range of 3.5 to 4.0 g. Juxtaposition of the average weight and volume of the right and left testes in different color types before and during the mating season has shown that there was a significant increase in testicular weight as well as volume for both color types, in both right and left testes.

Electronic Journal of Polish Agricultural Universities, Animal Husbandry 2013: 16(3)

http://www.ejpau.media.pl/volume16/issue3/art-12.html

Stimulatory effect of hcG on male american mink (*Neovison vison*) in the breeding season

B. Lasota, A. Maslowska, L. Felska-Blaszcyk, M. Dziadosz, B. Seremak, A. Skuratko

The aim of the study was to analyse the effect of a male mink single-dose hcG stimulation on the libido during the mating season and on blood testosterone levels after the season. The material involved males of American mink. The treatment-group males were administered a dose of 100, 150 or 200 u of hcG. blood was collected twice, approx. 2 weeks prior to and on the completion of the mating season. The group receiving 100 u hcG had the highest percentage of males effectively copulating with females within the first 24 hours after stimulation, whereas males stimulated with a dose of 200 u hcG showed the lowest libido over the same period. on the other hand, males of the group stimulated with 150 u hcG mated to the highest number of females throughout the mating season. The mean plasma testosterone concentration in all the studied males on 18 febru- ary was 12.44 ng/ml. The drop in testosterone concentration at the end of the mating season was significant.

Ann. Anim. Sci. 2013: 13(3): 563–570

http://www.degruyter.com/view/j/aoas.2013.13.issue-3/issue-files/aoas.2013.13.issue-3.xml

Effect of age and temperament type on reproductive parameters of female raccoon dogs (*Nyctereutes procyonoides* Gray)

S. Lapiński, J. Bzymek, P. Niedbala, L. Migdal, A. Zoń, M. Lis

The aim of the study was to determine the relationship between age and temperament as well as re-productive results in female raccoon dogs. The study was carried out at two raccoon dog breeding farms located in south-eastern Poland a total of 189 foundation stock females were evaluated for temperament using a modified behavioural empathy test. Animals were classified into five temperament groups: very fearful (VF), fearful (F), confident (C), aggressive (A) and very aggressive (VA). The animals with calm temperament (c) formed the largest group (49.9%) whereas the smallest number of animals was classified as VA (5.6%). The influence of age on the temperament of raccoon dog females and the number of young born and weaned ($P \leq 0.01$) was revealed. At the same time, temperament did not affect reproductive parameters ($P > 0.05$). Summing up, the results of this study indicate lack of correlation between temperament and reproductive parameters. it can be assumed that the elimination

of aggressive animals from the foundation stock will not compromise production results and can help to facilitate handling and improve animal welfare.

Ann. Anim. Sci. 2013: 13(4): 807–814

http://www.degruyter.com/view/j/aoas.2013.13.issue-4/issue-files/aoas.2013.13.issue-4.xml

NUTRITION, FEEDING AND MANAGEMENT

Invasive crayfish reduce food limitation of alien American mink and increase their resilience to control

Y. Melero, S. Palazón, X. Lambin

Trophic relationships between invasive species in multiply invaded ecosystems may reduce food limitation relative to more pristine ecosystems and increase resilience to control. Here, we consider whether invasive predatory American mink Neovison vison are trophically subsidized by invasive crayfish. We collated data from the literature on density and home range size of mink populations in relation to the prevalence of crayfish in the diet of mink. We then tested the hypothesis that populations of an invasive predator reach higher densities and are more resilient to lethal control when they have access to super-abundant non-native prey, even in the absence of changes in density dependence, hence compensatory capacity. We found a strong positive relationship between the proportion of crayfish in mink diet and mink population density, and a negative relationship between the proportion of crayfish in mink diet and mink home range size, with crayfish contribution to mink diet reflecting their abundance in the ecosystem. We then explored the consequence of elevated mink density by simulating a hypothetical eradication program with a constant harvest in a Ricker model. We found that mink populations were more resilient to harvest in the presence of crayfish. As a result, the simulated number of mink harvested to achieve eradication increased by 500 % in the presence of abundant crayfish if carrying capacity increased by 630 %. This led to a threefold increase in time to eradication under a constant harvest and an approximately 20-fold increase in the cumulative management cost. Our results add to evidence of inter-specific positive interactions involving invasive species, and our simple model illustrates how this increases management cost.

