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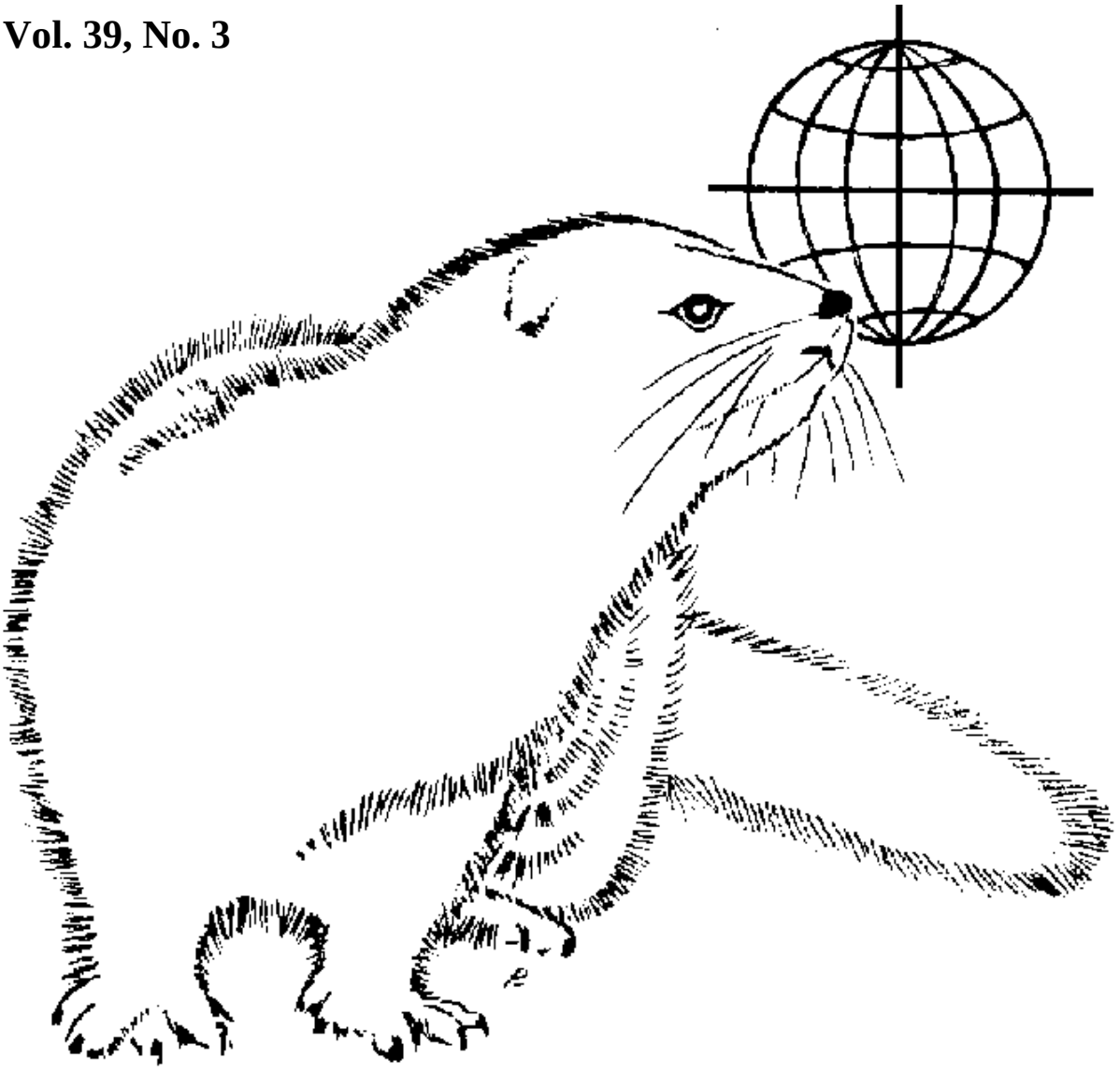

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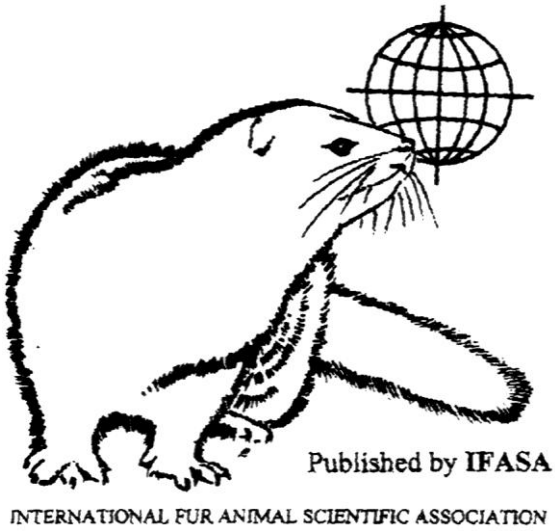

5. Symposiums, and congresses etc. 47

Notes from the Editor

In 2009, the “Welfure” project was initiated by the European Fur Breeders’ Association to develop a welfare assessment protocol for mink and fox farms in line with the “Welfare Quality” project focusing on cattle, pigs, and poultry launched by the European Commission in 2004. The assessment is based on four welfare principles – good feeding, good housing, good health and appropriate behaviour.

A reviewed article in Scientifur 39,3 deals with good feeding by focusing on the effect of addition of pine meal to conventional fox feed on production results and welfare in blue foxes. The authors suggest that addition of fibres in fox feed may be beneficial but that additional studies encompassing more animals and amounts of pine meal in the feed are necessary to determine the use of this feed additive.

Good housing and health are touched upon in a study of foot lesions in farmed mink. The experiment shows a significant effect of sex, age and colour type on lesions. Another study points out the possibility of addressing the increaseing frequency of eye infections in the Finnish blue fox population by selecting against eye infections.

A more basic study of shyness-boldness in farmed mink improves the understanding of behaviour in mink which potentially may provide new tools for improvement of welfare in fur animal production. A study of the association of nucleotide polymorphism in the DRD1 gene (dopamine receptor D1 gene) and stereotyped behaviour suggests that marker assisted selection may reduce self-biting in blue foxes.

The Nordic NJF meeting in fur animal research is held in Åbo in Finland from 29 September to 1 October 2015. Further information can be obtained at: Jussi Peura (jussi.peura@slu.se) or
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Please be aware in regards to future submissions of manuscripts to Scientifur, that INSTRUCTIONS FOR AUTHORS have been updated.

