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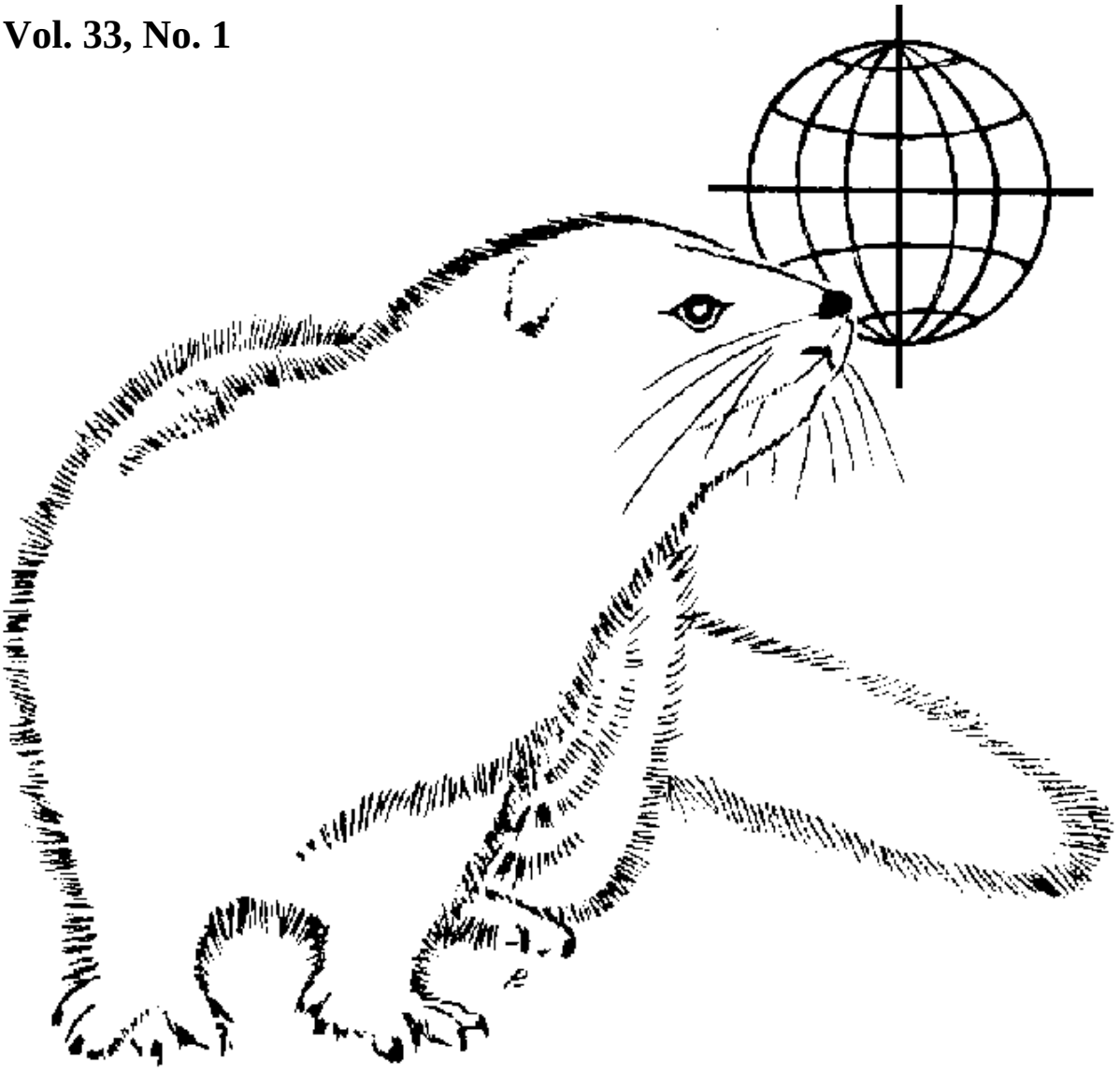

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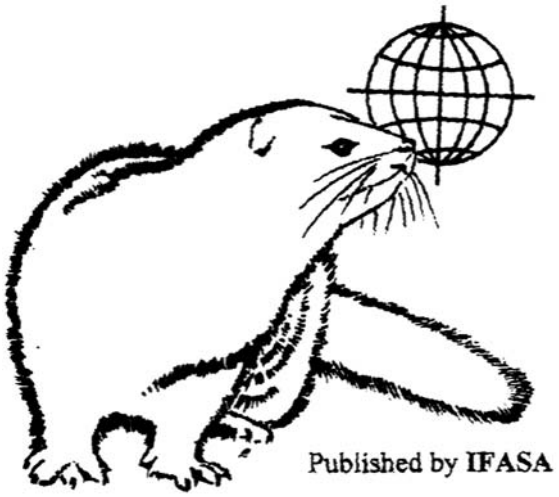

Notes from the Editor

Birthe Damgaard started as Editor of Scientifur in 2000. After nine years of excellent work, she has decided to resign as Editor due to other tasks. The large contribution Birthe Damgaard has made to maintain Scientifur as the most important journal for publication of research within fur animal production is greatly appreciated. Thanks to Birthe for her large effort. Since the turn of the year 2009, Vivi Hunnicke Nielsen has held the position as Editor of Scientifur.

The scientific information published in Scientifur is addressed to actors in fur animal production. It includes original work such as full articles and short communications, summaries or abstracts of scientific papers published elsewhere, publications from congresses, seminars, workshops etc. and summaries of books and reports. It is the aim, that all scientific work related to fur animal production is reported in Scientifur. Thus, submission to Scientifur of results from all scientific investigations regarding fur animal production is greatly encouraged.

Titles that have been published in SCIENTIFUR are covered in an electronic SCIENTIFUR INDEX. The index in being revised. A new index will be released in 2009.

This issue of Scientifur, Volume 33, No 1, contains a reviewed article, abstracts, a summary of the Satellite Symposium “Litter size and kit survival” held at the “IXth International Scientific Congress in Fur Animal Production” in Halifax, Canada in August 2008 and abstracts from Danish Fur Breeders Research Center Annual Report 2008.

It is a pleasure to announce that the X International Scientific Congress in Fur Animal Production will be held in Copenhagen, Denmark, August 21-25, 2012.

Vivi Hunnicke Nielsen
Editor Scientifur

Improving waste management practices on mink (*Mustela vison*) in Newfoundland

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Abstract
In recent years, Newfoundland has experienced a rapid growth of commercial mink farming which was economically advantageous for both mink producers and the provincial government. The rapid development of mink farms in Newfoundland, however, resulted in a highly productive industry that lacked the advanced waste management systems representing best management practices for intensive mink farming.

In 2006, a series of socio-political issues (allegations by farm neighbours of obnoxious odours and flies emanating from mink farms) highlighted the need to review deficiencies in waste management on Newfoundland's mink farms. This paper addresses the compelling need to address waste management in accordance to industry size and known best management practices. Our findings identify several areas for improvement of current waste management practices in Newfoundland and we discuss some industry constraints and research needs.

Keywords: Biosecurity, industry, carcasses, composting, flies, odours, manure.

Introduction

The development of rigorous waste management practices (WMPs) is generally accepted to be a crucial aspect of intensive livestock confinement. This can be especially true for the general health of the animals but also for biosecurity and environmental reasons (Nimon and Broom, 1999; Scarth, 2006). Best management practices (BMPs) for mink farming have emerged from industry leaders such as Denmark (e.g. Joergensen, 1985). These BMPs manifest themselves in the literature on standards and guidelines and occasionally in legislation. They address, inter alia, manure collection, storage and disposal, specifications for ranching facilities, and carcass disposal (Joergensen, 1985).