Oecologia. 2013 Sep 25. [Epub ahead of print]

http://www.ncbi.nlm.nih.gov/pubmed/24065555

BEHAVIOR AND WELFARE

Environmentally Enriched Male Mink Gain More Copulations than Stereotypic, Barren-Reared Competitors

M. Díez-León, J. Bowman, S. Bursian, H. Filion, D. Galicia, J. Kanefsky, A. Napolitano, R. Palme, A. Schulte-Hostedde, K. Scribner, G. Mason

Wild carnivores in zoos, conservation breeding centres, and farms commonly live in relatively small, unstimulating enclosures. Under these captive conditions, in a range of species including giant pandas, black-footed ferrets, and European mink, male reproductive abilities are often poor. Such problems have long been hypothesized to be caused by these animals' housing conditions. We show for the first time that rearing under welfare-improving (i.e., highly valued and stress-reducing) environmental enrichments enhances male carnivores' copulatory performance: in mate choice competitions, enriched male American mink (*Neovison vison*) mated more often than non-enriched males. We screened for several potential mediators of this effect. First was physiological stress and its impact on reproductive physiology; second, stress-mediated changes in morphology and variables related to immunocompetence that could influence male attractiveness; and third, behavioural changes likely to affect social competence, particularly autistic-like excessive routine and repetition ('perseveration') as is reflected in the stereotypies common in captive animals. Consistent with physiological stress, excreted steroid metabolites revealed that non-enriched males had higher cortisol levels and lower androgen levels than enriched conspecifics. Their *os penises* (bacula) also tended to be less developed. Consistent with reduced attractiveness, non-enriched males were lighter, with comparatively small spleens and a trend to greater fluctuating asymmetry. Consistent with impaired social competence, non-enriched males performed more stereotypic behaviour (e.g., pacing) in their home cages. Of all these effects, the only significant predictor of copulation number was

stereotypy (a trend suggesting that low bodyweights may also be influential): highly stereotypic males gained the fewest copulations. The neurophysiological changes underlying stereotypy thus handicap males sexually. We hypothesise that such males are abnormally perseverative when interacting with females. Investigating similar problems in other taxa would be worthwhile, since many vertebrates, wild and domestic, live in conditions that cause stereotypic behaviour and/or impair neurological development.

PLoS One. 2013: 8(11) e80494, 11 pp.
10.1371/journal.pone.0080494

http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3839975/

A foxy view of human beauty: implications of the farm fox experiment for understanding the origins of structural and experiential aspects of facial attractiveness

I.E. Elia

Within 20 years, experimental selection of quantified "not too aggressive, not too fearful" behavior to human approach was shown in silver foxes (*Vulpes vulpes)* to produce a neotenic package of traits in adults: ability to seek, induce, and sustain contact (called friendly or rapport behavior); relatively short limbs and foreshortened skull/face; and light pigmentation areas. Earlier sexual maturation, prolonged receptivity, and larger litters were also noted. The increased estradiol supporting these changes was apparently also responsible for faster skeletal maturation, including earlier fusion of the basicranium causing tooth crowding, but also paedomorphic craniofacial proportions that we find attractive in our own and other species. In this paper, these important findings of the farm fox experiment are juxtaposed with insights from social psychology, physical anthropology, and neuroscience about facial beauty and reaction to it. Since many unrelated species show some or all of the neotenic package or domestication profile when they have achieved rapport past the juvenile stage, craniofacial proportions considered attractive are discussed as genetically and hormonally linked to the evolution of rapport social contact, trust, and cooperation whether by natural, intuitive, intentional, or mixed paths of selection.