Vivi Hunnicke Nielsen

Editor Scientifur

Effect on pine meal on production results and welfare in blue foxes (*Vulpes lagopus*)

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Keywords: Vulpes lagopus; pine supplement; welfare; growing-furring; fibre component

Abstract

The aim of the present study was to clarify effects of pine meal on growth, feed intake, fur properties and welfare in juvenile blue foxes (*Vulpes lagopus*). Experimental groups were: (1) Group 1 (Gr 1): basic fox feed; (2) Group 2 (Gr 2): basic fox feed with 1% addition of pine meal; (3) Group 3 (Gr 3): basic fox feed with 2% addition of pine meal. Initial body weights of animals in groups were similar, i.e. they averaged 5.78-5.81 kg. Animals in all study groups grew normally. At pelting, no statistically significant differences were found among groups for final weights ($P>0.05$). Body weights then averaged 16.74-17.30 kg. However, final weights tended to be highest in control animals (Gr 1; $P<0.1$). Feed consumption was calculated for the entire study period (Sept1-Dec 6). No significant differences were found among the study groups. The general wellbeing of the animals was good throughout the study. Consistency of faeces tended to best in the pine meal groups. Any signs of diarrhoea were not detected. Palatability of feed was good for all animals. Grading of live animals before pelting did not show any statistical difference in size, mass, purity, colour or cover of hair coat ($P>0.05$). Evaluation of raw skins at pelting did not reveal any statistical differences in skin weight and length or in mass, cover and quality of fur coat ($P>0.05$). The statistical power to detect potential differences among the diets was restricted because of a rather small number of animals in the experimental groups. This should be taken into account in evaluation of the results. It is tempting to conclude that pine meal in amounts of 1-2% can be used in farm fox feed without any negative effect on welfare or production performance.

Introduction

Body size of farmed blue foxes (*Vulpes lagopus*) has increased dramatically during the last decades (Korhonen, 2014; Korhonen et al. 2014). At pelting, foxes nowadays typically weigh 15-20 kg compared to 10 kg or less 20 years ago. Blue foxes are fed with high-energy diets containing lots of fat (Pölönen, 2000). Typically, such a diet is not energetically very efficient and faeces are often loose during the autumn period (Korhonen & Harri, 1983; Koskinen et al. 2010). This easily leads to diarrhoea and thus, may be a welfare problem.

Dietary fibers are important components for creating a healthy working gastrointestinal tract (Koskinen et al. 2010). It is essential for normal digestion and may have essential production benefits for the animal. A crucial point is to find raw-material that could increase consistence of feed and faeces. Previously, various amounts of brewers' mash have been tested in the diets for farmed fur animals (Korhonen & Harri, 1985; 1988). Mash increases consistency of feed and faeces and, thus, increases energetic efficiency of feed. It also prevents effectively diarrhoea. Nowadays, availability of brewers' mash for farmed fur animals in large quantities is very limited. Therefore, it is necessary to find out potential substitutes. Some cellulose supplements have been tested lately for feed in foxes. Particularly results of using a pure fibre concentrates (lignocellulose) in fox diets are promising (Koskinen et al. 2012).

Pine meal is a new substance that has been recently brought to commercial use (Koskinen et al. 2012). However, it has not been tested yet in farmed fur animals. It can be assumed that pine meal will be a potential supplement to feed. It probably would affect the diet partly similarly as brewers' mash, i.e. it will increase consistency of feed and therefore, also enhance animal welfare (Korhonen & Harri, 1985; 1988; Koskinen et al. 2012). On the other hand, pine meal is nutrient free whereas brewers' mash has a much higher content of nutrients. The aim of the present study was to clarify effects of pine meal in the diet on growth, feed consumption,

fur properties and welfare in juvenile blue foxes. Two different supplement levels, i.e. 1 and 2%, were compared.

Materials and Methods

Experimental animals and set-up

The study was performed at Research Station, Kannus, in western Finland (63.54 ^{o}N, 23.54 ^{o}E) during the growing-furring period from September to December 2011. The use of experimental animals was evaluated and approved by the Animal Care Committee of MTT Agrifood Research Finland. The general health of the animals was checked daily. Health evaluation was based on general appearance of animals, including consistence of faeces. Furthermore, health of eyes and feet was also followed. Evaluations were done visually.

Three diet groups were employed: (1) Group 1 (Gr 1): basic fox feed; (2) Group 2 (Gr 2): basic fox feed with 1% addition of pine meal; (3) Group 3 (Gr 3): basic fox feed with 2% addition of pine meal. The groups were formed on Sept 1. Each group comprised 25 males and 25 females. Experimental animals were juvenile blue foxes born in May 2011. Study groups were made genetically equal by placing kits from same litter in different groups. The animals were housed in male-female pairs. Housing cages were 105 cm long x 115 cm wide x 70 cm high. Each cage had a wire-mesh platform (105 cm long x 25 cm wide) and a wooden block for chewing (diameter 7 cm, length 35 cm). Daily routine treatments were conducted according to standard farming procedures (Koskinen et al. 2012; Korhonen, 2014).

Diets and feeding

Details of the raw materials, vitamins and chemical compositions of the experimental diets are shown in Tables 1 and 2. Diets were the same throughout the study. Freshly mixed fox feed was supplied twice a day. The feed was manufactured by the MTT research station's feed kitchen. Palatability of feed was checked before the study. The feed was dispensed by a commercial feeding machine. Leftovers were collected the next day. Watering was automatic and *ad libitum*. Daily feed portions were adjusted according to the animals' appetite and seasonal standards (Koskinen & Sepponen, 2012).

Table 1. Calculated composition of experimental diets (%). Gr 1: basic fox feed; (2) Gr 2: basic fox feed with 1% addition of pine meal; (3) Gr 3: basic fox feed with 2% addition of pine meal.

Ingredient	**Gr 1**	**Gr 2**	**Gr 3**
Slaughterhouse offal	37.9	35.9	33.9
Broiler offal	7.5	7.5	7.5
Fish offal	7.0	7.0	7.0
Fish meal	3.5	3.5	3.5
Baltic herring	4.0	4.0	4.0
Fox carcass	4.0	4.0	4.0
Acidified carcasses	3.5	3.5	3.5
Feather meal	7.0	7.0	7.0
Cereals	10.0	10.0	10.0
Cooked barley	4.5	4.5	4.5
Fox fat	1.2	1.2	1.2
Soya oil	0.2	0.2	0.2
Pine meal	0.0	1.0	2.0
Water	9.0	10.0	11.0
Minerals	0.2	0.2	0.2
Soda	0.5	0.5	0.5
Per1000 kg feed			
Multivitamins, g[a]	170	170	170
Polifer Ultra, l[b]	1.0	1.0	1.0

[a] *A-vitamin 3500 IU/kg; D_3-vitamin 350 IU/kg; E-vitamin 80 mg/kg; thiamine 30 mg/kg: riboflavin 6 mg/kg; niacin 10 mg/kg; pantothenic acid 4 mg/kg; pyridoxine 3 mg/kg; biotin 0.1 mg/kg; B_{12} 0.02 mg/kg*

[b] *Iron solution*

Table 2. Analyzed chemical compositions and calculated metabolizable energy (ME) in experimental diets. Gr 1: basic fox feed; (2) Gr 2: basic fox feed with 1% addition of pine meal; (3) Gr 3: basic fox feed with 2% addition of pine meal.

