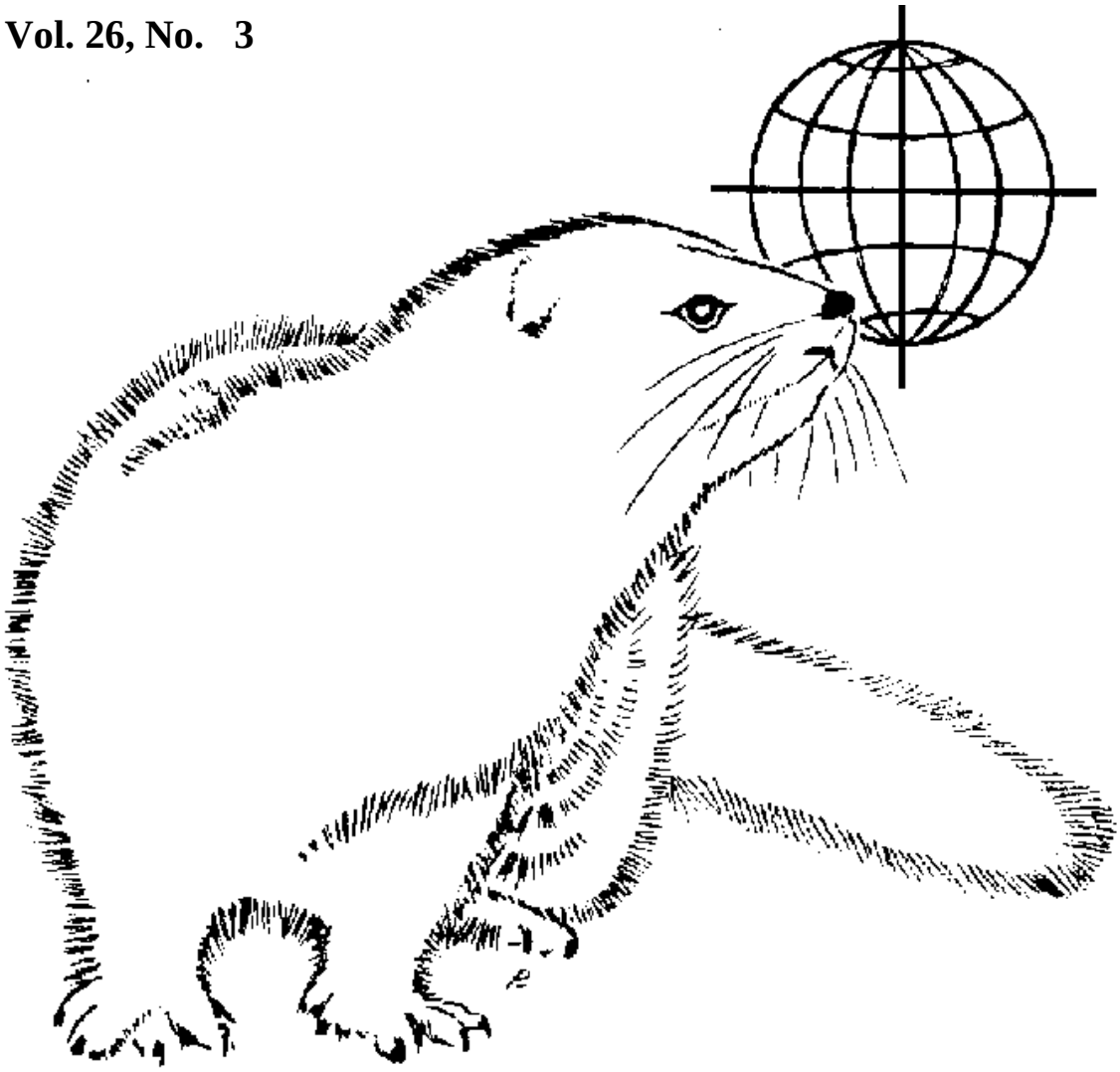
SCIENTIFUR

SCIENTIFIC INFORMATION IN FUR ANIMAL PRODUCTION

Vol. 26, No. 3



IFASA

INTERNATIONAL FUR ANIMAL SCIENTIFIC ASSOCIATION

SCIENTIFUR - scientific information in Fur Animal Production.

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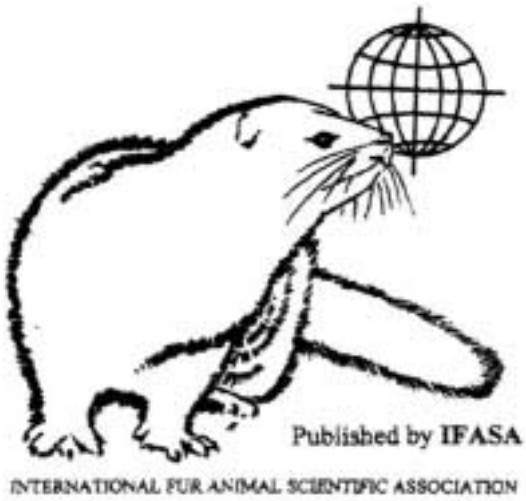

2. Notes

Notes from the Group of Editors

This electronic version of Scientifur is the third issue of volume 26. The issue of this volume will be published as a paper version as soon as possible.

We sincerely regret the delay in the publishing of volume 26. However, we promise our readers to commence the editing of volume 27 as soon as possible.

In this issue of Scientifur you will find abstracts, a short communication, and information on new books. You will also find information on a seminar arranged by the Nordic Association of Agricultural Scientists, Subsection for Fur Animals. The seminar is to take place in Bergen, Norway, 8 – 10 October 2003.