Q. Rev. Biol. 2013: 88(3): 163-183

http://www.ncbi.nlm.nih.gov/pubmed/24053070

HEALTH AND DISEASE

Cellular microRNA miR-181b Inhibits Replication of Mink Enteritis Virus by Repression of Non-Structural Protein 1 Translation

J.Z. Sun, J. Wang, D. Yuan, S. Wang, Z. Li, B. Yi, Y. Mao, Q. Hou, W. Liu

Mink enteritis virus (MEV) is one of the most important viral pathogens in the mink industry. Recent studies have showed that microRNAs (miRNAs), small noncoding RNAs of length ranging from 18–23 nucleotides (nt) participate in host-pathogen interaction networks; however, whether or not miRNAs are involved in MEV infection has not been reported. Our study revealed that miRNA miR-181b inhibited replication of MEV in the feline kidney (F81) cell line by targeting the MEV non-structural protein 1 (NS1) messenger RNA (mRNA) coding region, resulting in NS1 translational repression, while MEV infection reduced miR-181b expression. This is the first description of cellular miRNAs modulating MEV infection in F81 cells, providing further insight into the mechanisms of viral infection, and may be useful in development of naturally-occurring miRNAs antiviral strategies.

PLoS One 2013: 8(12): e81515, 14 pp.
10.1371/journal.pone.0081515

http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3859502/

Evaluation of two enzyme-linked immunosorbent assays for serodiagnosis of Aleutian mink disease virus infection in mink

A.M. Andersson, P. Wallgren

Aleutian disease in mink is caused by infection with Aleutian mink disease virus (AMDV). In Sweden, the infection most commonly causes classical Aleutian disease in which the immune system fails to neutralize the virus and the infection becomes

persistent. Diagnosis of AMDV infection is based on serological methods that detect virus-specific antibodies. Traditionally counterimmunoelectrophoresis (CIEP) has been the preferred method, but in order to enable automation interest has been paid to other antibody detecting systems. Recently, at least two different ELISA systems that detect antibodies to AMDV have been manufactured; one is based on an in vitro grown AMDV as antigen, and the other system is based on the AMDV capsid protein VP2 as antigen. The aim of this study was to evaluate the two ELISA systems for detection of antibodies to AMDV using CIEP as the gold standard.
When employing the mean optical density of the samples from CIEP negative mink plus three standard deviations as cut-off value, the ELISA with the VP2 antigen had a sensitivity of 99.7% and a specificity of 98.3% compared to CIEP (n = 364). Analysis of samples with the AMDV-G antigen based ELISA employing an assay cut-off value based on the negative control samples, as suggested by the manufacturer, resulted in a sensitivity of 54.3% and a specificity of 93.2% with reference to CIEP as the gold standard (n = 359). When employing the mean optical density of the samples from CIEP negative mink plus three standard deviations as cut-off value, the AMDV-G ELISA had a sensitivity of 37.6% and a specificity of 98.3%.
The ELISA system based on VP2 antigen had high sensitivity and specificity, and was concluded to be an alternative to the CIEP as a diagnostic tool for AMDV antibodies. In contrast, the AMDV-G ELISA suffered from low sensitivity when compared to CIEP.

Acta. Vet. Scand. 2013: 55(86): 6 pp.

http://www.ncbi.nlm.nih.gov/pubmed/24274663

Hepatitis E Virus Variant in Farmed Mink, Denmark

J.S. Krog, S.Ø. Breum, T.H. Jensen, L.E. Larsen

Hepatitis E virus (HEV) is a zoonotic virus for which pigs are the primary animal reservoir. To investigate whether HEV occurs in mink in Denmark, we screened feces and tissues from domestic and wild mink. Our finding of a novel HEV variant supports previous findings of HEV variants in a variety of species.

Emerg. Infect. Dis. 2013: 19(12): 2028–2030

http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3840851/

Novel Orthoreovirus from Mink, China, 2011

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

We identified a novel mink orthoreovirus, MRV1HB-A, which seems to be closely related to human strain MRV2tou05, which was isolated from 2 children with acute necrotizing encephalopathy in 2005. Evolution of this virus should be closely monitored so that prevention and control measures can be taken should it become more virulent.

