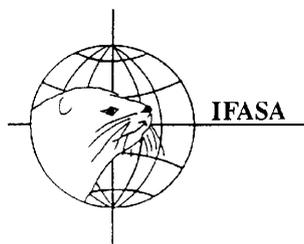
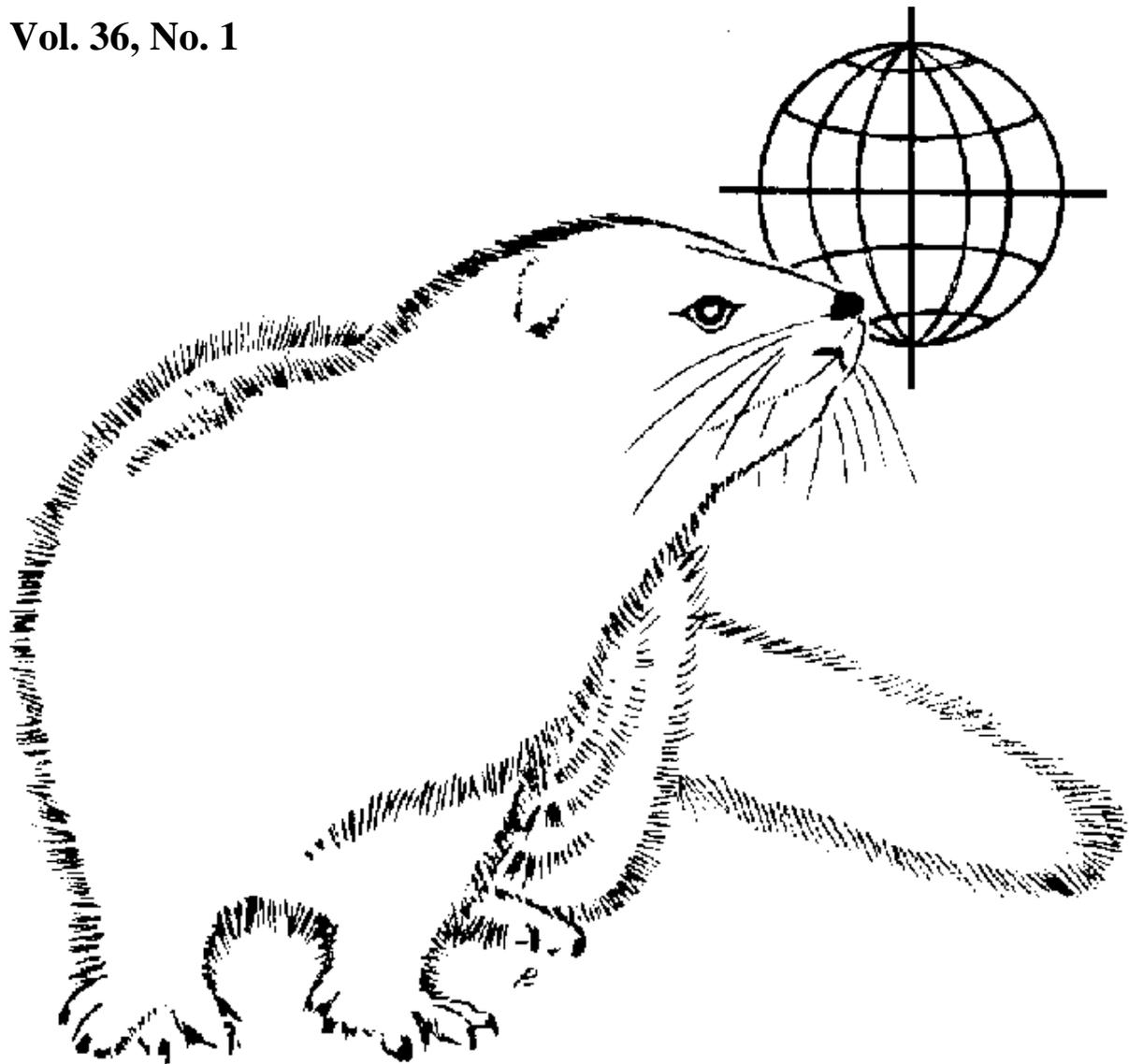