In Canada, a legacy of fur harvesting and use continues to this day, placing it as one of the top ten fur-producing countries in the world (Fur Commission USA, 2006). Canadian standards for mink farming WMPs are laid out in federal guidelines as recommended codes of practice (e.g. Agriculture Canada, 1976; 1988). More specific (and enforceable) standards fall under provincial jurisdictions (e.g. Agrifoods Branch, 2006; 2007).

Mink farming recently became an attractive alternative to fishing in the rural areas of Newfoundland due to the availability of cheap and plentiful fish offal (Fur Strategy Working Group, 1991), favourable climatic conditions (Wiseman, 1996), and a competitive market advantage due to the absence of Aleutian disease (AD) in the province (Whitney, 2005; Provincial Fur Committee, 2007b; Wiseman, 2007). As of November 2006, the Newfoundland mink industry consisted of 19 mink farms (Scarth, 2006).The rapid development of mink farms in Newfoundland,

however, resulted in a highly productive industry that lacked the advanced waste management systems representing best management practices for intensive mink farming.

The purpose of this paper is to evaluate the WMPs on Newfoundland mink farms with respect to contemporary advanced waste management systems representing industry BMPs.

Methods

We were contracted by the Government of Newfoundland and Labrador to undertake a review of WMPs in the province's mink industry and make recommendations on improvements. Before field visits and consultations took place, an extensive literature review was undertaken to familiarize us with the latest thinking of scholars and practitioners on WMPs on fur farms. The field component of the study was carried out on the island of Newfoundland with particular interest on the east and west coasts where the majority of the fur breeders are located. During the two-month field period (June-July 2007), the research team visited six mink farms. The farms visited ranged from 50 to 15,000 breeding females. On most of the farms visited, a comprehensive investigation was conducted. This included speaking with the owner/manager of the farm regarding manure management practices, carcass disposal methods, feeding practices, facility design, animal housing, and pest management while having an escorted tour of the facilities. Photographic records of specific farm practices were made with permission of the farm owner/manager. The research team also held consultations with a number of individuals employed by the Government of NL, specifically in the following units: the Agrifoods Branch of the NL Department of Natural Resources, and the Environmental Assessment Division, Land Management Division and Pollution Prevention Division of the NL Department of Environment and Conservation (DOEC). Furthermore, contacts within the NL fur industry (e.g. the Fur Breeders Association, the Provincial Fur Committee, the Federation of Agriculture) were consulted to ascertain their specific perspectives on the mink farming industry. In this paper, we report on our findings with respect to WMPs on three of the largest mink farms.

Findings

Newfoundland Mink Farm Design and Odour Control

The Newfoundland mink industry can be characterized as relatively small. Of the 19 registered farms (Scarth, 2006) only two are considered commercial-scale.[1] The third farm in our study forms a good basis for comparison due to similar management styles and construction. The farms in question have a typical shed length of 60-100 m and contain 4-8 rows of cages. Most new sheds in the Province are being built longer with more rows to facilitate efficiency in feeding, watering and cleaning.

Noteworthy waste management features present in all barns include watering troughs for the animals, ventilation features and cage design. Most manure is allowed to fall to the ground beneath the cages except during the whelping period when false bottoms are placed in the cages to prevent injury to kits. Feed is placed on cage tops and is left until it is eaten or falls through the cage.

Ventilation is rudimentary at best and composed of open airways at the base of shed walls or beneath roof trusses. On two of the farms, chicken wire is used while removable panelling is used on the third. Ventilation, especially in relation to predominant wind conditions (westerly), was duly noted as it is an important component of odour control. Odours were not deemed overly offensive but some speculation exists to causative atypically-cool climatic conditions during the early summer of 2007 for which we have no basis of comparison. Offensive odours occasionally did exist with strong presence of ammonia vapours in sheds where either cleaning had been delayed or had recently occurred due to agitated manure. The Government of Newfoundland and Labrador endorses the use of limed dirt floors in mink sheds. As a result, in-shed drainage was poor on all three farms.

[1] The Government of Newfoundland and Labrador Agrifoods Branch considers farms with over 10,000 breeding animals to be commercial-scale farms, a fact that is represented in legislation as a cut-off point for greater separation distances (Scarth, pers. comm.; Agrifoods Branch, 2007b).

Manure[2] *management*

We examined three aspects of manure management: collection, storage and disposal. Each is imperative for ecological, socio-political and biosecurity reasons. During industry expansion, complaints were met with complacency by farmers and government branches (Agrifoods Branch, 2006; van der Marel et al., 2007). Investigation into the causes of these issues revealed WMPs that were perfunctory at best but generally less than adequate.

1. Manure collection:

Two interrelated elements were analyzed: method and frequency. At the time of inspection, one farm used manual collection of manure while the other two used a tractor auger. The mechanised version is quicker and cleaner but also resulted in performance delays as backup systems were unavailable and mechanical failure affected frequency.

Frequency was variable (due to the synchronous disturbance sensitivity of the whelping period), but according to farmers and extension officers, one farm usually met provincial standards for bi-weekly cleaning while the other two exhibited a tendency to restrict the amount of cleaning for multiple reasons including cost control. The use of dirt floors compounded the issues associated with method and frequency.

2. Manure storage:

Covered piles are typically the means of manure storage in Newfoundland. While two farms indicated an intention of covering manure in an appropriate location, this behaviour was consistently observed only on one farm. The third farm piled manure until disposal (see below). Neglect or mismanagement (partial covering, no covering, and/or improper siting) was observed regularly on the other two farms. Explanations for these ad hoc systems ranged from lack of resources and fiscal restrictions to time constraints.

3. Manure disposal

includes, among other methods, the conversion of manure into compost suitable for land application. Complete disinfection is critical for biosecurity reasons (Ferguson, 2001). Two of the farms, when weather permitted, spread their manure on fields but did not possess an adequate land base. As with most types of intensive livestock rearing, mink farms do not require arable land, which is at a premium in Newfoundland. Recently, all farmers have been required to have commitments in the form of a letter of surety from land owners who are willing to accommodate excess manure (Agrifoods Branch, 2007). If manure pathogens are not neutralized, however, they may be spread unsuspectingly across the province and exposed to other vectors of cross-farm contamination. Currently, manure travels tens of kilometres (H. Scarth, 2007, Agrifoods Branch, Government of Newfoundland and Labrador, pers. comm.). One of the farms was conducting a pilot project on composting but it is not yet a routine practice on any farms. The other farm used landfill burial as a method of manure disposal.

4. Carcass disposal

poses similar hazards. Until recently, all carcasses in Newfoundland were land-filled. When concerns were raised in 2006, the Agrifoods Branch opposed the widespread composting of carcasses (Agrifoods Branch, 2006). In 2007 it began conducting pilot tests to increase expertise on thermophilic composting which is ongoing at one of the farms. The other two farms use burial as a method of carcass disposal. One farm did this on-site while the other used the same landfill as for its manure.

5. Pest management

is necessary on farms as flies and birds in particular are indicators of waste management deficiencies and are also vectors for pathogens. Current fly-specific control tactics include the use of Ectiban® (active ingredient permethrin) or Lagon 480® (contains dimethoate) on all three farms. Baited jug traps were used on one farm but were deemed ineffective. To address concerns, the Government of Newfoundland and Labrador simultaneously implemented an extensive fly monitoring program. While the latter is ongoing, preliminary results (K. Bradley, 2007, Agrifoods Branch, Government of Newfoundland and Labrador, pers. comm.) and stakeholder consultations showed that fly population targets were not being met on two of

[2] For the purpose of this paper, manure is defined as faeces, urine and contaminated water, bedding, feed, and absorptive media associated with waste matter.

the farms. This has led to ongoing socio-political conflict with neighbours. Birds (primarily herring gulls, *Larus argentatus*) were pests on all farms, with fish offal waste being the primary attractant.