Emerg. Infect. Dis. 2013: 19(12): 1985–1988

http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3840883/

Bacterial diskospondylitis in juvenile mink from 2 Ontario mink farms

J. Martínez, B. Vidaña, R. Cruz-Arambulo, D. Slavic, B. Tapscott, M.L. Brash

Nine juvenile mink with hind-limb paresis/paralysis from 2 Ontario farms were submitted for necropsy. Diagnostic tests revealed spinal compression and severe thoracic diskospondylitis with intralesional Gram-positive coccoid bacterial colonies. Streptococcus canis, Streptococcus dysgalactiae subsp. equisimilis, and hemolytic Staphylococcus spp. were isolated from vertebral lesions.

Can. Vet. J. 2013: 54(9): 859-863
http://www.ncbi.nlm.nih.gov/pubmed/24155490

Effect of infectious dose and season on development of hemorrhagic pneumonia in mink caused by Pseudomonas aeruginosa

C.M. Salomonsen, M. Chriél, T.H. Jensen, L. Rangstrup-Christensen, N. Høiby, A.S. Hammer

Hemorrhagic pneumonia is an acute and fatal disease of farmed mink caused by Pseudomonas aeruginosa. The pathogenesis of this disease has not

yet been resolved. Mink qre the only animals known to be susceptible to acute, contagious, and fatal lung infections caused by P. aeruginosa. The purpose of this study was to investigate the correlation between dose-response and season of infection and to clarify whether Danish mink are carriers of P. aeruginosa on their nasal mucosa during the season for hemorrhagic pneumonia. To elucidate the pathogenesis of the disease, an infectious dose-response trial was carried out on adult mink and mink kits, both in the season for hemorrhagic pneumonia (November) as well as out of season (July). It proved difficult to infect mink via the intra-nasal route. Only 4 out of 60 infected mink developed clinical disease and were euthanized, all of them in November, illustrating that predisposing factors in the mink itself and not infectious dose might be crucial for disease development. We were able to culture P. aeruginosa from the nasal cavity of the clinically healthy experimental mink 8 d after inoculation. This indicated that the mink can carry P. aeruginosa on their nasal mucosa without developing the disease. It was not possible, however, to culture P. aeruginosa from the nasal cavity of clinically healthy mink obtained from farms in November, which indicates that the organism is not a normal part of the nasal mucosal flora.

Can. J. Vet. Res. 2013: 77(3): 221-225

http://www.ncbi.nlm.nih.gov/pubmed/24101800

Comparison of histological lesions in mink with acute hemorrhagic pneumonia associated with Pseudomonas aeruginosa or Escherichia coli

C.M. Salomonsen, M. Boye, N. Høiby, T.H. Jensen A.S. Hammer

Hemorrhagic pneumonia can be a major cause of mortality in farmed mink in the fall. In its classic form, hemorrhagic pneumonia is caused by the bacterium Pseudomonas aeruginosa. In recent years, however, outbreaks of this type of pneumonia that are associated with hemolytic Escherichia coli have also occurred in farmed mink. The purpose of this study was to compare histological lesions of acute hemorrhagic pneumonia associated with both P. aeruginosa and E. coli in mink, including a description of tissue distribution of pathogens, in an attempt to differentiate between the 2 disease entities based on histopathology. The study included material submitted for diagnostic investigation to the National Veterinary Institute in Denmark from 2006 to 2009. Altogether, 19 cases of hemorrhagic pneumonia with a pure lung culture of P. aeruginosa and 18 cases of hemorrhagic pneumonia with a pure lung culture of E. coli were examined. Formalin-fixed paraffin-embedded lung tissue obtained from the mink was examined by histology and fluorescence in-situ hybridization (FISH). It was possible to detect a slight histological difference between hemorrhagic pneumonia caused by P. aeruginosa and by E. coli, as P. aeruginosa was most often found surrounding blood vessels and lining the alveoli, while E. coli showed a more diffuse distribution in the lung tissue. Furthermore, P. aeruginosa often elicited a very hemorrhagic response in the lung, while infection with E. coli was associated with a higher frequency of alveolar edema and mild lymphoid cuffing in the lungs.