We invite all our readers to submit articles for reviewing as well as short communications, abstracts, letters etc. with relation to fur animals.

We wish you all an enjoyable summer.

On behalf of the
Group of Editors

Birthe Damgaard

Outi Lohi – 'The Grand Old Lady' of fur animal research – celebrated her 70th birthday on January 10th 2003.

Outi Lohi's entire professional career has focussed on fur animal production. After her graduation in agronomics in 1965 and a job as fur animal adviser she moved to England. Her interest in colour mutants in mink was initiated here. Back in Finland she worked as a fur animal adviser in the western part of the country. In 1982 she moved to Denmark and initially worked at The Danish Fur Breeders' Association in Glostrup. Here she focused her efforts in the fields of skin quality, evaluation methods and quality principles in addition to the breeding system DanMink.

In 1985 Outi was employed at The Danish Institute of Animal Science at Trollesminde via the Danish Fur Breeders' Association. This was the job of her dreams – she had the possibility of doing research and at the same time interacts with new colleagues. Outi has introduced several young people to the world of fur animals and she has been able to attract and maintain their interest with her extraordinary knowledge in this field. As colleagues we have been fortunate to share the enthusiasm when things succeed as well as her encouragement when things have been tricky.

In 1989 The Department of Fur Animals moved from Trollesminde and into Research Centre Foulum near Viborg. Outi and Gunnar Jørgensen formed the leader team at the former Danish Institute of Animal Science, Dept. of Fur Animals. Gunnar took care of financial matters and Outi was the professional scientific sparring partner. A characteristic of Outi is her perseverance or that special Finnish "sisu" that always make her continue until a solution is found. In her first years at Research Centre Foulum Outi was deeply involved in making the department's computer hardware and software work in the best possible way. Later on, Outi's work became increasingly management oriented resulting in her scientific efforts being of a more indirect nature.

Outi has always been able to maintain a comprehensive view of things, thus combining practical issues with an extensive biological knowledge. She knows the animals and is able to handle them in a way that is respected by even the best breeders in the trade. She knows exactly where to draw the line – although she has occasionally transcended this, a fact clearly indicated by the holes in her thin leather gloves. Outi has an excellent gift for seeing the perspectives within many research areas, for finding ideas and for following up on these by relating them to production.

We all know that the love for qualitative genetics with colour mutants in mink as well as fox holds a very special place in Outi's heart. Outi gladly travels abroad if she learns about a new mutation. And then the heredity has to be tested – phenotype is not sufficient – you have to understand the background as well. The live gene bank with colour mutants at Research Centre Foulum is Outi's work, and it is quite exceptional to have such a huge variance of different colour mutants gathered at one place. Visitors as well as students often remember a visit to the mink farm at Foulum, particularly due to the gene bank. This specific area of interest has also resulted in the book "Beautiful Fur Animals - and their colour genetics". An extensive, well-written book with a lot of photos on the heredity of colour in fox and mink as well as other furred animals.

Another characteristic feature of Outi is her ability to study details in order to explain e.g. a problem in its entirety. For a number of years the breeding area has benefited from her efforts in areas, which may have been hard to handle, but which were also very valuable to examine – as it turned out in the long term – along with the development of software and better computers. Outi has a positive and open mind and is always ready to discuss results and look for the biological explanation behind these.

It is beyond doubt that Outi is international, even her answering machine is in English. Even though she has retired Outi is still among the active participants at national as well as international fur animal meetings and genetics congresses. Outi does not feel at home in the limelight, and she often acts as the busy secretary in the Breeding Committee, NJF Subsection for Fur animals; the Danish Working Group for Breeding, Genetics and Reproduction; DanMink user group or Scientifur. It is very important to Outi to maintain the spirit of solidarity between fur animal researchers nationally as well as internationally. In her modest and very cordial way she is always ready to make an effort, a fact that emphasizes her sincere interest in other people and their work.

In 1996 Outi retired and since then she has caught up with several scientific discussions. You never ask for her help in vain. For several years colleagues from all parts of the world have benefited from her generous helpfulness in relation to scientific questions, proof reading of articles or other scientific initiatives, and her e-mail is frequently used. And Outi is very pleased with her life, enjoying that her expertise is still needed. The difference between her working life and her retired life is that she is now able to spend all her time doing what she prefers the most.

Outi commits herself, no matter where she is. At present, she devotes much of her spare time to the local Net-café in her local Danish community, Purhus where she introduces other people to the mysteries of the computer world.

Outi has two native countries, Denmark and Finland. We are not entirely pleased with your decision to move back to Finland, but this will not increase the distance between us – the e-mail system will just be used even more frequently!

We all feel that we are a part of Outi's "fur animal family". We wish you all the best in the future!

Bente Krogh Hansen

Gunnar Jørgensen celebrated his 70th birthday on April 17th 2003.

Gunnar Jørgensen – The *Grand Old Man* of Danish fur research – celebrated his 70th birthday on April 17th 2003. During his entire active working years Gunnar Jørgensen has dedicated his energy and enthusiasm to the fur research. From 1958 he acted as a one-man army at the Danish Institute of Animal Sciences – at the Department of Experiments in Pigs, Horses and Fur Animals, where he devoted himself to mink research until 1965 when an independent Department for Research in Fur Animals was established at the experimental farms of Trollesminde and Favrholm near Hillerød. Supported by the Danish Fur Breeders' Association who paid for the building and later also contributed to the extension of the experimental farm at Trollesminde, Gunnar Jørgensen succeeded in extending the activities – by means of long steady pulls – and be able to employ 10 scientists. Due to Gunnar's considerable gifts as a "team builder" we all became a close-knit family, a fact resulting in the majority of researchers, laboratory assistants and technicians following him when he moved from the worn farm in Hillerød and into new, attractive and well-equipped facilities at Research Centre Foulum near Viborg in 1989. He had a unique gift for creating a sense of community within the fur animal department, he assumed the responsibility as head of the department and he was extremely successful in maintaining the high professional ambition and reputation of the department until he retired in 1993.