Table 1. Farm-based WMPs and discrepancy from industry BMPs

Practice	5,000†	10,000†	15,000†	Industry BMPs
Shed length	~100m	~100m	~100m	N/A
Cage rows	4-6 rows	6-8 rows	4-8 rows	N/A
Flooring	limed earth	limed earth	limed earth	Concrete
Ventilation	open concept	shed panels	shed panels	exhaust fans, biofilters, vent panels
Manure collection mechanism	manual	tractor auger	tractor auger	tractor auger, conveyor system[3]
Manure collection frequency	inadequate due to mechanism	bi-weekly	bi-weekly goal	bi-weekly
Manure disposal	landfill burial	composting pilot	spreading	thermophilic composting
Manure storage	piled until disposal	tarped on concrete storage	tarped windrows	covered concrete storage areas
Carcass disposal	landfill burial	composting pilot	private burial	thermophilic composting
Pest control	Ectiban	baited jug traps, Ectiban	Lagon 480	Integrated pest management; insecticides should not be used as primary pest control
Perimeter fence[4]	none	none	damaged/old fencing	fence for odour dispersal and pest control

† farm breeder numbers

moderate discrepancy from industry BMPs

significant discrepancy from industry BMPs

[3] Conveyors have been cited by farmers as impractical in the Newfoundland winter climate.

[4] Powers (1999) identified perimeter fences as a barrier and dispersal mechanism of odour control.

Industry Best Management Practices

Poor WMPs generally produce noticeable externalities such as flies and odours. When compared to Danish regulations, arguably leading internationally in these matters, and even federal and provincial government guidelines, WMPs on the three Newfoundland mink farms we studied were far from BMPs.

Ventilation BMPs are geographically variable. Biofilters and exhaust fans have been recommended elsewhere (e.g. Fur Commission USA, 2006) but pose additional costs to farmers. While some odours and flies are expected from intensive livestock farming, judgements of their potential excess remain subjective.

Typically, concrete floors are favoured since dirt floors can be a repository for disease, odour and pests (Oderkirk, 2002; Hunter, 2007 in Provincial Fur Committee, 2007b). Mink sheds, however, should be cleaned at least once a week (Joergensen, 1985) as opposed bi-weekly (or less).

From a waste perspective, storage units should be covered and impervious to reduce groundwater and surface-water contamination, nuisance flies and odours (Joergensen, 1985; Oderkirk, 2002; Agrifoods Branch, 2007,). For biosecurity considerations, they should also be managed as if they were breeding grounds for flies (Agrifoods, 2006) and also be considered reservoirs for AD and other diseases (Joergensen, 1985).

Based on the available literature (Kalbasi et al. 2000; Ferguson, 2001; Ferguson, 2002), composting is deemed the best available environmental and biosecurity practice for manure and carcass disposal. Achieving thermophilic thresholds for destroying Plasmacytosis and other pathogens is critical. To do so requires considerable competence and the ability to generate temperatures of 60oC for more than one hour (Ferguson, 2001). This should, however, be standard procedure in Newfoundland.

Again, as a byproduct of poor WMPs, pest flies should never solely be controlled using insecticides. Chemical control of flies should be used in conjunction with physical fly control (ventilation and screening) and manure management since flies can quickly become resistant to insecticides through avoidance behaviour and detoxification mechanisms (Rogers and Collett, 2003).

Industry Constraints

In Newfoundland, proper WMPs are difficult to enforce because of a reticent regulatory setting and inadequate resources. The Government of Newfoundland and Labrador has authority to regulate farming practices in the province. The Government Services Centre (GSC) under the direction of Department of Environment and Conservation (DOEC) currently enacts the only legislated monitoring pursuant to the Environmental Protection Act (SNL 2002 E-14.2) (Agrifoods Branch, 2006; Scarth, 2006). Accordingly, the GSC has a policy of one visit per farm per year with two hours allocated per visit. Multiple sources cite such a policy as inadequate for the monitoring and enforcement needs of the fur-breeding industry (Agrifoods Branch, 2006; Scarth, 2006; Provincial Fur Committee, 2007a; van der Marel et al., 2007). GSC, however, claims not to have the capacity to make additional farm visits. Disagreement exists as to which department should fulfill the enforcement role. Concerns over resource constraints also exist for monitoring and enforcing import regulations (Provincial Fur Committee, 2007a).

Without resources for effective regulation, voluntary compliance at the farm level can compensate somewhat for this deficiency despite disagreement and ambiguity over current guidelines. Lack of attention to this matter is mostly due to low levels of cognitive causality between sound waste management and environmental and biosecurity impacts (Scarth, Agrifoods Branch, Government of Newfoundland and Labrador, pers. comm.; van der Marel et al., 2007).

Discussion

Disease Risk Reduction

In 2007, the province experienced its first clinical AD outbreak. Government and industry representatives have debated whether this could have been mitigated by improving WMPs (Provincial Fur Committee, 2007b). Manure management in particular is conducive to reducing risk of acute farmed-mink diseases including, inter alia, mink enteritis virus (MEV) (Steinel et al., 2001), botulism and distemper (Nimon and Broom, 1999).

Newman and Reed (2006) suggested that disease may occur in larger ranch facilities due to “higher potential for spread of the virus between animals and [sic] inherent practices associated with more

intensive management." Larger ranches do have a higher susceptibility to loss; however, they are also suppliers to small producers indicating potential for cascading negative impacts throughout Newfoundland mink farms.

Research Needs

From our study, we have identified gaps in current research. These include the effectiveness of disease transmissibility via various vectors, especially flies and birds that are attracted to waste products. Most waste factsheets and biosecurity protocols suggest fly reduction as a necessary practice but rarely discern between fleas and filth flies.

For land application, manure's contributions to eutrophication are poorly understood, and pathogenesis (e.g. disease persistence in response to thickness) parameters are not well defined. Research should also include management implications for synchronous growth of mink and fly populations during warm months. Our literature review showed that the community of mink specialists is small and information dissemination, especially internationally, is extremely limited.

The information in this paper may be useful to the mink farming industry elsewhere (e.g. in Canada) where regulations are not as stringent as in Denmark. Several sources (e.g. Newell, 1999) suggest that Canadian regulation is inadequate vis à vis WMPs. Most of Canada's mink production occurs in Nova Scotia where the industry is also stricken with AD. Inadequacy in regulation is likely also due to the lack of information-sharing between farming jurisdictions and a corresponding need to standardize BMPs. Both the farmers and the rest of society should agree that this would be beneficial for the economic well-being of the industry and the welfare of farmed mink.

Acknowledgements

We are grateful for research contributions from K. Pickthorn, access to mink farms provided by their owners and managers, cooperation and kindness exhibited by H. Scarth and K. Bradley from the Government of Newfoundland and Labrador Agrifoods Branch, and leadership from Len Moores of the Department of Natural Resources.

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Diurnal activity patterns of farm mink (Mustela vison) subjected to different feeding routines

Steffen W. Hansen, and Steen H. Møller

Diurnal patterns and time courses of activity and feed availability were investigated in three generations of farmed mink (2003–2005) subjected to three different feedings routines; normal farm feeding (close to average *ad libitum*), *ad libitum*, and restricted feeding. The mink were fed daily at h12:00 (in 2005 at 13:00 h) and their activity were observed by hourly direct scanning during 24 h. On November 13, 2003 the feeding was postponed from 12:00 to 15:00 h and the activity observed from 9:00 to 17:00 h. The diurnal rhythm but not the average 24 h activity level differed between the mink on different feeding schedules. The diurnal activity rhythm in both the farm fed and the *ad libitum* fed mink consisted of three activity peaks; one around sunrise, one prior to feeding time, and one around sunset. However, the restrictively fed mink decreased their activity in the morning when feed was not available and increased their activity up to expected feeding time at noon and again around sunset.