Can. J. Vet. Res. 2013: 77(3): 199-204

http://www.ncbi.nlm.nih.gov/pubmed/24101796

Flow cytometric evaluation of sperm apoptosis in semen of silver foxes in the breeding period

K. Kostro, L. Krakowski, U. Lisiecka, A. Jakubczak, A. Zmuda, P. Wojtaszczyk, A. Wąchocka

Anim. Reprod. Sci. 2013: Oct 26. [Epub ahead of print] pii: S0378-4320(13)00302-3. doi: 10.1016/j.anireprosci.2013.10.006

http://www.ncbi.nlm.nih.gov/pubmed/24332010

Characteristics of selected peripheral blood parameters in polar fox (*Alopex lagopus* L.) fed diets with inulin

R. Szymeczko, B. Głowińska, K. Burlikowska, A. Piotrowska, M. Bogusławska-Tryk, I. Kozłowska, A. Brudnicki, D. Pietruszyńska

This study aimed at investigating changes in selected peripheral blood parameters in male polar foxes fed diets with different supplementation of inulin: 0.25% (group El), 0.5% (E2) and 1% (E3). The blood for analysis was sampled from the brachial vein. The study showed that adding 0.25

and 0.5% of inulin to fox feed resulted in a lower content of haemoglobin (Hb) as well as mean mass of Hb in red blood cells in the 0.5% inulin group. The total count of thrombocytes decreased significantly with a higher level of prebiotic, while the total number of white blood cells and the percentage of different leukocytes tested remained invariable. The lowest supplementation of inulin affected the partial pressure of carbon dioxide, however, the remaining acid-base parameters did not change. The present study provides the first preliminary information about the effect of dietary inulin on some haematological indices and acid-base parameters in adult polar foxes. The results may be helpful in practice to improve the health condition of farmed polar foxes.

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Actual Mink Research 2013

Meeting at Research Centre Foulum

Faculty of Science and Technology

Aarhus University, Denmark

Nutritional supplements to a low protein diet in growing-furring mink

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

The results of the experiment showed that nutritional supplements could not prevent negative effects on growth performance and development of fatty liver when feeding growing-furring mink a low protein diet. The liver seemed to be able to regenerate after fat infiltration when fed a high protein diet during one month.

Meeting at Research Centre Foulum, Faculty of Science and Technology Aarhus University, Denmark. DCA Report no. 28, September 2013 (in Danish) p. 6-10. Authors' abstract.

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

M. Engbæk, P.F. Larsen

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

Meeting at Research Centre Foulum, Faculty of Science and Technology Aarhus University, Denmark. DCA Report no. 28, September 2013 (in Danish) p. 11-16. Authors' abstract.

Protein reduction and metabolic changes – we are looking for a needle in a haystack

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

In order to reduce the environmental impact of mink production attempts has been made to reduce to protein content in mink feed. However, it is well known that a protein content lower than 25% of metabolizable energy (MEp) often results in impaired health that may be linked to imbalance in the metabolism.

The purpose of the present investigation was to study the effect of feeding mink different protein levels on the composition of metabolites in plasma. The effect of three protein levels: 20%, 24 % and 28% MEp was studied. In the group fed 20 % MEp the effect of various additives was investigated as well. Blood samples were collected from the mink in August, September, October, and November. The samples were analyzed on LC-MS and the data were analyzed using multi variate data analysis. The data analysis showed that the metabolic profile changed over time, and a clear separation between the blood samples collected in August and November was seen. A closer look at the data from October showed a clustering of the data according to protein level. Mink fed 20 % MEp formed one group and mink fed 24 % and 28 % MEp formed another group. There was no difference between mink fed 24 % or 28 % MEp and there was no effect of the additives in the group fed 20 % MEp either. Some of the metabolites responsible for the separation were tryptophan and phenylalanine; the level of tryptophan was high in plasma from mink fed 24 % and 28 % MEp whereas the level of phenylalanine was high in mink fed the lowest protein level. Furthermore, the level of several phospholipids was higher in mink fed 24 % and 28 % MEp.