Many of us have benefited from Gunnar's considerable professional energy, his catching enthusiasm and his impressive contact network, nationally as well as internationally. Gunnar often argued in favour of professional questions within fur animal production being just as important and complex as within cattle, pigs and poultry production. Although naturally, it was not possible to achieve corresponding research efforts in fur animals due to the modest international size and geographical area of the trade in relation to the bigger species. Therefore, his main attitude was that all efforts within fur animal research have to work closely together in order to achieve the desired results. Gunnar's contact network and his circle of friends are found in all areas of the international fur animal research, and his efforts in communicating the acquired knowledge as well as

in the collaboration with fur animal researchers from all parts of the world are exceptional and unique. Thus, in 1976 he took the initiative to publish an international scientific journal "Scientifur" with the purpose of disseminating the knowledge of published material in the field of fur animal research and production in all parts of the world. The scientific journal is a storehouse of articles and knowledge, which it would otherwise be very difficult or even impossible to obtain. "Scientifur" is well known and read by practically all fur animal researchers in the world, and in addition, it serves as a means of communication in relation to meetings, congresses, Ph.D. theses and birthdays in an informal way. Quite in Gunnar's spirit the editors of "Scientifur" are contributing considerable efforts in order to make this unique collection of literature available for all who are interested by establishing a search function of all references at the Internet. In addition to "Scientifur" Gunnar has also published several books on fur animals. The most well known of these are "Mink Production", 1984 and "Beautiful Fur Animals - and their colour genetics", 1988 – both published in several languages and still demanded in both the Danish and English version.

In connection with the Scandinavian collaboration Gunnar has been an unremitting participant in "Subsektion for Pelsdyr i Nordiske Jordbrugsforskeres Forening" (NJF) (Nordic Association of Agricultural Scientists – Subsection for Fur Animals), in which the annual meetings have formed the basis for a fruitful collaboration and exchange of knowledge and results. Gunnar Jørgensen was chairman of the feed committee of the NJF in the period 1974 – 1987, and hereafter he was a member of the board of directors of the Subsection for Fur Animals.

Furthermore, Gunnar Jørgensen was the prime mover in the establishment of international congresses for fur animal researchers every fourth year, as well as the chairman of the organization committee for the first two congresses, held in Helsinki in 1976 and in Vedbæk in 1980. In addition, Gunnar took the initiative to establish IFASA (International Fur Animal Scientific Association), which was established after an inspiring speech given by Gunnar at the gala dinner at Fox Hill in Wisconsin, USA after the Toronto congress in 1988, and needless to say – Gunnar was a member of the board of directors. Thus, IFASA provided the solid framework for the continued series of congresses as well as the publication of "Scientifur". And in 1993 this also allowed Gunnar Jørgensen to reduce his workload and enjoy life with Synnøve in Norway. In 2000 Gunnar let go of the lifeline to "Scientifur" as well as IFASA in the confident assurance that they will both continue to thrive even though the two "children" moved away from home at the age of 24 and 12 years, respectively.

Gunnar and Synnøve enjoy the winter months in Spain, where they also celebrated Gunnar's birthday, whereas spring, summer and autumn are spent in Norway or travelling to visit friends all over the world. Gunnar, we wish you a very happy birthday and all the best for the future from IFASA/Scientifur.

Steen H. Møller

3. Abstracts

Effect of the serotonin agonist buspirone on behaviour and hypothalamic–pituitary–adrenal axis in confident and fearful mink

J. Malmkvist, S. W. Hansen, B. M. Damgaard

Behavioural and hypothalamic–pituitary–adrenal (HPA) axis responses were investigated in farm mink (*Mustela vison*) selected for either confident or fearful behaviour for nine generations. Two groups of 2-year-old confident (*n*=12) and fearful (*n*=12) female mink were given the serotonin (5-HT) 1A receptor agonist buspirone (1.25 mg/kg/day), whereas two other groups of 2-year-old confident (*n*=12) and fearful (*n*=12) female mink were given saline, continuously for 5 weeks via osmotic minipumps. Behavioural reactions towards a novel object and towards humans were tested after 19–25 days, and HPA axis reactivity [adrenocorticotropic hormone (ACTH), cortisol] was measured after 28–31 days of treatment. Confident mink were more exploratory than fearful mink towards humans and a novel object. Confident mink spent more time in contact with the object than did fearful mink during saline—but not during buspirone—treatment. buspirone increased approach–withdrawal conflict behaviour towards a object in fearful mink only. The chronic dose of buspirone did not reduce fear towards humans and did not affect latencies to reaction, number of contacts, number and duration of manipulations, and stereotypic behaviour in a Novel Object test. Different HPA axis responses have emerged between confident and fearful mink, together with a different degree of fear-related behaviour. Fearful mink have a higher cortisol combined with a lower ACTH secretion than confident mink in response to capture and blood sampling. The central serotonergic system may be involved, and even though the precise underlying mechanisms are presently unknown, treatment with a 5-HT_{1A} receptor agonist reduces the difference between confident and fearful mink in HPA axis reactivity.