# SCIENTIFUR

SCIENTIFIC INFORMATION IN FUR ANIMAL PRODUCTION

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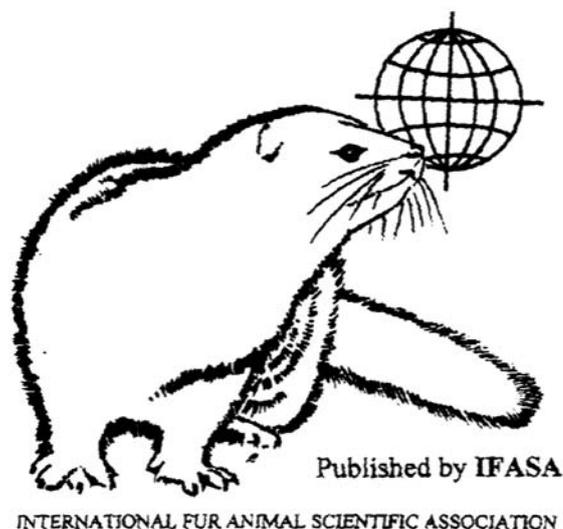
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## Notes from the Editor

This volume of Scientifur contains abstracts from Kopenhagen Research's Annual Report 2011. The report contains publications of scientific work within behaviour, breeding and genetics, nutrition and feeding, health and management. Furthermore, three www links are given to abstracts of publications describing regulation of embryonic diapause and embryo reactivation.

The Xth International Scientific Congress in Fur Animal Production is approaching. The congress will be held in Copenhagen, Denmark, August 21-25, 2012. The programme is available at <http://www.ifasanet.org/>

Vivi Hunnicke Nielsen  
Editor Scientifur



# **Faglig Årsberetning**

**2011**

**Kopenhagen Forskning**



**Annual Report**

**2011**

**Kopenhagen Research**



## Reports on: Behaviour

### Minks' use of occupational tubes, effect of various types of tubes

*L.L. Jeppesen*

In Danish farms, various types of plastic tubes are used as occupational objects for mink. However, it is not known, whether the different tubes are equally effective in promoting occupation of the mink. Therefore it was examined, how the tube parameters hardness (soft / hard), diameter (12 cm / 4 cm) and length (15 cm / 7 cm) influenced the minks' use of tubes. The examination was carried out with eight different types of tubes, including all combinations of the three parameters. The tube types were equally distributed in 4424 cages with two minks. The use of the tubes was primarily assessed by recording of bite marks in the tubes and by direct observations of the minks' behaviour towards the tubes three times during the autumn. The bite marks showed that mink preferred short and soft tubes to bite and carry around. The behavioural observations showed that mink preferred thick and long and to some extent hard tubes for the general contact with the tubes in the bottom of the cage. It is concluded that minks make use of all of the examined types of tubes and show preference for different parameters for different purposes. The examination shows, therefore, that all of the tested types of tubes may be used as enrichment of the minks' environment.

*Annual Report 2011: 7-19, Copenhagen Research, Denmark*

## Reports on: Breeding and reproduction

### Investigation of placental scars in mink females

*T.N. Clausen, L. Tinggaard*

After the nursing period 2010 the uterus from females with kits was investigated for placental scars. The litter size varied from 1 to 14, the number of scars varied from 3 to 18. The high number of placental scars shows that the flushing was good. There were on average 3½ fetuses more than the number of kits counted the day after birth. Some were lost in the pregnancy period some during birth, where the female eats the dead kits. Females with

different body conditions at birth have the same number of placental scars but we see fewer kits if the female is fat. To get more live born kits at birth the feeding and management in the pregnancy period should be optimised and the weight of the females controlled so that she is in the right body condition at birth.

*Annual Report 2011: 20-23, Copenhagen Research, Denmark*

### Selection against bite marks – results from first generation

*P. Berg, S.H. Møller, S.W. Alemu*

In order to reduce aggression in groups-housed mink a selection experiment is established by selecting against number of bite-marks at pelting. This is done by recording bite-marks on kits that have been housed two males and two females in a climbing cage and subsequently select traditionally pair-housed siblings for breeding. The selection experiment started in 2009 and ends in 2011. Results from 2010 shows that selection has an effect on number of bite-marks. After one year there is a clear difference between the two lines. Weight at pelting influences the number of bite marks and their distribution between minks in a group.