When feeding was postponed, the restrictively fed mink increased their activity up to expected feeding time, whereas the *ad libitum* or farm fed mink did not. The results indicate that mink fed restrictively synchronize their daily activity rhythm to the expected time of feeding. In addition, a high feeding motivation appears to be a precondition for circadian anticipatory activity in mink whereas anticipatory activity of mink fed *ad libitum* or close to *ad libitum* may be provoked by stimuli from the actual feeding procedure.

Applied Animal Behaviour Science, 2008: 111, 146-157

To swim or not to swim: An interpretation of farmed mink's motivation for a water bath

Claudia M. Vinke, Steffen W. Hansen, Jaakko Mononen, Hannu Korhonen, Jonathan J. Cooper, Maarit Mohaibes, Morten Bakke, and Berry M. Spruijt

How an animal's behavioural needs can be met is a pivotal issue in the assessment of welfare for captive animals. The value of swimming water for farmed mink is an example of how scientific and societal questions relating to animal welfare can be answered. A number of studies have addressed the issue of the indispensability of swimming water for mink; however, so far with inconclusive evidence. In this paper, the results of these studies and related literature are reviewed. First, the biological definition of need is discussed. Subsequently, we will review effects of the presence, absence and the removal of swimming water on behavioural and physiological correlates of well-being including stereotypic and anticipatory behaviour and urinary cortisol. Thereafter we will discuss individual differences in the use of swimming water, the price animals pay for access to a water bath, and the effect of access to swimming water on juvenile play. Our critical review of the available literature provides several conclusions: mink's water bath use appears primarily related to foraging behaviour; if mink have not had prior experience with swimming water the lack of this resource does not lead to consistent changes in stereotypic behaviour or anticipatory responses; when mink have had prior experience with swimming water, removal of this resource can induce short-term stress; most mink work hard for access to a swimming bath and running wheel in consumer demand studies; individual mink differ in how much they value a water bath: some mink never use a swimming bath; swimming water is likely not an “innate” need but rather an incentive that induces its own motivation.

Applied Animal Behaviour Science, 2008: 111, 1-27

Intestinal remodelling in mink fed with reduced protein content

Pengmin Chen, Jingbo Zhao, Vivi Hunnicke Nielsen, Tove Clausen, and Hans Gregersen

Low protein intake occurs in humans in relation to diseases, starvation and post-operatively. Low-protein diets may affect the gastrointestinal structure and mechanical function. The aim was to study the passive biomechanical properties and tissue remodelling of the intestine in minks on reduced protein diets. Twenty-seven male minks were divided into three groups receiving different protein level in the diet for 6 weeks: High protein level (group H, 55% energy from protein), moderate protein level (group M, 30% energy from protein)

and low protein level (group L, 15% energy from protein) (n=9 for each group). Ten centimetre long segments from duodenum, jejunum and ileum were excised at the end of the study period. The mechanical test was performed as a ramp distension experiment. The intestinal diameter and length, wall thickness, wall area and opening angle were obtained from digitized images of the intestinal segments at pre-selected pressures, no-load and zero-stress states, respectively. Circumferential and longitudinal stresses (force per area) and strains (deformation) were computed. The layer thickness was measured from intestinal histological images. No difference in body weight was found between groups at the start of the experiment. However, at the end of the experiment the body weight was smallest in group L (P=0.0003 and 0.0004 compared with groups H and M). Similarly, the wet weight per unit length, wall thickness and area were smallest in group L (P<0.05, P<0.01). The lowest wall thickness was found in the jejunum and ileum in group L (P<0.05), mainly due to decreased mucosa and submucosa thickness. The smallest opening angle and absolute values of residual strain were found in the jejunal segment in group L (P<0.05). No difference was observed for duodenal and ileal segments among the three groups. Feeding the low-protein diet shifted the stress–strain curves to the right for the circumferential direction, indicating the wall become softer in the circumferential direction. However, no significant difference was observed in the longitudinal direction for any of the intestinal segments. In conclusion, this study demonstrated that low-protein diet in minks induce histomorphometric and biomechanical remodelling of the intestine.

Journal of Biomechanics, 2009: 42, 443-448

Running in a running wheel substitutes for stereotypies in mink (*Mustela vison*) but does it improve their welfare?

Steffen W. Hansen,, and Birthe M. Damgaard

This experiment investigated whether access to a running wheel affects the development of stereotypies during restricted feeding and whether selection for high or low levels of stereotypy affects the use of the running wheel. Sixty-two female mink kept in standard cages and selected for high or low levels of stereotypy were used. Thirty of these females had access to a running wheel whereas thirty-two female mink had no access to running wheels. The number of turns of the running wheel, behaviour, feed consumption, body weight and the concentration of plasma cortisol were measured during the winter period. Mink with access to a running wheel did not perform stereotypic behaviour and mink selected for a high level of stereotypies had more turns in the running wheel than mink selected for low levels of stereotypies. Mink with access to a running wheel used the running wheel for the same amount of time as mink without access to a running wheel performed stereotypies, and the daily rhythms of the two types of activity were identical with a peak around feeding time. No other behavioural differences between stereotyping and non-stereotyping mink were found and neither was there any difference in plasma cortisol. Due to the similarities between stereotypies and wheel running it is not possible unambiguously to conclude that access to a running wheel improve the welfare of the mink.

Applied Animal Behaviour Science, 2009: 118, 76-83

Balancing of protein and lipid intake by a mammalian carnivore, the mink, *Mustela vison*

David Mayntz, Vivi Hunnicke Nielsen, Allan Sørensen, Søren Toft, David Raubenheime, Carsten Hejlesen, and Stephen James Simpson

Many herbivores and omnivores can balance their intake of macronutrients when faced with nutritionally variable environments. Carnivores, however, are widely believed to optimize their rates of prey capture and energy intake rather than balancing nutrients. We tested nutrient balancing in captive mink and found a pronounced ability to balance and regulate intake of protein and lipid. When faced with one of several different pairings of complementary foods varying in protein to lipid composition, mink apportioned intake between the two foods to defend a near constant ratio and amount (intake target) of the two macronutrients. When given only one food of fixed nutrient composition, mink balanced macronutrient intake relative to the intake target, without showing the excessive energy intake on diets with a low percentage of protein and energy deficit on diets with a high percentage of protein previously

reported for herbivores and omnivores, including humans. This demonstration of nutrient balancing in a carnivorous mammal indicates that the capacity for nutrient balancing is a more general phenomenon across trophic levels than was hitherto believed to be the case.

Animal Behaviour, 2009: 77, 349-355

Litter size and kit survival

Bente Krogh Hansen

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*Summary of the **Satellite Symposium** at theIXth International Scientific Congress in Fur Animal Production held in Halifax, Nova Scotia, Canada on August 19 to 23, 2008.*

Good reproduction is an important economic factor in fur animal production. This economic impact depends on the costs of breeding animals per skin produced. Several steps, both in relation to male and female reproduction, have to be passed successfully before we get an acceptable litter size. The animals are born with a genetic potential, which in combination with environmental effects throughout life, including feeding and management, determines to what extent the genetic potential is obtained.