Physiology and Behaviour, 2003: 78, 229-240, 1 figure, 5 tables, 68 refs.

Effect of temperament and behavioural reactions to the presence of a human during the pre-mating period on reproductive performance in farmed mink (*Mustela vison*)

H. T. Korhonen, L. Jauhainen, T. Rekilä

The present study sought to evaluate the relationship between temperament, pre-mating behaviour and reproductive performance in farmed female mink (*Mustela vison*). Temperament was measured by using a stick test and behavioural reactions to the presence of a human during pre-mating period by a walking test. The experimental animals comprised 100 confident and 100 fearful scanblack female mink. In each temperament group, 58% of female mink were primiparous and 42% were multiparous. The length and timing of mating periods and the length of the gestation period were similar in all groups. Pooled data showed that the length of the gestation period correlated negatively with litter size (r = -0.17, P = 0.03). The whelping proportions for confident and fearful primiparous female mink were 81% and 74% (P = 0.37), respectively, and for multiparous females 80% and 81% (P = 0.78), respectively. The number of kits per mated and whelped female at parturition ($P < 0.01$ and P = 0.04, respectively) and at weaning ($P < 0.01$ and P = 0.07, respectively) was significantly higher in confident than in fearful females. A significant correlation between kit losses and litter size was found only in primiparous and multiparous confident females (r = 0.35, P = 0.02; r = 0.32, P = 0.07). Postnatal kit mortality was higher in primiparous confident females than fearful females. During walking tests, fearful animals, irrespective of age, remained inside the nest box more frequently than did confident ones. Stationary behaviour outside the cage (lying, sitting, standing, etc.) was more common in confident than in fearful animals ($P < 0.001$). Significant differences in locomotor activity or stereotypies were not found between the groups. In multiparous fearful females, the whelping result declined significantly with the increasing incidence of stereotypies (r = -0.37, P = 0.04). In primiparous fearful female mink, the relationship was the reverse (r = 0.37, P = 0.01). We conclude that the significant temperament dichotomy (confident vs. fearful) found in farmed mink stock

has a marked effect on the reproductive performance of this species.

Canadian Journal of Animal Science, 2002: 82, 275-282, 4 tables, 54 references.

4. Short communications

An attempt to determine causes of lowered values of breeding indices on a chinchilla farm

Beata Seremak[1], Malgorzata Sulik[2]

[1]Division of Animal Breeding, Agricultural University of Szczecin
[2]Subdivision of Fur-Animal Breeding, Agricultural University of Szczecin

Summary
The present work defines effectiveness of reproductive usage of a chinchilla stock of about 100 females, within four consecutive years. The analysis of the reproductive parameters revealed that high percentage (21.3%) of females was infertile. The mean number of young reared through nursing period was 1.53 per female. Mortalities of young oscillated around 19%.
Summing up, the obtained results can be considered as moderate ones. Improvement can be achieved through selecting for reproduction of females from multiple pregnancies and also elimination of infertile females.

Key words: Chinchillas, reproduction, breeding, rearing through nursing period, infertility

Introduction
Chinchillas are poliestric animals with defined year seasons, when they show increased sexual activity (Jarosz 1969, Weir 1986). Studies conducted, among other places, in Denmark (Nordholm 1992) and Chile (Neira et al. 1989) indicated presence of year periods, when mating indices are higher. The period of increased sexual activity is dependant on climatic conditions and in Poland it lasts from November to May (Gromadzka-Ostrowska, 1998). One of the problems associated with culturing of this animals has been their relatively low fecundity. On the average, a female gives birth to two young (Barabasz 1997). It has been determined, at the same time, that during estrus**,** some 4 Ovarian follicles, which under optimal conditions can result in 4 offspring in a single litter (Jarosz et al. 1996). Low fecundity and high mortality in the postnatal period cause a substantial difference between the reproductive potential and the actual results achieved by farmers. Obtaining one litter in a year should be considered an extensive way of culture. In order to obtain optimal reproductive indices one should aim at receiving two kittenings a year. Triple reproductive usage of chinchilla females leads to their extensive exhaustion and can be a cause of longer reproductive pauses in the future. Possible potential for such intensive reproductive system needs further investigation (Sulik et al. 1995). The aim of this work were: an analysis of basic parameters of breeding usage on selected chinchilla farms and an attempt to determine causes of decreased values of individual reproductive parameters.

Material and methods

The present study was carried out on a chinchilla farm located in Polish Western Pomerania, within four consecutive years from the beginning of 1997 to the end of 2000. The farm employed polygamic rearing system, where the size of mating sets (number of males per one female) was different and it was chiefly dependant on the sexual performance of a male. In most cases the ratio was 1 : 4–6.
The animals were kept in four-store cages in a beddingless system. Al. cages were fitted with automated nipple drinkers, feeders, and bathing tubs. To assure suitable quality and stability of microclimate, the farm was equipped with additional devices, such as: air-conditioners, fans, heaters, and water filters. The farm was artificially illuminated 12 h/day.
The present study covered the entire brood stock with their offspring in the years of 1997–2000. The following reproductive indices were analysed:

- mean number of females used for reproductive purposes—sum of basic stock number (females) in consecutive months of a calendar year divided by 12.
- number and percentage of infertile females.

- Number of litters obtained from females of the basic stock in a given calendar year.
- mean number of litters obtained from a single female in a given calendar year.
- Number of young born till 31 December of a given calendar year, with sex distribution.
- mean number of young born to a female in a single litter.
- mean number of young born to a female in a given calendar year.
- Number of young reared through the nursing period (births given up to 31 December of a calendar year.
- mean number of young in a litter reared through the nursing period.
- mean number of young from a single female reared through the nursing period, in a calendar year.
- mortalities of young during the nursing period**.**

Results and Discussion

Basic parameters characterising reproductive condition of the stock investigated are shown in Table 1. In the farm studied, the number of females used for reproduction distinctly increased in consecutive years.