	Gr 1	**Gr 2**	**Gr 3**
Dry matter, %	41.2	40.9	41.0
Ash, %	4.4	4.3	4.0
Crude protein, %	13.1	13.1	13.0
Crude fat, %	12.2	12.3	12.2
Crude carbohydrates, %	11.6	11.2	11.8
ME, kcal/kg	1760	1760	1760
ME, MJ/kg	7.4	7.4	7.4
pH	5.3	5.3	5.3
From ME			
Protein, %	26.8	26.8	26.5
Fat, %	59.4	59.8	59.3
Carbohydrates, %	13.8	13.3	14.1

Weighings and fur evaluation

Animals were weighed three times during the study with a Mettler SM 15 balance, accuracy ± 1 g. They were pelted (Dec 5) according to normal farming practices. Skin grading was performed by Saga Furs Ltd, Vantaa. Fur characteristics evaluated were fur mass, cover of hair and quality. The scale ranged from 1 (poorest) to 10 (best). Fur defects were also evaluated. Skins were weighed with a Mettler SM 15 balance, accuracy ±10 g. Skin length was measured by using a tape measure, accuracy ±1 cm. Grading of live animals was made on Dec 1 according to method of (Koskinen et al. 2010). Raw furs were sold at Saga Furs Ltd 2012 auction in Vantaa, Finland.

Statistics

Statistical analyses were made by using SAS 9.2 statistical MIXED model procedure (SAS, 2009).

Feed consumption per cage was tested according to feeding group. The statistical model used was:

$$y_{ij} = \mu + \tau_j + \varepsilon_{ij}$$

where μ is the general mean, τ_j the effect of treatment j, and ε_{ij} the residual error.

Because animals kept in the same cage were not independent of each other, weighing results as well as fur evaluations were tested with cage as a random factor. The statistical model used was:

$$y_{ijk} = \mu + \tau_i + \rho_{j(i)} + \varepsilon_{ijk}$$

where μ is the general mean, τ_i the effect of treatment i, $\rho_{j(i)}$ effect of cage j for treatment i, and ε_{ijk} the residual error for animal k for the treatment i in cage j.

Pairwise comparison was made by Tukey's test. Classified data (size, colour, quality classes) was tested by a chi-square test. Statistical significance level: $P<0.05$. Data are given as mean ± Standard Deviation (SD).

Results

Initial body weights of animals in groups were similar, i.e. they averaged 5.78-5.81 kg. Animals in all study groups grew normally (Table 3). At pelting, statistically significant differences were not found among the groups for final weights ($P>0.05$). Body weights then averaged 16.74-17.30 kg. However, final weights tended to be highest in control animals (Gr 1; $P<0.1$).

Feed consumption was calculated for the entire study period (Sept 1-Dec 5). Significant differences were not found between the study groups ($P>0.05$) (Table 3). The general wellbeing of animals was good throughout the study. Visually estimated consistency of faeces was considered to be slightly better in pine meal groups (Gr 2, 3). However, signs of diarrhoea were not observed in any of the study groups. Palatability of feed was good in all animals. Animals remained healthy throughout the study. General wellbeing of eyes and feet was good in all groups.

Table 3. Body weight and feed intake in experimental groups. Statistically significant differences were not found among groups (NS; P>0.05). Data are given as mean ± SD. Gr 1: basic fox feed; (2) Gr 2: basic fox feed with 1% addition of pine meal; (3) Gr 3: basic fox feed with 2% addition of pine meal.

	Gr 1	**Gr 2**	**Gr 3**	**P**
Body weight, kg				
Sept 1	5.79 ± 0.54	5.78 ± 0.63	5.81 ± 0.49	NS
Oct 17	11.40 ± 0.94	11.23 ± 1.41	11.09 ± 0.96	NS
Dec 5	17.30 ± 1.71	16.74 ± 2.38	16.84 ± 1.66	NS
Feed intake, g/day/cage	1919 ± 15	1910 ± 44	1921 ± 10	NS

Grading of live animals before pelting did not show any statistical difference in size, mass, purity, colour or cover of hair coat (P>0.05). Evaluation of raw skins at pelting did not reveal any statistical differences in skin weight and length or in mass, cover and quality of fur coat (P>0.05) (Table 4).

Table 4. Fur properties from grading of live animals (Dec 1) and raw skins (Dec 6). Price of sold furs at auction (€/skin). Data are presented as mean ± SD. Statistically significant differences were not found among groups (NS; P>0.05). Gr 1: basic fox feed; (2) Gr 2: basic fox feed with 1% addition of pine meal; (3) Gr 3: basic fox feed with 2% addition of pine meal. Scales used were the following: size, 1=small, 5=large. Colour, 1=light, 5=dark. Mass, 1=light, 5=plenty of mass. Purity, 1=not clean, 5=clean. Cover, 1=poor, 5=good.

	Gr 1	**Gr 2**	**Gr 3**	**P**
Live animals				
Size	4.06 ± 0.74	3.98 ± 0.81	3.92 ± 0.80	NS
Color	1.94 ± 0.68	2.00 ± 0.58	2.10 ± 0.81	NS
Mass	3.30 ± 0.51	3.15 ± 0.50	3.10 ± 0.54	NS
Purity	4.40 ± 0.67	4.52 ± 0.62	4.40 ± 0.76	NS
Cover	4.48 ± 0.61	4.56 ± 0.62	4.40 ± 0.73	NS
Raw skins				
Length, cm	1319 ± 43	1313 ± 42	1304 ± 40	NS
Weight, g	879 ± 118	857 ± 137	861 ± 111	NS
Mass	7.58 ± 1.49	7.57 ± 1.74	7.54 ± 1.45	NS
Cover	7.08 ± 1.48	7.18 ± 1.74	6.82 ± 1.62	NS
Quality	7.64 ± 1.41	7.63 ± 1.68	7.74 ± 1.24	NS
Price, €	135 ± 19	130 ± 26	136 ± 15	NS

Discussion

Raising period of juvenile blue foxes on farms can be divided into two phases: (1) Growing phase from weaning (late July) to the end of bone development (mid-September). (2) Furring phase from late September until pelting in November/December. The present study was concentrated more on the latter phase, i.e. it was carried out during Sept 1-Dec 5.

The number of experimental animals in study groups was not very large, i.e. 25 males and 25 females in each. Thus the power to detect potential differences between the diets is restricted. This should be taken into account in evaluation of the results.