*Annual Report 2011: 24-27, Copenhagen Research, Denmark*

### Characterization and effect of the Aleutian and Silverblue genes and colour types in a Violet back cross family

*R. Anistoroaei, K. Christensen*

*Aleutian* (*aa*) is used in mink farming being part of the color types which combine more recessive mutations. Thus, the genotype for *Aleutian* occurs in combination with other color loci in different types such as Violet (*aammpp*) and Sapphire (*aapp*). The *Aleutian* colour allele is associated with the Chédiak-Higashi syndrome (CHS) which has been described in humans and several other species. *Silverblue* (*pp*) is farmed as such or in combination with other loci generating the phenotypes: *Pearl* (*kkpp*), *Sapphire* (*aapp*), *Violet* (*aammpp*) or *Palo-ale-silver* (*kkaapp*). These combinations generate

ultimately the different shades and variations of the fur.

Hereby we report the identification of a base deletion (c.9468 del C) in exon 40 of *lysosomal trafficking regulator (LYST)* gene, which causes a frameshift and terminates the LYST product prematurely which again causes the *Aleutian* phenotypes. We also investigated the blood parameters of one *Wildmink* and three *Aleutian* carrying individuals associated with CHS. No difference was observed in the platelet number between the two groups. However, accumulation of platelets appears when collagen is used as coagulant. Microscopic analysis of peripheral blood indicates inclusions bodies in the neutrophils of the *Aleutian mink* types.

We also report the identification of several point mutations in relation to the *melanophilin* gene (*MLPH*) associated with the *Silverblue* phenotype. The most important and suitable method used for genetic testing is a G/A polymorphism located at the first nucleotide of intron 8/9. The mutant allele is predicted to reduce splicing efficiency of the *MLPH* gene.

These findings provide the basis for an easy genetic test for identifying the carriers of each of these mutations enabling prediction of the phenotypes arising from different crossings. Segregations from a back-cross in four litters of *Violet* are show the expected 8 genotypes. The segregation was as expected with representation of animals in each of the 8 classes; there was, however, only one *Sapphire*. One of the double homozygotes was, as seen, difficult to distinguish from *Silverblue*. Only the red eye colour was unlike the *Silverblue* which has dark eyes.

*Annual Report 2011: 28-33, Copenhagen Research, Denmark*

### **Response to selection and genotype-environment interaction in lines of mink (*Neovison vison*) selected on *ad libitum* and restricted feeding**

*V.H. Nielsen, S.H. Møller, B.K. Hansen, P. Berg*

Mink were selected for high November weight (AL) and feed conversion ratio (FC) on *ad libitum* feeding and for high November weight (RF) on restricted feeding. A farm fed line (FF) was maintained as a control. After 3 generation's of selection in

generation 4, all 3 selection lines were tested on both *ad libitum* and restricted feeding. Heritabilities estimated for November weight in the AL, RF and FF lines were high (0.51-0.73). Breeding values for November weight increased in all lines, while breeding values for feed conversion ratio were reduced. The results in generation 4, indicates genotype-environment interaction. Thus, the genetic background for November weight under *ad libitum* feeding and restricted feeding differs. Furthermore, the results indicate, that in the AL line, feed conversion ratio was improved by an increased appetite. In the RF-line, it was decreased by an improved feed utilization. It appears that the genetic background for August and November weights differs.

*Annual Report 2011: 34-43, Copenhagen Research, Denmark*

### **Development of new SNP markers for mink (*Neovison vison*)**

*P.F. Larsen, D. Demontis, V.H. Nielsen, J.P. Thirstrup, V. Loeschcke, C. Pertoldi*

Single nucleotide polymorphisms (SNPs) representing the most widespread source of sequence variation in genomes, are commonly applied in studies of population genetics, ecology and conservation genetics. We have provided the first application of SNP genotyping in the American mink (*Neovison vison*). We have identified 111 SNPs by genotyping 12 American mink from four different color strains with the Canine SNP Genotyping BeadChip (Illumina®).

Population structure analysis based on the identified 111 SNPs showed a significant genetic differentiation ( $F_{ST}$ ) between strains (from 0.041 to 0.449). The level of relatedness (R) within the strains was shown to vary considerably (from 0.099 to 0.478). Our study demonstrates how it is possible to identify informative SNPs in mink based on a SNP marker panel created for the domestic dog.