Most reports indicates that during the last 10 years litter size has not improved, either in mink or in foxes. We can ask why the favourable development seen in 1970´s and early 1980's has ceased in spite of the great advances made in development of breeding programmes. Even though the heritability of litter size is generally low, it has been possible to improve reproduction by selection in many species. In fur animal production modern breeding programmes were developed in 1980's and include estimation of breeding value (BV) for female fertility. The models for breeding value estimation have continuously been improved and are based on the most modern knowledge on this field.

Therefore the aim of the satellite symposium was to increase our knowledge about this important topic by multidisciplinary interactions. Altogether around 200 international researchers, veterinarians, fur consultants and fur farmers were gathered at the Mariott Harbourfront Hotel in Halifax on August 19, 2008.

The Symposium started with a general introduction by Bente Krogh Hansen and a presentation of bottlenecks in reproduction by Bruce Murphy. These were followed by 12 presentations grouped around four topics

Body weight and body condition, litter size and kit survival

- Reduced litter size and percent kits alive is a consequence of selection for high body weight. *Bente Krogh Hansen* and Peer Berg*
- Feeding history affects cub survival of young breeding blue foxes (Alopex lagopus), a field study. *Nita Koskinen*, Anne-Helene Tauson, Juhani Sepponen and Teppo Rekilä*
- Female body condition and early kit mortality: A description from praxis. *Henrik Bækgaard*, Peter Foged Larsen and Michael Sønderup*
- Feeding during gestation in relation to litter size in mink .*Steen H. Møller*

How can we prepare dams to the lactation period?

- Development of mammary glands in mink. *Steen H. Møller*
- Genetics of early kit growth and maternal weight changes during pregnancy and lactation in mink. *Bente Krogh Hansen* and Peer Berg*

- Protein restrictions *in utero* - influence on metabolic traits and regulatory hormones in mink kits. *Connie Frank Matthiesen*, Dominique Blanche, and Anne-Helene Tauson*

Health factors that influence early kit mortality

- Review of factors associated with mink kit mortality. *Bruce Hunter*
- Early pup mortality in blue fox (Alopex Lagopus)- mechanisms and pathology. *Gorm Sanson*

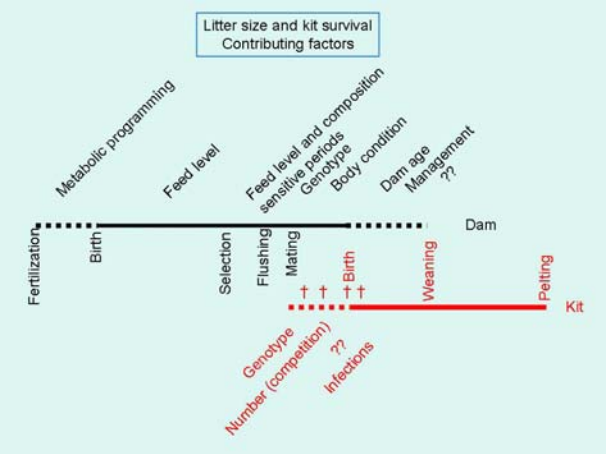
Dams are more fertile than expected

- Placental scars in barren mink females *Tove N. Clausen,* and Anne Sofie Hammer*
- Observations of deliveries in mink: Potential for more kits *Birthe Houbak*, and Jens Malmkvist*

After the presentations and discussions a summary was drawn up by Peer Berg. The main points of the symposium are presented here.

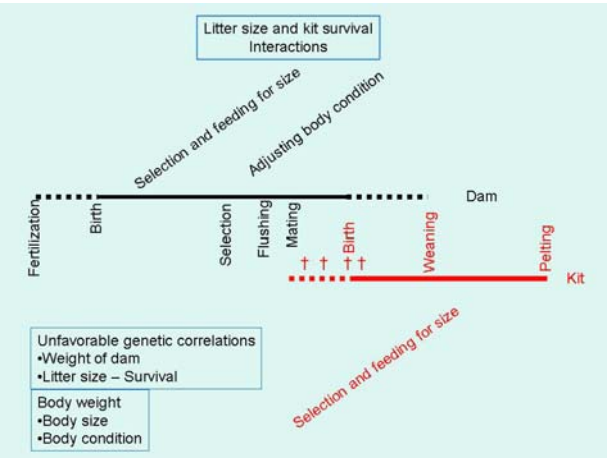
What has influence on litter size? (Figure 1)
Litter size depends on factors from both the dam and the pups/kits. Figure 1 illustrates a time line for dams and pups/kits from birth until pelting. After the best breeding animals are selected, they are conditioned before mating. The feeding level has influence on reproduction results in sensitive periods. Mink dams respond on flushing with increased number of ovulating follicles. There might also be a genetic factor in the frequency of ovulated follicles.

However, more embryos than expected are implemented in the uterus, - and video recordings of mink births have shown that the females give birth to more kits than expected on the basis of the counting carried out on day 1-3 after birth. Mortality is high on the day of birth and the day after, yet, the majority of the still born kits are fully developed.



Dams respond on feeding level in the pregnancy period. In mink restricted feeding in that period impairs number of mammary glands to milk production. In foxes vixens with low feed intake in the last week of pregnancy have high frequency of stillborn and weak born puppies, and obese fox vixens seem to have a higher risk to reduce feed intake during late pregnancy.

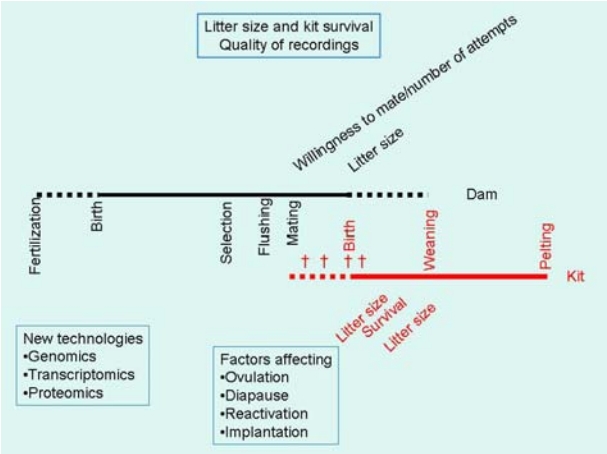
Interaction between dam and kits (Figure 2)
Females with high body weight and fed *ad libitum* to get large skins can result in poor reproduction because there is an unfavourable correlation between dam body weight and litter size and proportion of survived kits. This problem is parallel in mink and foxes. In foxes dystocia seems to be the most reliable explanation to the major part of early puppy losses. Also in mink dystocia may be a problem.



In the suckling period fur animal offspring depends very much on the mother – her milk production and how she takes care of the offspring. Research with mink has shown that there is a relation between weight gain of the dam in the pregnancy period and maternal induced growth in kits. In other words, there is a relation between development of mammary glands and milk yield. In mink it is possible to select for increased early body weight due to kits own growth or the maternal induced growth and thus give the kits a good start for the growth period after weaning. This also means that body weight of mink kits is inherited already from birth.

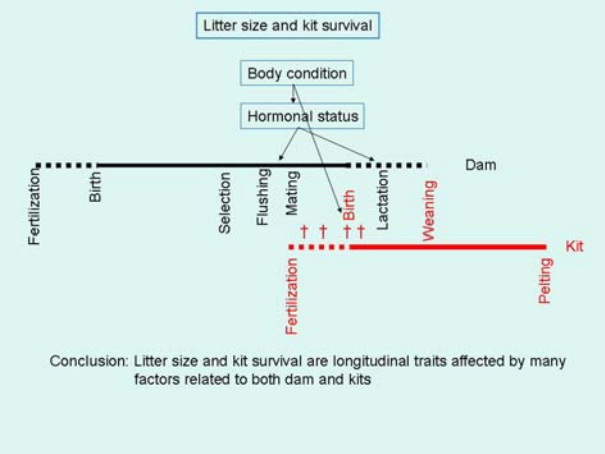
Both diarrhoea and diseases have crucial influence on kit/pup survival, and may change the results dramatically, e.g. sticky kits are still a problem in mink production.