Although not significantly smaller, final body weights in pine meal fed animals tended to be somewhat lower compared to control animals. As we can see also from the length of raw skins and body size evaluation of live animal grading, the highest values were found in control animals. It is possible that pine meal especially in larger amounts like 2% used here may result in reduced weight development. This assumption requires further studies. In previous studies (Korhonen & Harri, 1985; 1988), brewers' mash with higher amounts caused reduced weight gain in mink, polecat and raccoon dog. In those studies, the amount of added

mash content was, however, much higher (≥20% in the diet) than that of pine meal used here. On the other hand, brewers' mash is not totally comparable to pine meal, because pine meal is nutrient free whereas brewers' mash has a much higher content of nutrients. In another study (Koskinen et al. 2010), it was found that a maximum of 2% pure raw fibre concentrate (lignocellulose) can be recommended to use in fox feed to avoid harmful effects. So, feed components being rich in fibre in fur animal diets typically are efficient in small quantities but may cause some difficulties if used in larger quantities.

Use of insoluble fibre in feed is recommended particularly when feed consistency or energy content of the diet has to be modified (Koskinen et al. 2010; 2012). It is also recommended when high doses of fat are used as an ingredient in the feed (Korhonen & Harri, 1985; 1988; Gugolek et al. 2010). In the present study, energy contents of diets were very similar despite of pine meal supplements. Furthermore, the amount of fat in the diets was high, varying from 59.3 to 59.8 % of metabolizable energy. It is a general concept that high amount of fat in the diet may cause diarrhoea and thus lower digestibility of ingredients (Koskinen et al. 2010; 2012). Negative effects typically are a ceased growth and deteriorated fur properties. In the present study, consistency of faeces tended to be slightly better in pine meal groups. However, the difference was not very pronounced. Health of animals in all groups was good. So, pine meal supplement did not enhance or decline animal welfare. The amount of pine meal in the diets was low, however, i.e. only 1-2%. It is yet unknown to which extent higher amounts would influence animal welfare.

Feed intake in all groups was good and normal. Pine meal supplement from 1 to 2% in the diets did not affect palatability or feed consumption negatively. Similar results have been found from addition of brewers' mash to diets in fur animals (Korhonen & Harri, 1985; 1988). Neither did Koskinen et al. (2010) report negative effects of a pure raw fibre concentrate at level ≤ 2% on palatability. So, it seems that dietary fibre concentrates used at low amounts do not impair the palatability of the diet.

Quality of raw furs was similar in all diet groups. Also other variables describing fur properties were similar in group. Raw furs were finally sold at Saga Furs Ltd auction. The price of furs in all groups was of the same order of magnitude. This clearly shows that furs of control and pine meal groups were similar. So, farmers can without any production losses provide blue foxes pine meal added to feed with amounts of 1-2%.

Conclusion

The power to detect potential differences between the diets was restricted because of a rather small number of experimental animals. This should be taken into account in evaluation of the results. It can be concluded that pine meal in amounts of 1-2% can be added to fox feed without any negative effect on welfare and production parameters. Palatability of the diets was good in general. Pine meal may to a certain extent increase consistence of faeces. Higher amounts of pine meal should be tested in order to find the maximum limit for use.

Acknowledgments

This study was financially supported by the Finnish Fur Breeders' Association and MTT Agrifood Research Finland. The staff at the research station is kindly acknowledged for their valuable help in carrying out the experiment. Thanks to Nita Koskinen, Erkki Joki-Tokola, Juhani Sepponen and Pekka Eskeli for the Finnish report of this work from 2012.

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BREEDING, GENETICS AND REPRODUCTION

Correlation analysis between single nucleotide polymorphism of DRD1 gene and stereotyped behavior of blue fox

Z.Y. Liu, E.J. Ren, H.X. Ba, Q. Wu, H.W. Zhu, X.M. Xing, F.H. Yang

This study was performed to investigate the correlation between stereotyped behavior of the blue fox and single nucleotide polymorphisms (SNPs) of the DRD1 gene. We choose the DRD1 gene as a major gene for investigating the correlation of gene polymorphism and self-biting disease by means of direct sequencing. Part of the DRD1 gene exon of the blue fox was cloned; the length of the whole sequence was 864 bp. Four SNPs were detected and analyzed by the chi-square analysis; the results showed that the gene polymorphism of T206C in the DRD1 gene had a significant correlation with self-biting ($P < 0.01$). Therefore, marker-assistant selection on self-biting of blue foxes using these SNPs can be applied to select healthy individuals.

Genet. Mol. Res. 2015: 14(2): 6042-6047 doi: 10.4238/2015.June.8.1.

Patterns of genetic variation in the endangered European mink (*Mustela lutreola L., 1761*)

M.T. Cabria, E.G. Gonzalez, B.J. Gomez-Moliner, J.R. Michaux, D. Skumatov, A. Kranz, P. Fournier, S. Palazon, R. Zardoya

Background: The European mink (*Mustela lutreola, L. 1761*) is a critically endangered mustelid, which inhabits several main river drainages in Europe. Here, we assess the genetic variation of existing populations of this species, including new sampling sites and additional molecular markers (newly developed microsatellite loci specific to European mink) as compared to previous studies. Probabilistic analyses were used to examine genetic structure within and between existing populations, and to infer phylogeographic processes and past demography.

Results: According to both mitochondrial and nuclear microsatellite markers, Northeastern (Russia, Estonia and Belarus) and Southeastern (Romania) European populations showed the highest intraspecific diversity. In contrast, Western European (France and Spain) populations were the least polymorphic, featuring a unique mitochondrial DNA haplotype. The high differentiation values detected between Eastern and Western European populations could be the result of genetic drift in the latter due to population isolation and reduction. Genetic differences among populations were further supported by Bayesian clustering and two main groups were confirmed (Eastern vs. Western Europe) along with two contained subgroups at a more local scale (Northeastern vs. Southeastern Europe; France vs. Spain).

Conclusions: Genetic data and performed analyses support a historical scenario of stable European mink populations, not affected by Quaternary climate oscillations in the Late Pleistocene, and posterior expansion events following river connections in both North- and Southeastern European populations. This suggests an eastern refuge during glacial maxima (as already proposed for boreal and continental species). In contrast, Western Europe was colonised more recently following either natural expansions or putative human introductions. Low levels of genetic diversity observed within each studied population suggest recent bottleneck events and stress the urgent need for conservation measures to counteract the demographic decline experienced by the European mink.