The number of infertile females was very high and it ranged from 18.1 to 25%. They were females producing no litter in a calendar year. Such high sterility rate of females has an effect on the number of litters given by a female within a year. Taking into account only reproducing females this rate changes (e.g. in 1997 from 1.13 to 1.44). It translates into a difference of 27.4 percentage points, which constitutes the annual loss of a farmer keeping infertile females in his stock.

In the years of 1997–1999 a low fecundity (M/R) was observed in chinchilla females (1.13–1.16 litters from a female in a year), whereas in 2000 the situation improved and the fecundity index amounted to 1.31 litters from a female in a year. The above difference is statistically significant. None of the results achieved is satisfactory, because the physiological potential of a female is two, or more than two, litters from a female in a year.

The low index of the number of young delivered by a female per year (U/R) is greatly influenced by the number of litters delivered by a female in a year (Fig. 1), as well as by the size of litters. Low U/R index should be a distress signal for a farmer, because it contributes substantially to economic efficiency of the culture.

Similar conclusions can be drawn from the index of young reared through nursing period, per female, per year (O/R), which on average was 1.85 on this farm. This index was lowered by the mortalities during the nursing period (19% on the average). The most frequent deaths (over 25%) were recorded in 1998, which in conjunction with the low number of litters attained this year—resulted in the index value of 1.69 young per female, per year. In 2000 the highest number of young were born (2.04 on the average) and the highest number of litters per female (1.31). According to Jarosz et al. (1996), in Poland the average, annual ratio of the young reared through the nursing period was 2.5 per female of a brood stock in well maintained chinchilla farms. Barabasz (1997) insists that in Poland, despite the higher potential, a female gives some 2 young, on the average. According to Gromadzka-Ostrowska (1998) the fecundity of chinchillas is low, amounting to 2.2–2.8 young per female, per year and the mortality of new-borns, up to the 2nd year of life, reaches 20–22%. In selected farms of Polish Western Pomerania, according to Sulik et al. (1995), the fecundity was 1.7–2.4 births per female, while the number of young reared successfully through the nursing period was 1.5–2.09. The above authors considered such results as relatively high ones, but at the same time the mortality rate was also high and it ranged from 6.6 to 22.6%.

The size of litters is a very significant parameter (Fig. 1), which has effect on the annual reproductive results of a farm. Female's potential is high, because, according to Jarosz et al. (1996) it is feasible to obtain four young in a litter, and the farm studied yielded 1.98 young per litter on the average. Despite the above believe, the litter size obtained can be considered satisfactory and not contributing to lower reproductive results of chinchillas on this farm, because it does not differ from literature data recorded on other chinchilla farms (Barabsz, 1997). The least numerous litters were recorded in 1999 (1.84), but no significant differences were observed between this parameter in consecutive years.

Mean number of births in a litter does not reflect the real reproductive results, which can be traced through analysis of the litter size distribution (Table 2). The most frequent were double litters (41.49%) and single ones (36.16%). More numerous litters

constituted 22.34%. Quadruple births constituted in all years studied a small fraction (1.56–4.35%) of all litters and this facts can be a key factor contributing to lower reproductive results on this farm. The above distribution was more favourable than that described by Gromadzka-Ostrowska (1998). According to the latter author the litters were single in most cases (47.2%) and rarely double (29.7%).
The above index can be improved by selecting for further culture, females giving multiple births.
Table 3 shows values of inter-birth intervals of females used for reproduction within 1997–2000. Classes for the inter-birth intervals were assumed for average duration of pregnancy, which can be 102 to 115 days (Jarosz 1996), the time of first estrus which is 35–62 hours after birth (Gromadzka-Ostrowska 1998), and the average interestrus period of 40–50 days. The first class (102–120 days) includes females covered immediately after birth, while the remaining classes—those remaining ones inseminated in later estruses. Their highest number was covered immediately after birth (31.03%) and this constitutes a very good result, giving evidence about effective reproductive usage of females. It is also clear that females, which were not covered immediately after birth are usually inseminated as late as in the 3rd estrus after birth (27.59%).

Recapitulation

The present study demonstrated that indices of breeding usage in the stock investigated attained moderate levels. They were lowered substantially by high percentage of infertile females, therefore females producing no offspring within one year should be eliminated from the stock in order to improve the reproductive results.

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Table 1.
Basic reproductive indices of the stock within 1997–2000

Parameter	1997	1998	1999	2000	Total
Annual average number of females in basic stock	55	83	112	140	390
Number of infertile females	12 21.8	15 18.1	28 25.0	28 20.0	83 21.3
Total number of litters	62	96	128	184	470
Mean number of litters per female	1.13^{A}	1.16^{B}	1.14^{C}	1.31^{ABC}	1.21
Number of young born: Females Males Sex ratio (F : M)	117 58 59 1: 1.02	186 86 100 1:1.16	236 118 118 1:1	350 157 193 1:1.23	889 419 470 1:1.12
Mean number of young per litter	1.89	1.94	1.84	1.9	1.89
Mean number of young born by a female in a year	2.15	2.25	2.1	2.5	2.29
Number of young reared through nursing period	101	140	194	286	721
Mean number of young reared through nursing period in a litter	1.63^{A}	1.46^{A}	1.52	1.55	1.53
Mean number of young reared through nursing period by a female in a year	1.84	1.69^{A}	1.73	2.04^{A}	1.85
Mortalities during nursing period	17 14.4	47 25.1	41 17.4	64 18.3	169 19.0