In conclusion, feeding mink different protein levels caused differences in the metabolic profile of plasma. The metabolic changes observed have similarities to metabolic disorders detected in obesity, diabetes and metabolic syndrome in humans.

Meeting at Research Centre Foulum, Faculty of Science and Technology Aarhus University, Denmark. DCA Report no. 28, September 2013 (in Danish) p. 17-22. Authors' abstract.

Examination of mink's ability to taste sugar and potential preferences

T.M. Schou, C. Pertoldi, J. Malmkvist

Loss of sweet taste ability has occurred for several species within the order Carnivora, and also within the family Mustelidae to which the mink belong. This study contains two sweet taste experiments with choice between a pure-water-solution and a sugar-water-solutions (sucrose sugar). Experiment 1 showed that mink significantly preferred a 0.5M sugar-water-solution over a pure-water-solution. Dose response test for the solutions 0.125M, 0.25M, and 0.5M showed no significant preference of the sugar-water-solutions against pure-water-solution. This study found that the mink has not lost the ability to taste sugar in a water solution and prefers a sugar-water-solution rather than a pure-water-solution. The preference was not stable over time, as there was a time difference between the two experiments.

Meeting at Research Centre Foulum, Faculty of Science and Technology Aarhus University, Denmark. DCA Report no. 28, September 2013 (in Danish) p. 23-29. Authors' abstract.

What characterises male mink with a high reproductive success?

N.H. Andersen, J. Malmkvist

Earlier studies have examined the importance of various factors important to a high reproductive outcome in female mink, whereas the reproduction of male mink has received less attention. The aim of this study was to explore which traits characterise male mink with the highest reproductive success. The behaviour, body condition, fur chew and hormone levels (cortisol and testosterone) were examined and compared to male reproductive success. Here we used mating success, mean litter size, kit mortality and kit growth to evaluate male reproductive success. Since the copulation abilities and willingness to mate are essential to male mink reproductive success, we likewise tried to examine which factors characterise males with a high vs. low mating success. We found that aggressive males sired larger litters, had lower kit mortality and a higher mating success. Furthermore, we found that the group of males with a high mating success had fewer barren females and exhibited more abnormal behaviour in the pre-mating period. No correlation between hormone concentrations and any of the reproductive parameters were detected in this study.

Meeting at Research Centre Foulum, Faculty of Science and Technology Aarhus University, Denmark. DCA Report no. 28, September 2013 (in Danish) p. 29-39. Authors' abstract.

When is the optimal time for moving the mink dam after mating?

J. Malmkvist

Mink females are typically moved to new, cleaned cages at the farm at some point after the mating. In addition, according to Danish legislation, mink dams should be housed with an empty cage between them from around medio April. However, the timing of moving mink to the delivery unit varies in the production, and the optimal timing is currently unknown. Some producers prefer to move the mated females later in April, closer to the expected day of delivery, to reduce the risk of stress around the time of implantation (16-24 days before delivery). The current study therefore investigated whether timing of movement after mating and before delivery – early (March 23rd), intermediate (April 10th) or late (April 25th) – affects maternal stress, care and the early kit vitality. Double-mated female yearlings (n = 180) were distributed to these three groups. Mink dams build and maintain a nest at least 1 month prior to delivery, in case of access to abundant nest building material. The timing of moving mated dams from mating cages to delivery cages does not affect the visible size of the nest after the delivery or the growth in surviving kits. However, after delivery, late moved dams had colder nests than nests of early

moved dams. Late transfer tended to increase the mortality among litters affected by early mortality. Fewer kits from early transferred dams vocalise when away from the female, tested day 5 after birth; based on previous knowledge this is interpreted as if these kits are in a better state. Dams moved around April 10th had approx. 50 % higher concentration of the hormone cortisol during the period prior to delivery; this indicates elevated stress as this higher concentration was not due to a higher number of kits. In case females are to be moved, transfer just after mating is preferable, as negative effects were present following later times of movement, in particularly in case this takes place around April 10th.