BMC. Evol. Biol. 2015: 15:141. doi: 10.1186/s12862-015-0427-9

Breeding for better eye health in Finnish blue fox (*Vulpes lagopus*)

R. Kempe, I. Strandén

J. Anim. Breed. Genet. 2015: doi: 10.1111/jbg.12170. [Epub ahead of print]

Noninvasive monitoring of female reproductive hormone metabolites in the endangered European mink (*Mustela lutreola*)

A. Nagl, N. Kneidinger, K. Kiik, H. Lindeberg, T. Maran, F. Schwarzenberger

Theriogenology. 2015: pii: S0093-691X(15)00381-7 doi: 10.1016/j.theriogenology.2015.07.023. [Epub ahead of print]

NUTRITION, FEEDING AND MANAGEMENT

Effects of dietary copper on organ indexes, tissular Cu, Zn and Fe deposition and fur quality of growing-furring male mink (*Mustela vison*)

X. Wu, X. Gao, F. Yang

The objectives of this study were to study the effects of different levels of dietary copper on organ indexes, tissular Cu, Zn and Fe deposition and fur quality of mink in the growing-furring periods. One hundred and five standard dark male mink were randomly assigned to seven groups with the following dietary treatments: basal diet with no supplemental Cu (Control); basal diet supplemented with either 6, 12, 24, 48, 96 and 192 mg/kg Cu from copper sulphate, respectively. The colour intensity scores displayed a linear trend ($P = 0.057$). The spleen Cu concentrations responded in a linear ($P < 0.05$) fashion with increasing level of Cu, but copper supplementation did not affect speen concentrations of Fe or Zn. Supplemental dose of Cu linearly increased ($P < 0.05$) liver Cu and Fe concentrations but did not alter ($P > 0.10$) liver Zn. Our results indicate that Cu plays an important role in the pigmentation in growing-furring mink, and supplemental dietary Cu in growing-furring mink improve hair colour, and copper has limited effects on liver mineral deposition.

J. Anim. Sci. Technol. 2015: 57:6 doi: 10.1186/s40781-015-0040-x. eCollection 2015

Effect of Carotenoid Supplement on Production Performance in Mink (*Neovison vison*)

H.T. Korhonen, H. Huuki

The present study sought to find out how carotenoid supplement influences on body weights, feed consumption and reproductive success in standard farm mink (*Neovison vison*). Carotenoids were from microalgae *Haematococcus pluvialis*. A dose of carotenoid supplement of 0.20, 0.25, 0.20, 0.20, and 0.10 g/animal was added daily in feed in February, March, April, May, and June, respectively. Experimental groups were: 1) control group, and 2) carotenoid group. Each group comprised 100 females and 25 males. The results showed that appetite of animals in all groups was good. Significant differences were not found in body weights before breeding. However, weights of control females were significantly ($P < 0.05$) lower compared with those of carotenoid fed animals when kits aged 21 days. At the age of 21 and 42 days, body weights of kits were similar in both groups. However, kits from carotenoid group tended to grow better ($P < 0.1$) than those from control group. Number of whelped females was lower in control group (81 vs 85 females). Number of barren females was higher in control than in carotenoid group (16 vs 13 females). Significant differences were not found in number of kits per mated and whelped female. Number of lost kits was higher in the control group at the age of 21 days (24 vs 20 kits) and the age of 42 days (40 vs 26 kits). The present study showed that carotenoid supplement could be used in mink diet. The results are promising, but require further studies before final implementation.

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BEHAVIOUR AND WELFARE

Context Matters: Multiple Novelty Tests Reveal Different Aspects of Shyness-Boldness in Farmed American Mink (*Neovison vison*)

C.L. Noer, E.K. Needham, A.S. Wiese, T.J. Balsby T. Dabelsteen

Animal personality research is receiving increasing interest from related fields, such as evolutionary personality psychology. By merging the conceptual understanding of personality, the contributions to both fields of research may be enhanced. In this study, we investigate animal personality based on the definition of personality traits as underlying dispositional factors, which are not directly measurable, but which predispose individuals to react through different behavioural patterns. We investigated the shyness-boldness continuum reflected in the consistency of inter-individual variation in behavioural responses towards novelty in 47 farmed American mink (*Neovison vison*), which were raised in identical housing conditions.

Different stages of approach behaviour towards novelty, and how these related within and across contexts, were explored. Our experimental design contained four tests: two novel object tests (non-social contexts) and two novel animated stimuli tests (social contexts). Our results showed consistency in shyness measures across multiple tests, indicating the existence of personality in farmed American mink. It was found that consistency in shyness measures differs across non-social and social contexts, as well as across the various stages in the approach towards novel objects, revealing that different aspects of shyness exist in the farmed American mink. To our knowledge this is the first study to reveal aspects of the shyness-boldness continuum in the American mink. Since the mink were raised in identical housing conditions, inherited factors may have been important in shaping the consistent inter-individual variation. Body weight and sex had no effect on the personality of the mink. Altogether, our results suggest that the shyness-boldness continuum cannot be explained by a simple underlying dispositional factor, but instead encompasses a broader term of hesitating behaviour that might comprise several different personality traits.

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HEALTH AND DISEASE

Foot Lesions in Farmed Mink (*Neovison vison*): Pathologic and Epidemiologic Characteristics on 4 Danish Farms

A. Jespersen, A.S. Hammer, H.E. Jensen, N. Bonde-Jensen, M.M. Lassus, J.F. Agger, P.F. Larsen

Vet. Pathol. 2015: pii: 0300985815600502. [Epub ahead of print]

Dermatophytosis in farmed mink (*Mustela vison*) caused by *Trichophyton equinum*

D.P. Overy, F. Marron-Lopez, A. Muckle, A. Bourque, L. Lund, D. MacHattie, A. Lopez

J. Vet. Diagn. Invest. 2015: pii: 1040638715596036. [Epub ahead of print]

Pathogenesis of canine distemper virus in experimentally infected raccoon dogs, foxes, and minks

J. Zhao, N. Shi, Y. Sun, V. Martella, V. Nikolin, C. Zhu, H. Zhang, B. Hu, X. Bai, X. Yan

Antiviral Res. 2015: 122: 1-11. doi: 10.1016/j.antiviral.2015.07.007. [Epub ahead of print]

A comparative study of *Toxoplasma gondii* seroprevalence in mink using a modified agglutination test, a Western blot, and enzyme-linked immunosorbent assays

Y. Gu, Z. Wang, Y. Cai, X. Li, F. Wei, L. Shang, J. Li Q. Liu

J. Vet. Diagn. Invest. 2015: pii: 1040638715596033. [Epub ahead of print]

Cloning and expression of mink (*Neovison vison*) interferon-γ gene and development of an antiviral assay

H. Zhang, J. Zhao, X. Bai, L. Zhang, S. Fan, B. Hu, H. Liu, D. Zhang, S. Xu, X. Yan

Res. Vet. Sci. 2015: 101: 93-98. doi: 10.1016/j.rvsc.2015.06.012. [Epub ahead of print]

Observations on hippocampal mossy cells in mink (*Neovison vison*) with special reference to dendrites ascending to the granular and molecular layers

J. Sigurd, B. Blackstad, K.K. Osen, H.E. Scharfman, J. Storm-Mathisen, T.W. Blackstad, T.B. Leergaard

Hippocampus. 2015: doi: 10.1002/hipo.22518. [Epub ahead of print]