Table 2.
The litter size within 1997-2000

Litter size	Single		Double		Triple		Quadruple		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
1997	23	37.1	25	40.32	12	19.35	2	3.23	62	13.19
1998	27	28.13	50	52.08	17	17.71	2	2.08	96	20.43
1999	51	39.84	48	37.5	27	21.09	2	1.56	128	27.23
2000	69	37.5	72	39.13	35	19.02	8	4.35	184	39.15
Total	170	36.16	195	41.49	91	19.36	14	2.98	470	100

Table 3.
Distribution of inter-birth intervals of chinchilla females within 1997–2000

Length of inter-birth intervals (in days)	102-120	121-160	161-200	201-250	251-300	Above 300	*Total*
No.	90	23	80	38	18	41	290*
%	31,03	7,93	27,59	13,1	6,21	14,14	100

5. Symposiums and congresses etc.

Nordic Association of Agricultural Scientists

Subsection for Fur Animals

Autumn meeting 8-10 October 2003

At the annual meeting recent research results and other scientific activities will be presented. The scientific program begins in the afternoon of October 8, and will be concluded before noon on October 10. In case you wish to stay for more than two nights please contact the hotel.

Where:
Radisson SAS Lillehammer Hotel, Turisthotelveien 6, 2609 Lillehammer, Norway (www.lillehammerhotel.no)
Nearest airport: Oslo Airport Gardermoen, approx. 120 km
Train service directly from Oslo Airport Gardermoen to Lillehammer

Price:	**Single room**	**Double room**
NJF members:	3.300 NOK	2.800 NOK
Non-members:	3.800 NOK	3.300 NOK

Registration:
Not later than 20 June 2003
To Lars.Christensen@ihf.nlh.no

Payment:
Not later than 1 September 2003
To NJF-Subseksjon for pelsdyr, Institutt for Husdyrfag. P.O. Box 5025, 1432 Ås, Norway, Account No. 8120-10-46971
Bank address: Fokus Bank, Moerveien 2, 1430 Ås, Norway
Please state name of participant

Oral presentations and posters are to be announced not later than 15 May 2003. Final manuscripts written in English and including summaries in English are to be submitted electronically (MS Word) before 1 September 2003 to Lars.Christensen@ihf.nlh.no . Contact person is Lars Christensen, Institutt for Husdyrfag, P.O. Box 5025, 1432 Ås, Norway. Tel.: +47 64 94 79 62.

See you in Lillehammer!

Meeting at the Danish Institute of Agricultural Sciences, Research Centre Foulum, on 25 September 2002 on the subject:

Quality skins from healthy mink

The meeting hosted ten presentations on the topics:

- Feed composition
- Feeding
- Management
- Genetics
- Behaviour
- Welfare and health
- Quality of hair and skin

Quality skins from healthy mink. Background, contents and course of research efforts

C. F. Børsting

The research efforts in the project "Quality skins from Healthy Mink (Mink Chain)" are part of a major research programme "Future Animal Production with a high level of Product- and Environmental Quality". The background for initiating the research efforts was a desire of accomplishing joint efforts in relation to the production of quality skins based on healthy animals fed in way, which minimizes the environmental strain.

The 5 project titles are:

- Selection for kit growth considering the welfare of the female
- Feeding strategies and nutrient utilization
- Protein synthesis and composition of skin and hair
- Feeding and metabolic disorders in mink
- Product quality. Composition and functional properties

Results from all 5 projects will be presented at the Project Day, from which it will appear that essential knowledge of significant importance to research as well as in practice has been achieved in all projects. In addition, the results have been published in 47 Danish articles, 24 articles in international scientific journals with a review procedure as well as in 28 other international scientific articles.

The effects of the winter diet on behaviour, welfare and performance of mink females

Birthe M. Damgaard & Steffen W. Hansen

The effects of traditional and alternative feeding strategies on mink females' body weight and behaviour were investigated in female kits from August 2000 to June the following year. The investigation included 180 females divided into three groups. From October 16 to February 18 one group (group ADL) was fed conventional wet mink diet ad libitum, another group (group SUB) was fed ad libitum as group ADL, but was offered a substantial diet from December 22 to February 18. The third group (group RE) was fed a conventional diet restrictively. The females were weighed approximately every second week and behavioural observations were made using focal sampling before and after feeding from December to March. Restrictive feeding stimulated stereotypic activity. The weight of stereotypic females was lower than the weight of non-stereotypic females from September 20. Changing the level of energy in the feed may be a useful parameter for regulating the weight loss in mink without at the same time stimulating stereotypic activity.

Effects of dietary composition and feeding strategy on health and performance of mink females

Birthe M. Damgaard, Christian F. Børsting & Rikke Fink

During the period, in which the mink has been bred as a domestic animal in animal husbandry the number of kits per female has increased considerably. In Denmark, approximately 5 kits per mated female were weaned in 2001. In nature, the mink delivers 2 to 3 kits per litter.
An increased number of kits per litter increases the need for milk production of the female, and thereby the female's need of nutrients. The energy

consumption of the females during the lactation period is lower than the energy requirement resulting in mobilisation of energy deposits in the females. Thus, a risk of metabolic disturbances, related reduced mink production as well as nursing diseases exists.