Meeting at Research Centre Foulum, Faculty of Science and Technology Aarhus University, Denmark. DCA Report no. 28, September 2013 (in Danish) p. 40-46. Authors' abstract.

Effects of nestbox size and access to elevated structures during lactation in domestic mink (*Mustela vison*)

M.V. Rørvang, S.W. Hansen

The lactation period is a crutial period for the mink. Nestbulding and care of the pups are demanding, and these demands increases as pups grow older. Former studies indicate that the mink will try to get away from the pups during lactation, thus she favours access to elevated structures. But as the access to elevated structures are examined, the effect of the size of her nestbox remain yet to be studied. This study focusses on the effect of the nestbox size and access to elevated structures. The study indicated that access to bigger nestboxes during lactation increases time spend in the nestbox, nursing, teathealth and the weight of male pups at weaning. Furthermore, minks in big nestbox used less time on elevated structures compared to minks in small nest boxes.

Meeting at Research Centre Foulum, Faculty of Science and Technology Aarhus University, Denmark. DCA Report no. 17, September 2013 (in Danish) p. 47-50. Authors' abstract.

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

B.I.F. Henriksen, S.H. Møller

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

Meeting at Research Centre Foulum, Faculty of Science and Technology Aarhus University, Denmark. DCA Report no. 28, September 2013 (in Danish) p. 51-55. Authors' abstract.

Cutaneous wounds in mink kits during the lactation period - classification, prevention and therapy

A. Jespersen, A.S. Hammer, T. Clausen, J.F. Agger, H.E. Jensen

Cutaneous wounds in farmed mink are considered an indicator of reduced welfare in mink production as stated by the EU Scientific Committee on Animal Health and Animal Welfare (2001). Danish studies have shown, that a significant number of mink kits die or are euthanized due to skin wounds. This, in addition to the lack of knowledge on key aspects like etiology of different wound types, risk factors and effect of treatment, has in recent years made the topic a target of increased attention from the public, authorities as well as the industry. The main aim of a 3 year project initiated in 2012 in collaboration between the fur industry and the University of Copenhagen is to characterize the different wounds types, which can be seen in mink during a production year and to optimize prevention and treatment of cutaneous wounds in mink. This will be of importance to animal welfare as well as economy in mink production.

Here we report initial results from investigations conducted on mink kits during the lactation period, including characterization of cutaneous wounds, the effect of providing water directly in the nesting case for the prevention of cutaneous wounds in the early growth period and studies of wound healing in mink kits treated with three types of topical wound solutions.

The results showed a tendency for wounds in mink kits in the weaning and pre-weaning period to be located primarily on the front parts of the body and the head, most frequently on the neck, shoulders and ears. Providing water directly in the nesting case had a reducing effect on occurrence of cutaneous wounds and mortality among mink kits in the late lactation period. Finally, initial results indicate, that topical solutions others than antibiotics might be applicable as useful alternatives in wound therapy in mink.

Meeting at Research Centre Foulum, Faculty of Science and Technology Aarhus University, Denmark. DCA Report no. 28, September 2013 (in Danish) p. 56-61. Authors' abstract.

Mechanical pressures in mink skins provide bite marks on the leather side of the skin

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

Bite marks occur more frequently in group housed mink than in mink kept pairwise during the growing up period. However, it has been questioned whether bite marks are caused by bites, and they have alternatively been interpreted as a spotwise delayed maturation of the winter coat unrelated to the level of aggression. Therefore, we tested the hypothesis that experimentally applied pressures/bites to the mink skin, during the growth phase of the winter coat, will produce bite marks that can be recognized as such at pelting. Furthermore, we also tested that the longer time mink are kept in groups, the more bite marks can be observed on the skin.

The results from the study show that mechanical pressure on the skin, probably damaging the hair follicles during the growth phase of the winter fur, can be recognized as bite marks in dark coloured mink at pelting. The result indicates that aggression or other social contact is the cause of bite marks. Bite marks do not occur in light coloured mink, possibly due to the lack of dark melanin grains in the hair follicles. Group housing after the autumn equinox significantly increases the incidence of bite marks, and individual housing increases the incidence of fur chewing. Bite marks in dark coloured mink can be quantified and reflect the level of aggressive interactions between mink and thus the risk of physical injury.