Causes of mortality in farmed mink in the Intermountain West, North America

D.J. Wilson, T.J. Baldwin, C.H. Whitehouse, G. Hullinger

J. Vet. Diagn. Invest. 2015: 27(4): 470-475. doi: 10.1177/1040638715586438. [Epub ahead of print]

Novel calicivirus from a ferret badger (*Melogale moschata*) in China

F.M. Miao, Y.H. Li, Y. Liu, S.F. Zhang, F.C. Miao, J.H. Zhao, R.L. Hu

We describe the isolation and complete genome sequence of a new calicivirus, FBCV-JX12, isolated from a ferret badger (*Melogale moschata*). Comparison of FBCV-JX12 with other vesiviruses revealed that it shared the highest amino acid sequence identities of 71.6, 60.5, and 59.3% in the nonstructural protein, VP1, and VP2, respectively, with MCV-DL2007 (mink calicivirus). Phylogenetic analysis of the whole genomic sequence showed that it clustered most closely with MCV-DL2007 of the genus Vesivirus, but with low nucleotide similarity in the three open reading frames (62.1-68.5%).

Arch. Virol. 2015: 160(7): 1797-1800. doi: 10.1007/s00705-015-2432-0. [Epub ahead of print]

Morphological changes in the tympanic membrane associated with *Haemophilus* influenzae-induced acute otitis media in the chinchilla

X. Guan, S. Jiang, T.W. Seale, B.M. Hitt, R.Z. Gan

Int. J. Pediatr. Otorhinolaryngol. 2015: 79(9): 1462-1471. doi: 10.1016/j.ijporl.2015.06.030. [Epub ahead of print]

Actual Mink Research 2015

Meeting at Research Centre Foulum

Faculty of Science and Technology

Aarhus University, Denmark

Are we able to do an early detection of pregnancy in mink by analyzing a urine sample?

M.S. Hedemann

The possibility of early and easy detection of pregnancy in mink would provide the farmers with the opportunity to pelt barren females while still carrying their winter fur which would be economically attractive compared to pelting while wearing summer fur or feeding the female to the pelting season in November. At present no method to detect pregnancy in mink exists and in this study we explored the possibility of using non-targeted metabolomics to detect barren female mink. Urine samples were collected from female mink after mating was finished (March 24), when implantation was expected to have taken place (April 8) and when the females were moved to the cages where they should whelp (April 15). The samples were analyzed with liquid chromatography-mass spectrometry and the results showed a clear separation of urine samples collected between end-March and mid-April, the separation being especially evident between April 8 and 15. The number of barren females in the studies was too low to permit identification of biomarkers of "non-pregnancy". The metabolites causing the separation were primarily associated with protein metabolism. Further studies are needed to elucidate whether the differences in metabolite concentrations are associated with pregnancy or if it is general changes in the metabolism observed in all female mink during this period.

Meeting at Research Centre Foulum, Faculty of Science and Technology Aarhus University, Denmark. DCA Report no. 066, September 2015 (in Danish) p. 7-12. Authors' abstract.

How can we get more mink kits to survive?

J. Malmkvist

There is a potential for an increased kit survival in the production of mink. Access to adequate material for nest building prior to delivery reduces dam stress, improves deliveries and subsequently maternal care and kit survival. However, knowledge of several aspects in the management of dams from mating to the first 7 days after delivery is lacking as to actually increase the early kit survival on commercial farms. In the year 2015, we tested the effect of: (1) the timing of the onset of providing nesting material to dams (early: March 23, mid: April 10, Late: April 20), (2) the timing of transferring dams to the maternity unit (early: March 23, Late: April 20) and (3) the type of nesting material given in the cage from April 10 to day 7 after delivery (barley straw, "easystroe+" , free choice of barley straw and lamb's wool). In total, we used 480 first-parity double-mated brown dams distributed to six experimental groups of 80 dams each at the farm at Aarhus University, Denmark. In the same experiment, we also tested whether two types of nest box inserts (brick stone n=240 vs. "easybrick" n=240) – using a split-plot design in a balanced way between the experimental groups and in every second nest box within the shed – affected indicators of dam stress, early kit survival and maternal care. Selected results are presented, whereas data on in-nest climate (temperature and humidity measured every 15 min using loggers) and dam cortisol (FCM) currently are under analysis. Preliminary results indicate that (1) free access to lamb's wool in addition to shredded barley straw increases the nest score (> straw alone > "easy-stroe+") both before and after delivery, (2) the risk for the liveborn kits (reduced survival, reduced growth postnatal day 1-7) increases with the number of stillbirths in the litter, whereas (3) the number of live kits day 1 positively affects early kit growth day 1-7 – "the more the merrier" – suggesting that within-litter competition/dam ability

after the first critical day of delivery is not a limiting factor, (4) straw provision starting April 10 was unfavourable for kit survival, but further indicators are to be included to fully interpret this result, (5) the commercial product "easy-brick" in the nest box increases the survival of liveborn kits significantly compared to a brick stone (however, we did not have an experimental group without any of these two alternatives) and (6) the kit growth day 1-7 was unaffected by the experimental treatments.

Meeting at Research Centre Foulum, Faculty of Science and Technology Aarhus University, Denmark. DCA Report no. 066, September 2015 (in Danish) p. 13-22. Authors' abstract.

Allocation of straw during winter time shows that mink dams have early motivation for nest building, and it increases reproduction success

T.M. Schou, J. Malmkvist

When allocating straw to mink dams in January, the study found that mink dams have motivation for nest building during winter time, before mating and parental care. The effect of straw was only seen if straw was allocated in the cages instead of on the top of the nest box. Opposite expected, access to straw in the cages did not reduce the occurrence of the abnormal types of behaviour; stereotypy and fur chewing. However, dams with access to straw from 15th January did get a significantly greater litter size day 7 after birth compared to dams with access to straw from 23rd March. Thus, the result shows for the first time that time of allocation of straw in cages affects reproduction success measured as number of kits alive day 7.

Meeting at Research Centre Foulum, Faculty of Science and Technology Aarhus University, Denmark. DCA Report no. 066, September 2015 (in Danish) p. 23-31. Authors' abstract.

Can multiparous mink dams also produce more milk for a longer period if they are fed *ad libitum* from delivery?