For the purpose of standardizing future parentage and identity analyses, and the estimation of genetic relatedness between individuals, a panel of SNPs characterized by high heterozygosity could be selected. Customizing off-the-shelf SNP marker panels created for domestic species can provide powerful, low-cost tools for genetic analysis in

related species and provide an efficient and reliable method for parentage and identity analysis in mink.

*Kopenhagen Research, Annual Report 2011: 44-49*

**Genetic mapping in (*Neovison vison*) shows evidence for QTL for guard hair thickness, guard hair length and skin length**

*J. Thirstrup, R.S. Labouriau, B. Guldbbrandtsen, R.M. Anistoroaei, K. Christensen, M. Fredholm, V.H. Nielsen*

Fur quality in mink (*Neovison vison*) is a composite trait, consisting of e.g. guard hair length, guard hair thickness and density of wool. A genome wide QTL-search was performed to detect QTL (quantitative trait loci) for fur quality traits in mink. Here we present the results of QTL-analyses for guard hair length, guard hair thickness and density of wool. Data from an F<sub>2</sub>-cross were analysed across fourteen chromosomes using 100 microsatellites as markers with a spacing of approximately 20 cM. The two lines used for the F<sub>2</sub>-cross were Nordic wild type mink and American short nap mink. In total 1,083 animals (21 wild type, 25 short nap, 103 F<sub>1</sub> and 934 F<sub>2</sub>) were genotyped and recorded for the three presented fur quality traits. For the QTL-analyses a regression analysis implemented in QTL Express software was used.

Evidence was found for the existence of QTL for guard hair length, guard hair thickness and density of wool on 8 out of 14 autosomes. There was evidence for QTL for guard hair thickness on chromosomes 1, 2, 3, 6, 7 and 8, guard hair length on chromosomes 1, 2, 3, 4, 6, 7, 8 and 11 and wool on chromosome 7. On chromosomes 2, 6, and 7, QTL for guard hair length and guard hair thickness were located near each other. This indicates that variation in the two traits to some degree may be under the control of the same genes.

*Annual Report 2011: 50-59, Kopenhagen Research, Denmark*

**Reports on: Nutrition and feeding**

**Addition of the amino acid tyrosin and the minerals iron and copper to feed to black mink at four farms**

*M. Blæsbjerg, P. Sandbøl, J. Clausen, T.N. Clausen*

The amino acid tyrosine and the minerals iron and copper were added to the feed to black mink at four farms during the growth period 2009. The results showed that the colour of the skins became darker, but the increased price for the skins could not pay for the increased cost off adding the product.

*Annual Report 2011: 56-59, Kopenhagen Research, Denmark*

**Effect of high amounts of shrimp shells on the colour of dark mink**

*T.N. Clausen, T.M. Lassén*

To investigate the effect of high amounts of shrimp shells on pelt colour in black mink, 20 percent shrimp shells was added to feedkitchen feed from the 28<sup>th</sup> of September. The results showed that the use of high amounts of shrimp shells in the furring period resulted in a lighter pelt colour.

*Annual Report 2011: 60-63, Kopenhagen Research, Denmark*

**Continued investigations of the importance of phenylalanine and tyrosine for growth and pelt colour in black mink**

*T.N. Clausen, P.F. Larsen*

To find the optimal level of phenylalanine (phe) and tyrosine (tyr) for growth and fur colour in black mink, the feed content of these amino acids was varied to 5 groups of 150 black male and female mink throughout the growing and furring period.

The results showed that the need for phe to growth should be kept at 0.29 g digestible phe per 100 kcal metabolized energy (ME). There are, however, indications that it would be beneficial for the dark colour of the skins, if the content of phe + tyr per 100 kcal ME in the period 10<sup>th</sup> August to 1<sup>st</sup> October is increased to 0.55 g. Thereafter 0.47 g / 100 kcal ME is sufficient.