During the period 1997-2002 we have performed investigations in females during the winter, gestation, and lactation periods. The overall purposes of the experiments have been to elucidate the correlation between milk production, metabolism, feed consumption and mobilisation of body reserves. A further purpose has been to elucidate the correlation between milk production and metabolic diseases. The effects of different feeding strategies and different energy ratios of metabolisable energy derived from protein, fat and carbohydrates have been investigated.

The health and the performance of the females have been described through blood analyses, changes in the body weight of females, behaviour observations, clinical observations, number of kits per female, and kit growth.

The investigations have shown that the mink females are very robust to variations in the dietary composition and to different feeding strategies. Furthermore, the health and the performance of the females could not be described by means of one parameter, and therefore detailed health descriptions should include more parameters.

Coming investigations in mink females have to focus on how we can secure a good reproduction result and at the same time take care of the welfare and the performance of females during the winter as well as the health and the performance of females and kits during the lactation period.

Can mink, as a strict carnivore, utilise carbohydrates?

Rikke Fink , Christian Friis Børsting and Birthe Marie Damgaard

Increased litter sizes place higher energetic demands on the lactating dam, and usually voluntary feed intake is insufficient to meet nutrient demands for maintenance and milk production. Thus, since protein metabolism is an energetically expensive process surplus protein supply should be avoided, especially during the lactation period where an adequate glucose supply is essential for milk secretion. However, the mink is a strict carnivore and therefore the objective of these experiments was to investigate the lactating mink's capability to utilise glucose and thereby maintain glucose homeostasis when fed carbohydrate-free or high carbohydrate levels. The dams (3*18) nursing 6 kits were fed ad libitum from parturition on diets with different ratios of metabolisable energy (ME) derived from protein:fat:carbohydrate (Exp. 1: 61:37:2, 46:37:17, 31:37:32; Exp. 2: 61:38:1, 47:52:1, 33:66:1 and Exp. 3: 32:67:1, 32:52:16, 32:37:31). Four weeks post partum the dams were catheterised. The dams were fasted for 3 hours and then fed 210 kJ ME of the experimental diets. Two hours postprandially a single dose of 50µCi U-^{14}C- og 2-^{3}H-labelled glucose was administred to each dam. Blood samples were drawn 5 and 10 min. before feeding and 30, 60, 90, 120, 125, 130, 140, 150, 165 and 180 min. postprandially. The main findings were the following: 1) Lactating mink are capable of synthesising sufficient amounts of glucose to support a normal glucose flux even when fed carbohydrate free diets, however, then they are depending on the availability of sufficient gluconeogenic precursors in the form of amino acids. 2) Simultaneously, the lactating mink are capable of utilising digestible carbohydrates of up to 32% of the total ME, without critically elevated plasma glucose concentrations. These findings demonstrate that the mink has a high activity of the gluconeogenic enzymes, but also a large glycolytic capacity, and thereby a high ability to adapt to variations in dietary protein and carbohydrate supply. Thus, there are no physiological obstacles in considering the dams increased glucose requirement during lactation by reducing the protein and increasing the content of digestible carbohydrates in the diet.

Direct response by selection on early kit growth.

Hansen, B.K. & Berg. P., 2002.

Correlated response in dam weight changes by selection on early kit growth.

Hansen, B.K. & Berg. P., 2002.

Behaviour in breeding mink females selected for early kit growth

Jens Malmkvist & Bente Krogh Hansen

The aim of the present study was to investigate whether selection for early kit growth affected (i) the reaction of the breeding females towards their kits early in the period of lactation and (ii) the welfare of the breeding females.
The selection procedure and animal material is described in Hansen & Berg (this volume). Each year 1998-2001 on day 5 (± 2 days) after giving birth, all females were observed directly for 10 min. to count number of shifts between nest box and cage, and tested for kit retrieval. The amount of activity, stereotypic and fur chewing behaviour was observed the last year of selection (2001) as indicators of welfare.
Older females reacted quicker and more often compared to young females in the kit retrieval test (e.g. latency times in 2001: 2-year-old females 25 [12-55] sec., 15.5% not reacting versus 1-year-old females 46 [27-72] sec., 26.9% not reacting; $p<0.001$). However, there was no difference between females of the three breeding lines in the reaction towards their own kit. The kit mortality for the tested animals was within the normal range of 16.0-25.8% of the litter from birth until weaning. The prevalence of fur chewing differed between the three lines ($p=0.038$, N=419) in September. Line 53 (selected for the mother's ability to determine growth in kits) had more fur chewing on both the tail- and body region in comparison with the two other lines ($P=0.003$).
We conclude that the selection not has resulted in obvious changes in the maternal reactivity towards kits in the first period after birth. Data on stereotypic behaviour are under analysis. Present results indicates that the breeding females of line 53 may experience reduced welfare, since they had more fur chewing on tail and body before fur moulting the last year of selection.

Possibilities of reducing methionine content in the feed during the furring period

B. Riis & C. F. Børsting

Methionine is the first limiting amino acid in regard to fur development and quality in mink. Therefor, it is likely that the requirement varies between the growing and furring periods. We addressed this question by using the breath test method where the proportion of methyl-^{14}C-labeled methionine expired as CO_2 in the respiration air was tested. Additionally, the incorporation of the label in different organs was measured. The tests were done in the early growth period (3rd to 12th of July) and during the winter fur synthesis period (8th to 24th of October). 3 levels of methionine equal to 70%, 85% and 100% of the present Danish recommendation (0.160 g digestible methionin/100 kcal.) were given to the male mink kits. Two levels of betain (4.4 and 17.2 mg/100 kcal.) were given for each level of methionine. In July as well as in October the proportion of $^{14}CO_2$ in the expiration gasses increased with increasing dietary level of methionine. In October, increasing levels of betaine led to elevated proportion of $^{14}CO_2$ in the breath. When it comes to the incorporation into the organs it was found that the liver was independent of both the season and the nutrition. The incorporation into muscle and skin were highest in July when the kits were growing fast. During this period increased amounts of methionine as well as increased betaine amounts in the feed caused lower incorporation of label. Hence, the amount of methionine can be reduced by additional supply of betaine because the methyl group from these two products has the same effect. Therefor, the amounts of methionine may be reduced if the betaine level is increased during the furring period, where methionine is the limiting amino acid. Combined, this indicates that is possible to reduce the total amount of protein in the mink feed if betain is given as a supplement. This will reduce both the environmental nitrogen load and reduce the feed prices.