S.H. Møller, P. Bouyssie, A.F. Marsbøll, B.I.F. Henriksen

According to Danish and European legislation it is not allowed to wean mink kits before they are 8 weeks old. This is too late if the dam has no or very little milk left at 6–7 weeks, where the kits often challenge until they drink sufficiently from the watering system. Therefore, we tested the hypothesis that an *ad libitum* feeding strategy in the beginning of the lactation period could prolong the lactation period of old dams, as it has been demonstrated in young dams, and thereby improve the welfare of mother and kits. Eighty-four brown female mink were fed *ad libitum* and 84 female mink were fed somewhat restricted in the first four weeks of the lactation period. Four females with litters of 4, 6, 8 and 10 kits where killed from each treatment in week 3, 4, 5, 6, 7, and 8 after birth and their mammary gland tissue weighed. Contrary to young dams, *ad libitum* fed dams had more gland tissue before six weeks, the same amount of gland tissue at 6 weeks and less tissue after 6 weeks. Little gland tissue remained 8 weeks postpartum and litter size had no apparent effect on the amount of gland tissue

Meeting at Research Centre Foulum, Faculty of Science and Technology Aarhus University, Denmark. DCA Report no. 066, September 2015 (in Danish) p. 32-38. Authors' abstract.

Scabs may occur when the mink kits are 6-7 weeks of age without prior visible open wounds

S.W. Hansen, T.M. Schou, S.H. Møller, P. Bouyssie, J. Malmkvist

In this experiment we observed the occurrence of damages in 177 mink litters from the age of 5 weeks and until weaning and replacing of the kits. Fifty litters had access to an extra water supply placed in the cage in front of the nest entrance, and in 45 litters the female mink were fed 15% restricted in the first 4 weeks of the nursing period. The rest of the litters were fed ad libitum feeding and had only access to the standard water nipple at the end of the wire cage. All the litters were scanned for potential damages 3 times a week. If one kit in the litter was affected all the kits in the litter were examined, and the type, location and size of the damages were registered.

The main part of damages observed in mink kits (70%) were scabs observed primarily in the neck region of the female kits. As only a small fraction of

the kits was observed having open wounds, it seems as scabs develop without prior visible open wounds, possibly due to small invisible bites or excessive licking especially in the neck region of the kits. The occurrence of scabs and wounds was restricted to the period when the kits were 6-7 weeks old.
Access to an extra water supply did not prevent the occurrence of scabs or wounds but reduced the occurrence of scabs ($P<0.09$) and wounds ($P<0.05$). The feed restriction of the females did not in this experiment increase the occurrence of scabs.

Meeting at Research Centre Foulum, Faculty of Science and Technology Aarhus University, Denmark. DCA Report no. 066, September 2015 (in Danish) p. 39-47. Authors' abstract.

Optimal feeding of mink in the lactation period

T.N. Clausen, P.F. Larsen

In recent years it has become more and more common to feed mink females slightly restrictive just before birth and the first days of the lactation period. However, if the females are fed after body condition in the winter period higher feeding intensity up to birth did not result in more birth problems or more dead kits at birth, and for both black and brown mink kit weight, there was a positive effect of higher feeding intensity immediately after birth. Females and kits do not have the same need to feed composition in the lactating period and different feeding principle and feed to females and kits has been tested

Meeting at Research Centre Foulum, Faculty of Science and Technology Aarhus University, Denmark. DCA Report no. 066, September 2015 (in Danish) p. 48-52. Authors' abstract.

Mink's requirement for vitamin E in the growing ad furring period

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

Vitamin E is one of the most expensive vitamins to add to the feed. Commercial vitamin E is available as both natural and synthetic supplement. The vitamin E recommendation for mink varies in the Nordic countries between 50-80 mg per kg feed of synthetic *all-rac*-α-tocopheryl acetate in order to maintain a plasma status of 10-15 µg/ml. The vitamin E requirement is linked to the content of poly-unsaturated fatty acids in the feed or if the feed is oxidized. Natural vitamin E is more expensive than the synthetic form, but has higher biological efficacy.
The present paper comprises an experiment with two doses of either natural (20 or 40 mg RRR-α-tocopheryl acetate) or synthetic (40 or 80 mg *all-rac*-α-tocopheryl acetate) vitamin E per kg feed to mink kits from weaning to pelting. 1080 mink of the genotype Brown randomly assigned to 4 groups so each treatment consisted of 135 pairs (male and female). Mink were weighed monthly and blood samples from 8 mink per treatment for plasma analysis of tocopherols were also taken monthly. At pelting (November 13) plasma, liver, heart, brain, lungs and abdominal fat from 8 mink from each group were sampled, weighed and analysed for tocopherol content. After pelting male pelts were sorted and ranked. Dead animals were registered and autopsied.
There was no difference in fur quality and growth of the animals between the treatments. Total α-tocopherol concentration followed the dietary dosage with a great preference for the natural RRR stereoisomer in plasma and tissues. Generally in plasma and tissue, concentration of RRR stereoisomer was highest followed by RRS, RSR, RSS and the four 2S except in the liver, where the 2S concentration was higher than the RRS, RSR and RSS. In November, the average total α-tocopherol concentration in plasma in group 40 mg *all-rac*-α-T and 20 mg RRR-α-T was 13.3 and 11.4 ug/ml, respectively. This may be a consequence of an increasing content of polyunsaturated fatty acids in the diets and thereby an increased vitamin E requirement. The ratio RRR/*all-rac* in plasma increased over time and ended in 1.7:1 in November.

Meeting at Research Centre Foulum, Faculty of Science and Technology Aarhus University, Denmark. DCA Report no. 066, September 2015 (in Danish) p. 53-59. Authors' abstract.

Necrotizing pyoderma in farmed mink (*Neovison vison*) – results and experiences from Danish farms

A. Jakobsen, B. Aalbæk, P. Damborg, L. Andresen, A.S. Hammer

Outbreaks of necrotizing pyoderma characterized by occurrence of unusual wounds in the face and paw region of mink was diagnosed on 5 Danish farms in 2014-2015 (Hammer et al 2015). Similar disease previously referred to as "pododermatitis", *"face and footrot"* or – "fur animal epidemic necrotic pyoderma" has been reported from several fur producing countries including Canada in 2000 (Brøjer 2000, Chalmers et al 2015) and Finland in 2007 (Nordgren et al 2014). The outbreaks of necrotizing pyoderma in Danish mink farms were associated with occurrence of unusual wounds in the face and paw region and increased mortality. The researchers at the University of Copenhagen have diagnosed the disease based on traditional microbiological culture, molecular biological methods and pathology. Findings were similar to reports from other fur producing countries. Copenhagen University have analyzed data and material collected on 5 Danish farms. The cause of disease has not been identified and it has not been possible to identify a common risk factor. Since the disease occurs simultaneously in many genetic types on the farms it does not appear to be genetically inherited. FENP is a disease of concern for mink breeders worldwide, compromising animal welfare and causing considerable economic losses to farmers.

Meeting at Research Centre Foulum, Faculty of Science and Technology Aarhus University, Denmark. DCA Report no. 066, September 2015 (in Danish) p. 60-64. Authors' abstract.