*Annual Report 2011: 64-69, Copenhagen Research, Denmark*

### **The requirement of isoleucin for growth and fur development in mink**

*T.N. Clausen, P.F. Larsen*

To investigate the requirement of isoleucine (ile) for fur quality 5 groups of 130 male and female brown/glow mink kits were used in the period from 8<sup>th</sup> of August to pelting. The feed content of ile varied from 0.14 g to 0.26 g digestible ile per 100 kcal metabolizable energy (ME) in the feed. The results indicate that the requirement of ile to mink in the growing and fur development period can be reduced. Future standard will be 0.21 g digestible ile per 100 kcal (July to mid-August) and the requirement to fur production can be reduced to 0.23 g digestible ile per 100 kcal ME for fur development (mid-August to pelting).

*Annual Report 2011: 70-73, Copenhagen Research, Denmark*

### **Mash and Easy-Strø in the feed in the winter period**

*T.N. Clausen, P.F. Larsen*

To control the body condition during the winter period 15 percent brewery's mash or 15 percent Easy-Strø was added to the feed to black and brown/glow mink females during the period mid December to 22<sup>nd</sup> of February.

Feed with 15 percent mash had no effect on reproduction results and kit body weight at day 28 after birth in the following nursing period. No effect was seen of mash on eating time. Eating time seemed instead to be the consequence of the amount of feed and the feed energy content.

Females fed 15 percent Easy-Strø ate very slowly compared to the control group due to very low energy content and thereby a very large portion of feed, the result was that they lost body weight drastically. Therefore 15 percent Easy-Strø in the whole period appears to be too much.

Reproduction results for Easy-Strø in brown/glow females were not different from the control group, as long as the amount of energy from protein was at least 35 percent of metabolisable energy in late March and the beginning of April.

Reproduction results in the Easy-Strø group in black females were very poor compared to the other groups, probably due to diarrhoea at the beginning of the mating period and thereby a low percent of females mated twice, resulting in a higher percentage of barren females and lower litter sizes. Feeding with Easy-Strø ended on the 22<sup>nd</sup> of February and comparing the results with the brown/glow group, it is assumed that Easy-Strø is not responsible for the diarrhoea or poor reproduction results, however further investigations are necessary.

*Annual Report 2011: 74-83, Copenhagen Research, Denmark*

### **Investigation on how much fibre mink will accept before they reduce their energy uptake**

*T.N. Clausen, P.F. Larsen*

Barren mink females were fed different levels of fibre 21 days in May. EasyStrø Bedding was added in the quantity 0-2,5-5-10-15-20 %. Fibre addition reduced feed dry matter and feed energy considerably. After 2-3 days the control group and the 2.5% fibre group got used to the feed, at 5 and 10% addition it took 7-8 days. Addition of 15 and 20% fibre (29 and 35 percent of dry matter) made the females increase their energy consumption during most of the period, but they never got to eat the whole feed ration. Registration of how fast they ate the feed showed that fibres up to 5% had no effect, but more than 5% increased the time with feed.

Total water intake was found to be around 3 grams of water per gram of feed dry matter and 60–80 grams of water per 100 kcal in the control group and groups with up to 5% fibre addition. Thereafter we saw a marked increase in water uptake and water balance, most of the water came from the feed. It is

possible that the high water intake has contributed to a reduced feed uptake. Other factors might be the influence of fibres on feed digestibility, taste of the feed, and the fact that the energy content is so low that it is too “expensive” for the animal to eat it.

*Annual Report 2011: 84-93, Kopenhagen Research, Denmark*

### **Investigation of shrimp shells to mink females during the winter period**

*T.N. Clausen, T.M. Lassén, P.F. Larsen*

To investigate whether shrimp shells can be used during the winter period, high amounts of fermented shrimp shells were added to the feed from mid December to birth of the kits in April/May. At the same time digestibility trials with fermented and enzyme treated shrimp shells were performed. The results showed that shrimp shells can be used to mink females during the winter period with 15 percent added to the feed, without negative consequences in terms of litter size and kit weight during the nursing period. However, use of the product is limited by a very low protein digestibility and neither fermentation nor enzyme treatment increased protein digestibility to a satisfying level.