Quality of recordings (Figure 3)
It is very important to follow a standard procedure in recordings in order to get a clear picture of the actual situation and its development. E.g. the litter size has to be counted at the same age each year.
On commercial farms the early loss of kits is not seen as the litter is often counted later than three days after birth.



New registrations e.g. willingness to mate or number of attempts to mate can possibly be additional information of good dams. However, all new traits have to be analysed and validated before they are included in the breeding programme.

Litter size and kit survival are affected by many factors related to both dam and kits (Figure 4)
In conclusion litter size and kit survival are longitudinal traits affected by many factors related to both dam and kits. In both fox and mink production the relation between dam body weight and litter size is crucial. To get breeding animals in optimum size and condition needs knowledge of breeding, feeding, reproduction physiology, metabolic energy turnover, management and behaviour.



The symposium has clearly shown that in reproduction we are definitely dealing with a multifactorial process. Many of the influencing details are already known but there are still possibilities to improve production systems so that the animals´ total genetic and physiological capacity can be utilized. So more research is needed on all fields and especially the co-operation and interaction of different disciplines is important for further improvement of reproduction of fur animals.

Annual Report

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Danish Fur Breeders Research Center

Abstracts

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Reports on: Behaviour

Winter feeding to reduce stereotypies and increase reproduction

Hansen, S W., Clausen, T N, and Sandbøl, P.

In this study we compared the level of stereotypic behaviour during postponed feeding and the reproduction results in females slimmed in early and late winter, respectively. Furthermore, we studied the effect of two different methods of feeding fibres during winter.
The results showed that the level of stereotypic behaviour in females slimmed in February was reduced to 1/3 of the level in females slimmed in December-January. At flushing, the weight of the females slimmed in February was significantly higher than the weight of the females slimmed in December-January. This weight difference did not have a negative effect on the effect of flushing, but it may have affected the weight at birth and thus the reproduction result. The result indicates that the females insufficiently slimmed at flushing may risk getting too fat during gestation, and this may affect the reproduction results negatively. The two methods of feeding fibres did not affect the behaviour or the reproduction results differently.

Annual Report 2008, 7-18. Danish Fur Breeders Research Center, Holstebro, Denmark.

Some practical conditions concerning tubes and shelves

Jeppesen, L L.

The use of tubes and shelves (see e.g. Jeppesen, 2004) was examined in 406 cages with juvenile mink from August to October. The tubes were used the most in the beginning of the autumn, and they were used to an equal extent by females and males. One group got tubes at weaning, another one got tubes in the middle of August, which has been considered to be the optimal time of assigning tubes. However, there was no effect of this difference in time of allocation on the later use of the tubes. The permanent access to tubes or shelves, which is demanded by the Danish departmental order on protection of fur animals, can therefore as regards the tubes be implemented without harming the use of the tubes. The shelves were used more than the tubes, and more by females than males. The shelves were used to the same extent throughout the autumn. In previous examinations, the diameter of the tube and the diameter of the opening between nest box and cage was the same, 11 cm, and the mink always left the tubes in the cages. In the present experiment, the tube was still 11 cm, but the net box opening was 12 cm, and the tubes were to a large extent pulled into the nest boxes and out again by the mink. Since the mink were able to remove the tubes from the nest boxes it is assumed that the possibility of taking them there does not harm the beneficial effect of the tubes to the welfare. However, it has to be controlled that all mink can do the job, so that the tubes does not remain in the nest boxes and thereby impairs the space and the insulation capacity of the nest box.

Annual Report 2008, 19-22. Danish Fur Breeders Research Center, Holstebro, Denmark.

Additional nest box in climbing cages and additional floor for standard cages on behaviour, bite marks and low grades in mink

Jeppesen, L L.

The aim of this project was to examine the effects on behaviour, bite marks and low grades of an additional nest box in climbing cages with four juveniles and of an extra cage level on the top of conventional standard cages with two juvenile mink. In climbing cages with two nestboxes the additional nest box was placed outside the cage in the back of the upper level of the cage with the box opening facing towards the feed gangway. In the standard cages with an extra floor, the upper cage level was designed to fit the low height of the conventional two row sheds. For comparison, the effect of a conventional climbing cage with two animals was also examined. The behaviour was observed three times during the autumn and bite marks on the leather side of the skins were counted after euthanisation. Data on low grades were drawn from the production year statistics at Kopenhagen Fur.
Stereotypic behaviour did not occur, and on the basis of comparisons with previous examinations this is assumed to be due to increased genetic adaptation to the farm environment.
The four mink in climbing cages with one nest box spent more time in their single nest box than the

mink with two nest boxes spent in their two boxes altogether. The reason for this could be that the mink in the one box cages were more reluctant to leave the nest box due to a greater competition for access to the restricted nest box space, or that the mink in cages with two boxes were more activated by the observer, since one nest box opening faced the feed gangway, and that activity was maintained for longer time due to the greater complexity of these cages. Mink from climbing cages with two nest boxes had less bite marks than mink from climbing cages with one nest box. This effect was most pronounced for the males. The reduction in the number of bite marks is supposed to reflect better welfare in the cages with two nest boxes. However, there was still significantly more bite marks on the skins from climbing cages with two nest boxes than on the skins from standard cages, and it is recommended to examine whether group selection against bite marks would be a means to eliminate the increased amount of bite marks on skins coming from climbing cages.
Standard cages with an additional upper floor and climbing cages with two animals gave rise to more bite marks than standard cages, and on this basis it is concluded that these cage types do not constitute a welfare improvement for the housing of two juvenile mink as compared to the conventional standard cage. Generally, there were more low grades among the skins from climbing cages. This tendency was reduced when there were two nest boxes or just two animals in the cages.

Annual Report 2008, 23-36. Danish Fur Breeders Research Center, Holstebro, Denmark.

Effect of tryptophan on behaviour in mink

Simonsen, T.

The part of the mink production, in which four juveniles are kept together in one cage, faces problems with aggression: The mink fights and bites each other to an extent that impairs their welfare and fur quality. Aggression may be reduced by selection and by environmental enrichment. Another potential possibility is to add tryptophan to the feed instead of a comparable amount of other large neutral amino acids. Tryptophan and the other amino acids compete for the access to the brain through the blood-brain barrier, and the accessibility of tryptophan for the brain is therefore reduced when there are many competing amino acids in the feed. In the brain, tryptophan is converted to serotonin that is known to reduce stress and aggression in many animal species and reduce irritability and bad mood in humans. Serotonin also takes part in the induction of satiety and reduction of feed intake in a number of species.
In this project it was examined whether tryptophan addition to the feed can be used to reduce aggression in adult female mink, and whether feed intake is reduced by such a treatment. It was done by comparing two groups: one that was fed tryptophan added feed (TRYP) and one that got feed with an equal amount of other large neutral amino acids (AS). The groups were observed for four weeks, and they got the experimental feed in week number 2 and week number 3. The results showed that there were transient and modest effects of the experimental feed: In the TRYP-group the intensity of contact with an unknown mink was lower than in the AS-group in week 2, and the latency to contact was accordingly increased. In the same week, the TRYP-group was also less active and exploratory or vigilant towards unknown observers. In week 3 there were more mink in the TRYP-group that did not eat all their food as compared to the mink in the AS-group. So, it was confirmed that tryptophan may reduce aggression and feed intake in adult female mink. However, the effects that were obtained in the present experiment are assumed to be too weak to counteract the practical problems with aggression among four mink kept in the same cage. It could be examined, therefore, whether further addition of tryptophan to the feed leads to greater effects. Naturally, it should also be examined whether the effect of tryptophan also is valid in juveniles that have the greatest problem with aggression.