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

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

The prevalence of animal welfare problems in each of the minks' three main production periods may vary with date of assessment. This has been shown in the nursing period for several animal based measurements, with increasing welfare problems closer to weaning. The time windows for assessing the animals' welfare in WelFur-Mink are limited to three periods of six to eight weeks each. A further reduction of the assessment periods will dramatically reduce the feasibility of the assessment. However, if similar tendencies are seen in the winter and in the growth period, a practical solution could be to stratify the three farm visits per year into the beginning, the middle and the end of the assessment periods. The aim of this investigation was, therefore, to explore if there is a variation within the winter and growth assessment period that need to be taken into consideration in the WelFur assessment of mink. We hypothesised that the prevalence of mink in too low body condition, stereotypy and fur chewing increase with the date of assessment within the winter period, and the prevalence of injuries, diarrhoea and exploratory mink increase with the date of assessment within the growth period. Eight private Danish mink farms were included in this study. Each farm was assessed three times during the winter period and four times during the growth period according to the WelFur-Mink protocol. The preliminary results support the hypotheses, except for the percentage of too thin animals in the winter period, which seemed to decrease with date of assessment. The potential changes in welfare with date of assessment point in opposite directions, as the changes in some indicators may have a positive effect on the overall welfare score, while other may have a negative effect. Further analysis will investigate the effect of assessment date on criteria, principle and overall assessment level.

Meeting at Research Centre Foulum, Faculty of Science and Technology Aarhus University, Denmark. DCA Report no. 066, September 2015 (in Danish) p. 65-69, Authors' abstract.

Can the WelFur-assessment be simplified, with reducing the number of periods or measurements per period?

B.I.F. Henriksen, J.T. Sørensen, S.H. Møller

The objective of the study was to test if the overall annual classification of welfare of a mink farm in the welfare assessment system WelFur–Mink can be based on assessment in just one of the three annual production phases. This will save time and money compared with today's practise with assessment in

all the three phases of mink production, and can provide the farmer with an immediate result. Based on the WelFur-Mink protocol, data from 19 farms were collected in each of the three production phases: Winter period with breeders in January-February; Nursing period in May-June; Growth period from late September until pelting or selection. The data were recorded by two external assessors per farm, on 9 farms in 2011 and 10 other farms in 2013. WelFur score values were calculated based on information from the three phases, and score values for each of the three visits were estimated. Data from the three assessments per farm were compared both at criteria-, principle-, and at overall classification level according to the Welfur-mink concept. The results showed that the estimated WelFur classification of farms differed between the assessment periods, especially due to low score-value of the principal "Good Feeding" in the lactation period. The results did also show that scores from the nursing period and the growth period are needed for predicting the full annual score of the four WelFur principles, while the scores from the winter period are less important. It might not be necessary to measure all the different measurements in every assessment period to get the full annual scores. Based on the present results we reject our hypothesis that the overall annual classification of welfare of a farm in the WelFur system can be based on one period. A simplification of the WelFur-assessment system may be possible, with excluding welfare assessment in period one.

Meeting at Research Centre Foulum, Faculty of Science and Technology Aarhus University, Denmark. DCA Report no. 066, September 2015 (in Danish) p. 70-74. Authors' abstract.

Selection for confident mink increases pelt quality

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

According to Danish legislation, fearful mink cannot be used as parents for the next generation, and selection for confident animals must be included in the breeding programme. The purpose of mink production is to produce high-quality fur, and selection for one trait (e.g. behaviour) can potentially influence other production traits due to correlated responses. Therefore, the aim of this analysis was to estimate heritability for fearful/confident behaviour and to calculate genetic, residual, and phenotypic correlations between behaviour and economic important production traits. Ten thousand nine hundred Brown mink born 2013 and 2014 were used. The stick test (in principle a voluntary approach-avoidance test) was used to assess behavioural response in October. Pelt quality and body weight were evaluated during live grading in November in the first year of the mink, skin quality and skin size were evaluated on dried skin from the pelted mink, barren females were defined as females that were mated but did not deliver, and litter sizes for females were counted approximately three days after birth (1st counting) and at day 21 (3rd counting) at sex sorting. Survival percentage is calculated from number of offspring survived from first to third counting. Production traits were analyzed separately for males and females in order to test if the traits were independent of sex. We found that 1) genetic correlations between traits evaluated on each sex were high but significantly different from one, indicating that the genetic background for the traits is depending on sex, 2) heritability for behaviour was moderately high (h^2 = 0.44), indicating a larger selection potential for confident behaviour than previously reported, 3) positive and significant genetic correlations between behavioural response and pelt quality, indicating that selection for confident mink also increases the pelt quality, and 4) positive phenotypic correlations to litter size at third counting and to survival of offspring, suggesting that confident females may have an increased ability to care for kits or that kits from confident females have an increased ability to survive.

Meeting at Research Centre Foulum, Faculty of Science and Technology Aarhus University, Denmark. DCA Report no. 066, September 2015 (in Danish) p. 75-81. Authors' abstract.

Stochastic simulation of breeding plans reveals how the profit from genomic selection can be disseminated to the industry

K. Meier, M.S. Lund, A.C. Sørensen

Previous simulations of genomic selection at the farm level revealed an increased profit compared to traditional breeding methods. However, a challenge is how to transmit this additional improvement to the industry level, which was the focus in this study.

Using stochastic simulations we evaluated different infrastructures based on different levels of collaboration. Collaboration was evaluated a) between farmers from the breeding nucleus, multiplier units and production units, and b) between farmers within the breeding nucleus.

Our results reveal that the profit from genomic selection from the farm level can be transferred to the industry. The dissemination of the profit is effective at a high accuracy of genomic tests, and for an infrastructure with a large degree of collaboration between the nucleus, the multiplier and production units. Finally, our simulation results suggest that one large breeding nucleus is more effective than several farms collaborating within the nucleus

Meeting at Research Centre Foulum, Faculty of Science and Technology Aarhus University, Denmark. DCA Report no. 066, September 2015 (in Danish) p. 82-86. Authors' abstract.

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References in the text should be made according to the following examples: Nielsen, 1992; Hansen & Berg, 1993; Bakken *et al*., 1999. The list of references should be arranged in alphabetical order according to the name of the first author and the year of publication within names. The year of publication should be written between the name(s) and the title. Examples of references are:

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

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

Tables shall be numbered consecutively with Arabic numerals and have a self-explanatory title. The Table should fit a final width of 80 or 170 mm.

Figures All graphs, photos and pictures are considered as Figures. Figures shall be numbered consecutively with Arabic numerals and have a self-explanatory title. All drawings have to be professionally drafted (photocopies are not an acceptable standard). The Figures should be JPG-, GIF- or TIF-files. Any halftones must exhibit high contrast and text and other details must be large enough to retain the readability after reduction of figure size to single column (width 80 mm); the width of 170 mm is also accepted.

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