*Annual Report 2011: 94-97, Kopenhagen Research, Denmark*

### **Reduced protein in the growing and furring period**

*T.N. Clausen, T.M. Lassén, P.F. Larsen*

The purpose of the investigation in the growth and pelting period was to reduce protein content and the content of some of the essential amino acids. Five groups each of 276 male and female brown / glow mink kits were used. The kits were fed varied levels of protein and amino acids from 14<sup>th</sup> July to pelting. The investigations showed that reduced protein content to 21.5 percent of metabolizable energy (MEp) from July to pelting or from 10<sup>th</sup> of August to pelting and a changed amino acid profile, cannot be used. The skin length is shorter, the pelt quality is not so good and there is an increased risk of fatty liver. 28 MEp from middle July to mid-August and thereafter 24 MEp revealed the longest skins but a

little reduced pelt quality, maybe due to a low content of some amino acids in July.

*Annual Report 2011: 98-105, Kopenhagen Research, Denmark*

### **Reduced protein in the growing-furring period. Blood and organ investigations**

*T.N. Clausen, B.M. Damgaard, J.L.F. Harslund, A.S. Hammer*

The purpose of the investigation in the growth and pelting period was to reduce the protein content and the content of some of the essential amino acids in the feed. Five groups each of 276 male and female brown / glow mink kits were used. The kits were fed diets with varied protein and amino acid content from 14<sup>th</sup> July to pelting.

Minks fed a diet with a reduced protein content in the feed - 21.5 % of metabolizable energy from protein (MEp) during the growing-furring period had reduced health condition and there were indications of a negative effects on the immune system compared to minks fed a diet with a high protein content. The protein and urea content in the blood reflected the content of protein in the feed. The liver content of fat and free fatty acids was highest in minks fed a low protein diet (21.5 MEp) through the whole growing-furring period and there was a tendency of more dead minks with fatty liver when the dietary protein content was below 25 MEp in October.

*Kopenhagen Research, Annual Report 2011: 106-111*

### **Effect of low protein feeding in the growth period on the reproduction results in the following nursing period**

*T.N. Clausen, T.M. Lassén, P.F. Larsen*

In order to evaluate the reproductive performance of female kits fed with a low protein diet in the growth period, male and female mink kits fed reduced protein during the growth period were selected for breeding. Feeding with reduced protein and amino acids in the growth period did not affect reproduction parameters in the following season.

*Annual Report 2011: 112-115, Copenhagen Research, Denmark*

### **Minks' requirement for vitamin A and its importance for vitamin D and E status**

*S.K. Jensen, T.N. Clausen*

A well balanced vitamin supplementation is a prerequisite for a good growth and well being of mink. Fat soluble vitamins are most sensitive towards over- or undersupply, especially because several of them interact with each other with respect to dose and chemical form. The purpose of the present experiment was to investigate the effect of increasing amount of vitamin A and either synthetic vitamin E or natural vitamin E in the feed to growing mink on their vitamin A, D and E status. Two forms of vitamin E was used (synthetic *all-rac- $\alpha$ -tocopheryl acetate* and natural RRR- $\alpha$ -tocopherol (Immun E<sup>®</sup> Natur)). The experiment showed that mink already in the unsupplemented feed met their vitamin A requirement. Further the experiment showed that minks did not face a negative effect of large amounts of vitamin A on vitamin E status as pigs and calves do. However, the experiment showed that vitamin D status in plasma decreased with increasing vitamin A in the feed. Also natural vitamin E in the feed decreased plasma vitamin D status compared to synthetic vitamin E. However feeding natural vitamin E had a positive influence on vitamin A status in the kidneys. Generally females had higher vitamin status than the males.

*Annual Report 2011: 116-123, Copenhagen Research, Denmark*

### **Pilot study of fibres and water binders in the feed for adult male mink**

*T.N. Clausen*

The effect of fibres and feedbinder on water consumption of adult male mink was investigated. Arbocel, Fiprodan, Peafibres, feedbinder 450/1, glycerol, Sugar beet pulp, Scanpro T95 and Danpro fibres were investigated.

Adding fibres or feedbinders to the feed changes the animal's water intake. High water content in the feed will reduce the drinking water consumption. For the investigated products the water balance was 23 to 34

grams per 100 kcal. The total water consumption was 67 – 86 grams per 100 kcal or 2.8 to 3.4 grams per gram dry matter.