Annual Report 2008, 37-50. Danish Fur Breeders Research Center, Holstebro, Denmark.

Reports on: Nutrition and feeding

Effect of low protein in the gestation period on skin size, pelt quality, and reproduction results in the following nursing period

Clausen, T.N., and Sandbøl, P.

In 2007 and 2008 we investigated whether feeding low protein in the gestation period 2007 had any influence on pelt length, skin quality and reproduction results in the following nursing period. In the period April 6 to April 26 2007 the amount of metabolizable energy from protein (MEp) in 6 groups of 135 brown mink females each, was varied from 24 to 52 percent. Skin quality and pelt length of pelted kits from these groups were registered, and reproduction results 2008 of breeding females from these groups were examined.
The results showed that the feed from April 6 to April 26 should contain at least 40 percent of the MEp to get many live borne kits at birth and a good kit body weight growth. At 28 MEp and below the male kits remain small until pelting, and there is a tendency that female kits borne by females fed 24 MEp in the gestation period, get fewer kits in the coming nursing period.

Annual Report 2008, 51-54, Danish Fur Breeders Research Center, Holstebro, Denmark.

Energy distribution in the feed for mink kits in the early growth period - II

Clausen, T.N, and Sandbøl, P.

To evaluate whether 32 percent of the metabolizable energy from protein (ME_P) is sufficient for optimal live weight gain of mink kits in July, 6 groups of each 128 brown male- and female mink kits were fed different energy composition in July. Further 9 groups were investigated to find the optimal energy composition in the period August 1 to September 15. The results showed that 32 ME_P is sufficient for growth in July, and that mink kits has a better live weight gain in that period at the highest amount of energy from fat and the lowest from carbohydrates. In August the live weight gain decrease with increasing amount of ME from carbohydrates (ME_C), further the skin length is shortest at the highest carbohydrate level.
An energy composition to mink kits in early growth (July) at 32:50:18 gives optimal live weight gain. In August the best live weight gain is found at 18 ME_C or less.

Annual Report 2008, 55-60, Danish Fur Breeders Research Center, Holstebro, Denmark.

Amino acid in feed for mink kits. Effect and weight development for 4 – 12 weeks

Helwing, A.L.F, and Hansen, N.E.

The aim of the experiment was to investigate the effect of the level of nutrients in the diet on weekly weight gain in adult female mink, and mink kits respectively 8 and 12 weeks post partum. Right after giving birth the litters of 40 females were standardized to 7 kits per litter. Four weeks after birth the animals were split into 4 groups receiving diets with the following distribution of metabolizable energy (ME% from protein:fat:carbohydrate): 45:40:15 (HPLK); 30:45:15 (LPHK); 45:30:25 (HPHK) and 30:55:15 (LPLK). There were no differences in weight for any of the diets given to adult females. For the mink kits, however, a significantly lower weight was seen after 6 weeks in the group receiving LPLK and after 10 weeks the weight was lower for the mink kits receiving the HPHK diet compared to those getting the HPLK and LPHK diets.

Annual Report 2008, 61-66. Danish Fur Breeders Research Center, Holstebro, Denmark.

Continued investigations on the need of ω6 : ω3 too achieve good skin length and pelt quality

Clausen, T N., and Sandbøl, P.

To investigate the optimal ω6:ω3 ratio in the feed for good pelt quality, 5 groups of each 145 male- and 145 female black mink kits were used. Investigation feed was fed from September 15 until pelting, and the ω6:ω3 ratio varied from 3.0 to 13.1.
Compared with earlier results it is shown that a ω6:ω3 ratio in the feed after September 15 on 2.1 and more is sufficient for a good skin length, and a ω6:ω3 ratio on 3.0 and more is sufficient for a good pelt quality.

Annual Report 2008, 67-70, Danish Fur Breeders Research Center, Holstebro, Denmark.

Reports on: Physiology and analytical techniques

Digestibility of amino acids in a synthetic diet (*Mustela vison*)

Schulin-Zeuthen, M, and Sandbøl, P.

In a diet where the protein fraction entirely is made up by individual amino acids, it is assumed that 96% of the amino acid is digestible. The purpose of the trial was to determine the digestibility of the individual amino acids. Four adult male mink were offered the diet in 11 days and samples were collected the last 4 days of the period. The apparent digestibility was between 89 and 95% for the majority of the amino acids. Exceptions were the apparent digestibility of Methionine, Cystine and Threonine, which were determined to be 98, 74 and 79%, respectively.

Annual Report 2008, 71-72. Danisk Fur Breeders Research Center, Holstebro, Denmark.

Effect on palatability in mink feed of L- and DL-methionin

Hvam, K., Clausen, T.N, and Sandbøl, P. .

A possible effect on palatability with L- and DL-methionin inclusion of 0; 0,1and 0, 2 % and respectively 0; 0,16 and 0,33 % of the feed was investigated. We used 25 male mink of the colour type Brown/Glow, in 5 groups of each 5 animals, housed in balance cages.
We found no negative effect on the feed intake with the used inclusion levels of up to 0,16 and 0,33 % of respectively L- and DL-methionin.

Annual Report 2008, 73-76, Danish Fur Breeders Research Center, Holstebro, Denmark.

Iodine requirement in mink – part 1
Blæsbjerg, M.S., Hansen, N.E., Sandbøl, P., and Schulin-Zeuthen, M. .

Five adult male mink of the colour type brown/glow were given a feed containing 25, 75, 125, 175 or 225 µg iodine/100kcal, starting with 25 µg. A trial period consisted of six days of adaption and one day of quantitative urine and faeces collecting, where after the animals were switched to the next diet. Feed consumption was registered daily. From the calculated intakes and the analyzed excretion of iodine the estimated requirement is 24.9 µg iodine/$kg^{0.75}$/24 hours (corresponding to 0.2 ppm) with an ambient temperature at 15.9 °C and 115 kcal/100 g feed (~26% dry matter). The estimated requirement corresponds to the norm of 0.2 ppm, set in the 1960's for mink.

Annual Report 2008, 77-86, Danish Fur Breeders Research Center, Holstebro, Denmark.

Iodine requirement in mink – part 2

Blæsbjerg, M.S., Hansen, N.E., Sandbøl, P., and Schulin-Zeuthen, M.

Iodine is an essential trace element, and is a component in the thyroid hormones T_3 and T_4. In order to reaffirm the methodology applied in Blæsbjerg et al., (2008), urine from three male mink were collected after the mink were offered a diet containing 3 levels of potassium iodate. Linear extrapolation showed that urinary excretion of iodine was 17.78 µg/$kg^{0.75}$/day at a dietary iodine intake of zero. The iodine requirement for maintenance was 21.48 µg/$kg^{0.75}$/day. This is in agreement with previous findings (Blæsbjerg et al., 2008), where the requirement for maintenance was 24.9 µg/$kg^{0.75}$/day. Despite a high variation in dietary intake and uncertainty in the chemical analysis of iodine, the methodology can be applied for determination of a requirement for iodine in mink. In conclusion, the requirement estimate was 24.9 µg/$kg^{0.75}$/day.

Annual Report 2008, 87-90, Danish Fur Breeders Research Center, Holstebro, Denmark.