Meeting at Research Centre Foulum, Faculty of Science and Technology Aarhus University, Denmark. DCA Report no. 28, September 2013 (in Danish) p. 62-67. Authors' abstract.

Can we breed for more social mink?

P. Berg, S. Alemu, S.H. Møller, L. Janss, P. Bijma

This investigation shows that bite marks measured after pelting to a large extent is explained by indirect genetic effects, genetic effects of other animals in the cage. The sum of direct and indirect genetic effects explains a large proportion of the total variation in bite marks. The implication is that is it possible to select for mink that will bite other animals in the cage less as well as receive less bites from other animals in the cage.

Meeting at Research Centre Foulum, Faculty of Science and Technology Aarhus University, Denmark. DCA Report no. 28, September 2013 (in Danish) p. 68-71. Authors' abstract.

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

S.H. Møller, S.W. Hansen

A selection experiment have demonstrated that bite marks in mink may be reduced efficiently if the indirect social effects between mink in a group is included in terms of group selection. Other factors are, however, equally important for the number of bite marks in group housed mink and the number of bite marks was not reduced in the selection line, and the number increased in the control line. We tested the hypothesis that early separation of mink kits into group housing reduces the number of bite marks compared to late separation. We reject the hypothesis as the date of separation had no clear effect on the number of bite marks in juvenile mink. The expected effect was seen in the females but not in the males at Foulum, while the opposite effect was seen in males on the private farm where no effect was seen in females. Therefore the search for influential management and environmental factors that affect the number of bite marks in mink continues

Meeting at Research Centre Foulum, Faculty of Science and Technology Aarhus University, Denmark. DCA Report no. 28, September 2013 (in Danish) p. 68-75. Authors' abstract.

Optimization of the current breeding scheme for Blue fox

PhD thesis by Jussie Peura

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Finland is a leading blue fox pelt producer globally. Approximately every second blue fox pelt in the world is produced in Finland. The mean size of blue fox pelts has increased rapidly during the last 20 years. Over the same period, the mean litter result (number of pups born per mated female) has decreased. Poor fertility is especially a problem of young females. The goals of Finnish blue fox production are to increase pelt size, improve pelt quality and increase the litter result. Breeding values are estimated for litter size and for pelt size, quality, color darkness (scale from white to black) and color clarity (scale from red to blue). Two separate approaches to characterize pelt traits are in use: grading of live animals and evaluation of pelts in the auction house. The pelt traits, such as size, quality and color darkness and clarity are first graded on live animals (grading traits) and later after slaughtering evaluated on processed pelts displayed for auction sales (pelt character traits).

The study was divided into three parts. The first part was to estimate state of variation. The second part estimated genetic (co)variation for pelt traits and litter size. The third part used bio-economic modeling to estimate economic weights in Finnish blue fox production and compared different selection strategies from an economic point of view. Finnish blue fox population has relatively large effective population size and inbreeding is not a problem in the Finnish blue fox population.

The heritabilities of the traits in Finnish blue fox breeding vary from 6-10% for fertility traits and 10-55% for pelt traits. The highest heritability was found for color darkness and the lowest for litter size. Among traits that are easy to measure such as animal size, pelt size and color darkness, the genetic correlation between live animal grading and pelt grading was high. Color clarity is a difficult trait to measure under farm conditions. Genetic correlation between pelt color clarity and grading color clarity was low. Pelt size and animal size have antagonistic genetic correlation with litter size.

Fertility and pelt quality are the most economically valuable traits in Finnish blue fox production. The selection based on litter size, grading traits and pelt character traits gave only slightly better economic results than selection based on only pelt character traits and on litter size. Using the grading traits gave a poorer economic outcome than pelt traits. The selection of breeding candidates while restricting genetic change in pelt size to zero caused only minor loses in economic results.

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