*Annual Report 2011; 124-131, Copenhagen Research, Denmark*

### **Protein provision during gestation affects the offspring in subsequent generations in mink (*Neovison vison*)**

*C.F. Matthiesen, A.-H. Tauson*

The knowledge of nutrient requirements for gestation and foetal development is limited in mink, but the importance of gestational nutrition, particularly protein supply, has long been recognized. The objective was to study the effects of late-gestational low protein supply to mink on the reproductive performance, metabolism and kit birth weight. Further, to study if yearling offspring of protein restricted mothers were affected by foetal protein restriction in their own first gestation and lactation, and if changes in gene expression of key hepatic enzymes in the glucose and fat metabolism caused by maternal low protei supply were transgenerational. Mink dams were fed either a low (14% of metabolizable energy ME), or an adequate-protein diet (29% of ME, control) from when implantation was completed until parturition (18  $\pm$  3.6 days). It can be concluded that low protein supply in late-gestation led to poorer reproductive performance among dams but also among their female offspring in their first reproductive period. The protein restriction resulted in lower kit birth weight compared to controls, whereas dams (F<sub>1</sub>-generation) exposed to protein restriction during foetal life gave birth to kits (F<sub>2</sub>-generation) with higher birth weight than controls. The gene expression of some key hepatic enzymes with importance for fat or glucose metabolism were significantly affected in foetuses (F<sub>1</sub>-generation) of protein restricted dams (F<sub>0</sub>-generation), adult offspring (F<sub>1</sub>-generation) and among foetuses (F<sub>2</sub>-generation) of the F<sub>1</sub>-generation dams compared to controls. This confirms that changes obtained due to foetal life malnutrition also can be found in the subsequent generation.

*Annual Report 2011: 132-141, Copenhagen Research, Denmark*

## Reports on: Health

### Aleutian mink disease virus in environmental samples

*T.H. Jensen, U.B. Goosewinkel, L. Haaning, M. Chriél, A.S. Hammer*

Aleutian mink disease virus (AMDV) was found in feces, slurry, fat and skin with different DNA purification kits followed by PCR analysis. Air, soil, cages and different passive carriers (beetles, rats and cats) were tested by PCR without detection of AMDV. Maybe the purification was not sensitive enough to detect the presumed small amounts of virus. Because of the environmental resistance of the virus and the risk of many different ways of transmission, farmers are advised to increase focus on disease management and prevention.

*Annual Report 2011: 142-147, Copenhagen Research, Denmark*

### Experimental infection of mink with *Pseudomonas aeruginosa*

*C.M. Salomonsen, A.S. Hammer*

This study describes an experimental investigation of different aspects of hemorrhagic pneumonia in mink. Wild-type female mink were infected with various doses of *P. aeruginosa* in July and in November to investigate if age and season influence the pathogenesis of hemorrhagic pneumonia. In 2010 barren females were used, while in 2011 we used female kits for the study. The mink were infected via the intranasal route. Only few cases of disease were recorded but several mink carried *P. aeruginosa* on their nasal mucosa after the end of the experiment, showing that *P. aeruginosa* can survive on the nasal mucosa of mink for several days without causing clinical disease. No mink developed the disease during the summer experiments indicating that it is not the infectious dose that leads to disease but rather a increased susceptibility of the mink in the autumn. We collected heads from mink carcasses on pelting from 4 mink farms and swabbed the nasal mucosa. It was not possible to grow *P. aeruginosa* from the nasal cavity of these mink showing that *P. aeruginosa* is not a part of the

normal nasal mucosal flora in healthy Danish mink at pelting time.

*Annual Report 2011: 148-155, Copenhagen Research, Denmark*

### Diarrhea and *Campylobacter* in mink

*A.S. Hammer, M.H. Josefsen, S. Nordentoft*

Here we present preliminary results of a survey of potential causal factors of diarrhea in mink during the growth period. Samples from 262 mink collected from 75 diagnostic submissions to the DTU National Veterinary Institute during the period 2006-2011 were analyzed with bacteriological culture. The samples were categorized in three groups: samples from mink with diarrhea (not parvo viral enteritis), samples from mink with parvo viral enteritis, samples from mink without diarrhea and samples from healthy free-ranging mink. In July 2011 additional 44 samples were collected from four farms with diarrhea and four control farms without current diarrhea problems. From the farms with diarrhea both animals with and without symptoms were collected. The 44 samples were tested for *Campylobacter* by PCR. The study shows that *Campylobacter* was detected in all groups of mink and the carrier state was often not associated with diarrhea. The organism was also detected in healthy free-ranging mink, but with a very low prevalence, which confirms that the organism is not a part of the normal intestinal flora of mink. In this study *Campylobacter* seemed to be more prevalent in samples from submissions from farms with diarrhea compared to other submissions.