Sodium requirement of adult mink males

Clausen, T.N., Damgaard, B.M., and Sandbøl, P.

To the investigation on the need of Na to adult male mink, we used 4 groups each consisting of 5 brown males. The males were feed a purified diet supplemented with various levels of sodium chloride (NaCl) for one week.
We found that adult mink males have their requirement for Na fulfilled with 0.017 – 0.020 g Na/100 kcal. Our recommendation is minimum content of NaCl in Danish mink feed of 0.13 g NaCl / 100 kcal in the winter period and 0,08 g NaCl / 100 kcal in the growing- furring period.

Annual Report 2008, 91-96, Danish Fur Breeders Research Center, Holstebro, Denmark.

Increasing sodium cloride content in the feed for 11 week old minkkits, and its importance for their water consumption

Clausen, T.N., and Sandbøl, P.

Six groups each of five black mink kits were used in an investigation on whether, by increasing the feed sodium chloride content in the feed, it is possible to make mink kits drink more and urinate more and thereby hopefully prevent urinary diseases, without any negative effect on kit growth and health. In the period June 29 to July 13 the kits were feed different sodium chloride content. Growth, amount of feed, manure, urine and drinking water was measured.
The results showed that when the Na content in the urine is close to 250 mmol/l, in 11 weeks old kits we see that with a feed Na content on 0.27 g Na/100 kcal (1 % NaCl), the kits start to increase there water consumption and urine production to excrete excess Na. However when the feed Na content is that high, the body weight increase is reduced.
Further the amount of Na excreted in the faeces is constant, independent of the feed Na content, excess Na is excreted in the urine, to a certain amount. When the feed Na content get as high as 0.73 g Na/100 kcal (2.7 % salt) the kits can not drink enough / concentrate their urine more, and excess Na is retained in the body. After a while that would intoxicate the kits.
It can not be recommended to use high amounts of sodium chloride in the feed to prevent urinary diseases, when the feed Na content get so high that they have to drink more, their growth is reduced.
It is recommended that the feed Na content to 10 - 12 week old kits is lower than 0,27 g Na/100 kcal (1 % NaCl; 0.68 g NaCl/100 kcal).

Annual Report 2008, 97-102, Danish Fur Breeders Research Center, Holstebro, Denmark.

Salt in the feed for 6 – 9 week old mink kits

Clausen, T N., Damgard, B. M., and Sandbøl, P.

To the investigation of 6 – 9 week old mink kits need of sodium (Na), we produced a feed with a very low Na content, to that feed we added increasing amounts of Na. A total of 9 groups each consisting of 20 litters of black mink kits were used.
The results showed that 6 – 9 week old mink kits requirement of Na is meet with 0.11 g Na/100 kcal (0.27 g NaCl /100 kcal; 0.4 % salt). When there is 0.05 g Na/100 kcal or lower we see a reduced growth, symptoms indicating Na deficiency, low urinary Na and high plasma aldosterone.

Annual Report 2008, 103-108, Danish Fur Breeders Research Center, Holstebro, Denmark.

Palatability of a synthetic diet in mink

Schulin-Zeuthen, M., Hvam, K, and Sandbøl, P.

In investigations requiring a synthetic diet, some low and varying intakes have been experienced. Therefore, two trials were conducted with the purpose to examine effects on dietary intake by addition of chicken breast or by regulation of the dietary pH-values. Addition of 14.6% chicken breasts in the diet (fresh weight-basis) significantly ($p < 0.0002$) increased dietary intake compared to addition of 3.3% or 6.4% chicken breasts, or addition of soy sauce. Dietary pH-values were 4.24, 4.30, 4.71 and 4.14 for respectively 3.3, 6.4, 14.6% chicken breast and soy sauce. Likewise, regulation of dietary pH by addition of $NaHCO_3$ increased dietary intake to a level that sufficiently met the metabolic energy (ME) requirement of maintenance in mink. In conclusion, addition of 14.6% chicken breasts or dietary pH-regulation to 4.7 by addition of $NaHCO_3$ stabilized and ensured a sufficient dietary

intake in mink offered a diet based on crystalline amino acids.

Annual Report 2008, 109-112. Danish Fur Breeders Research Center , Holstebro, Denmark.

Reports on: Health

Susceptibility of post weaning diarrhoea in mink kits in relation to the female activity level

Damgaard, B M., and Hedemann, M S.

The aim of the project was in a challenge model to measure the susceptibility of post weaning diarrhoea in mink kits. The kits were from litters born of females with high activity level and with low activity level, respectively. The project was performed during the first 7 days after weaning. The mink kits were orally challenged with coli bacteria (*Escherichia coli O68*) 1 and 2 days after weaning. The frequency of mink kits with diarrhoea was not affected by the activity level of the females. The frequency of kits with diarrhoea was higher in challenged kits than in control kits. The body weight and the growth were not influenced by the challenge with bacteria or by the activity level of the female. The number of erythrocytes and the content of haemoglobin in the blood were higher in kits born of females with a high activity level than in kits born of females with a low activity level. The plasma content of the acute phase protein haptoglobin was higher in challenged kits than in control kits. The height of the intestine villi and the depth of the intestine crypts were not affected by the challenge with bacteria or by the activity level of the females.

Annual Report 2008, 113-118. Danish Fur Breeders Research Center, Holstebro, Denmark.

Fat and lean male mink at pelting. Organs and blood values

Clausen, T.N.

To investigate whether there is a difference in the metabolic profile of fat and lean mink at pelting, we used 15 fat and 12 lean male kits. Blood samples were taken for glucose, triglycerides, cholesterol and blood percent. The animals were weighed, measured and body score was calculated. After euthanasia liver and heart were weighed, liver and heart in percent of body mass and metabolic body mass were calculated. Liver dry matter was measured and liver fat percent calculated.
The results showed that the used measuring instruments for analysing mink blood were not optimal. Often the blood percent was too high for the method used or the values were out of range. No difference between groups was found. Liver and heart in percent of body mass were highest in lean animals, but in percent of metabolic body mass only the heart was bigger. Liver fat percent was highest in fat male mink.

Annual Report 2008, 119-122, Danish Fur Breeders Research Center, Holstebro, Denmark.

Reports on: management

Influence of female bodycondition on littersize in mink

Bækgaard,H., Larsen, P.F., Clausen, T., and Sønderup, M..

Female body condition, in the period from January to birth in late April or early May, is an important factor for the duration of the birth as well as the number of kits in mink. In this study body condition was scored on a total of 3231 females from 4 farms. The females were scored 4 times, ultimo February, ultimo March, primo April and ultimo April. We found that the body condition of the females, in ultimo March and ultimo April had a significant effect on the number of kits, and that the effect was both on young and older females. Moreover, we found that it was important for the females to gain in body condition score from primo April to ultimo April, in this study referred to as the pregnancy. This study confirms earlier studies and underlines the importance of females increasing their body condition during pregnancy. The conclusion of this study is that females give birth to the largest litters if they have a body condition 3 in late March and rise to a body score 4 in late April.

Annual Report 2008, 123-128, Danish Fur Breeders Research Center, Holstebro, Denmark.

Validation of subjective body condition scoring

Hansen, B K., Møller, S H., Berg, P., and Bækgaard, H.

The method to body condition scoring of mink is assessed. It is concluded that when the same person due the scoring, a relative high correlation is achieved. More introductions to discuss the level of categories are needed, when more persons are involved in the scoring. A total of 200 wildmink males were subjectively scored twice for body condition. The 2th of September was chosen because at that time the growth in body length is expected to be finished.

Annual Report 2008, 129-136, Danish Fur Breeders Research Center, Holstebro, Denmark.

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