*Annual Report 2011: 156-161, Copenhagen Research, Denmark*

### Impact of weaning time on mink kits day 49 or day 56

*T.N. Clausen*

To get more knowledge on the influence of weaning time on health and wellbeing among mink kits, autopsy was made and bite marks registered in the period from 24<sup>th</sup> May to 28<sup>th</sup> June 2011, in two

groups of mink kits weaned at day 49 or 56 after birth.

The influence of the females on whether the kits bite each other in the period from day 49 to day 56 seems to be of lesser importance, since there was no difference between weaning time. Bite marks are seen from 6 weeks of age (day 42) and especially in the period from day 42 to day 49. It is mainly in the big litters and among the smallest kits we observe bite marks. 80 percent of kits with bite marks were female kits. To prevent bite marks it would probably be a good idea to separate big litters after 6 weeks of age.

*Annual Report 2011: 162-167, Copenhagen Research, Denmark*

**Slimming, fibre feeding and enrichments - effects on body weight, body condition, stereotypy, temperament and reproduction in mink**

*S.W. Hansen, S.H. Møller, J. Malmkvist, B.M. Damgaard*

The aim of this study was to investigate whether feeding with energy poor food (fiber feeding) during the winter reduces hunger in mink measured as a reduced incidence of stereotypic behavior and whether access to a shelf or a tube affects the

development of stereotypic differently. Furthermore, we wanted to study whether fiber feeding and access to a shelf or a tube affect the reproduction result in mink. The study included 784 female mink divided into four groups.

The slimming of the females during the winter period increased the incidence of stereotypies before expected feeding time. The incidence of stereotypies before feeding, or during postponed feeding revealed a good picture of the hunger motivation of the mink and is therefore a useful tool for controlling feed allocation during the winter. The slimmed females reacted more aggressive and accordingly less confident and less fearful. The fiber diet reduced the hunger motivation of the mink and thus the incidence of stereotypies. The fiber diet had no influence on the temperament, the use of enrichments or on reproductive outcome. The females used the shelves more than the loose tubs especially before the expected feeding time. Access to a shelf reduced energy consumption. The difference in weight loss had no effect on the number of surviving kits. Fertile females with access to the shelf had a better reproduction result than females with access to the loose tube. The mechanism behind this finding remains under investigation.

*Annual Report 2011: 168-177, Copenhagen Research, Denmark*

**Spatiotemporal expression pattern of progranulin in embryo implantation and placenta formation suggests a role in cell proliferation, remodeling, and angiogenesis**

*J.A. Desmarais, M. Cao, A. Bateman, B.D. Murphy*

*Reproduction*, 2008: Aug 136(2): 247-257. [Epub 2008 May 9]

<http://www.ncbi.nlm.nih.gov/pubmed?term=Spatiotemporal%20expression%20pattern%20of%20progranulin%20in%20embryo>

**Uterine signaling at the emergence of the embryo from obligate diapauses**

*P.L. Lefèvre, M.F. Palin, D. Beaudry, M. Dobias-Goff, J.A. Desmarais, V.E.M. Llerena, B.D. Murphy*

*Am. J. Physiol Endocrinol Metab.*, 2011: May 300(5): E800-808. [Epub 2011 Feb 8]

<http://www.ncbi.nlm.nih.gov/pubmed?term=Murphy%20Uterine%20signaling%20at%20the%20emergence%20of%20the%20embryo%20from%20obligate%20diapause>

**Polyamines are implicated in the emergence of the embryo from obligate diapauses**

*P.L. Lefèvre, M.F. Palin, G. Chen, G. Turecki, B.D. Murphy*

*Endocrinology*, 2011: Apr 152(4): 1627-1639. [Epub 2011 Feb 8]

<http://www.ncbi.nlm.nih.gov/pubmed/21303959>



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