Objective colour measurement applied on brown mink - Estimation of genetic variation.

Hansen, B. K., Rasmussen, P. V. & P. Berg, 2003.

Traditionally colour intensity and clarity are visually graded. A method for objective measuring of colour on skin is developed on Research Centre Foulum. This article describes a trial to validate this method, by comparing results from measures on the dorsal

side of live animals, on kits or adults in December-January, and dorsal and ventral side on dried skins, when measuring is conducted either WITH or AGAINST the guard hair direction. Results from 1103 animals and 858 skins are included from the period 1997 to 1999. The animals represent a large range of the subjective grading scores of clarity. The objective method results in four parameters: lightness, red colour and yellow colour and croma (saturation). Each colour is measured 10 times per animal per round. The repeatability coefficients are based on the 10 repeated measurements. Heritabilities, genetic and phenotypic correlations are estimated on the basis of the means of each trait per animal or skin, respectively. Red and yellow colour and croma, respectively, can be measured with high repeatability on live animals and on dried skins (r^2 ~ 0.32-0.80). In all four objective traits the measuring results are higher on the ventral side of the skin. Intermediate to high heritabilities (h^2 ~ 0.25-0.58) were found for red and yellow colour and for croma. Heritability of lightness on skin was also intermediate to high (h^2 ~ 0.30-0.56), but low for measures on live animals (h^2 ~ 0.10-0.12), where environmental effects are more pronounced.

I all estimations the genetic correlations are higher than the phenotypic ones. High genetic correlation is found between measures: WITH and AGAINST guard hair direction, on live animals and dried skin, and on dorsal and ventral side. The lowest genetic correlation was found for lightness measured on the dorsal side of live animals and measured on the ventral side of the dried skin.

It is concluded that the presented objective method has reliable repeatability both when used on live animals and on the dried skin. The objective traits for colour show high heritabilities when measured on skin and medium high heritabilities when measured on live animals.

The effect of pelting time on pelt quality in mink

Steen H. Møller

Danish mink farmers tend to pelt their mink at their prime in order to get the best quality and skin length possible. However research has shown that the skin length and the stretchability of the skin do not change within the pelting season from mid November to mid December. In order to investigate the effect of pelting time on fur quality, two groups of 25 brown males were pelted at their prime (approx. November 15th) or two weeks later (approx. December 1st). Weight at pelting and skin length was measured and two official pelt graders graded the fur quality. The investigation confirmed that the date of pelting has no effect on skin length or elasticity. On average, the pelt quality was somewhat better at the latest pelting date. This was due to two of the six farms, while there was no difference in pelt quality between the two dates of pelting on the other four farms. It is concluded that when the pelt is prime, the actual date of pelting within the pelting season has no significant effect on neither pelt quality nor skin length. The mink farmer may therefore plan the pelting season relative to feed cost, manpower, capacity and other relevant factors.

6. New Books

Faglig Årsberetning

2002

Pelsdyrerhvervets Forsøgs- og Rådgivningsvirksomhed

Annual Report

2002

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Reports on: Behaviour

Selection for and against stereotypy in mink

Jeppesen, L.L., Hansen, B.K., Pedersen, V. & T. Simonsen

Selection in two lines for and against stereotypy in mink was started in 2001 on the basis of a P-generation consisting of 495 females. These females were born in year 2000 and they delivered a litter in 2001. The frequency of stereotyped behaviour in the P-generation was established in October 2001. The 75 most stereotyping P females gave rise to line 92

(high stereotypy) while the 75 least stereotyping gave rise to line 91 (low stereotypy). In both lines 1-3 female kits and at the most one male kit were taken from each of the litters delivered by the P-females in 2001; in total 150 females and 30-35 males were chosen to each line of the F1 generation. F1 animals were tested for behaviour in February and in October 2001. They were weighed at weaning (kits age 56 days), in October and in November. The F2 animals, born in 2002, were weighed at weaning and in November. The F1 females in line 91 performed less stereotyped behaviour and were more in the nest than females from line 92. They were also heavier and they weaned fewer kits. The fraction of P females that gave rise to line 91 were also more in the nest, were heavier and weaned fewer kits. The weight of the F2 animals did not differ significantly between the two lines, maybe because stereotypies are weakly if at all developed in November. The selection procedure appears to have a considerable impact on aspects of the adult animals biology.

Annual Report 2002, 7-11. Danish Fur Breeders' Research Center, Holstebro, Denmark.

Mink behaviour towards humans. Influence by direct and indirect genetic effects

Berg, P., Hansen, B. K., Malmkvist, J. & S. W. Hansen

The behaviour of mink is inherited and is influenced by the genotype of the mother and the cage mate. Records from a 12-year selection experiment for confident or timid behaviour are analysed. In total 23397 observations for reactions towards humans in stick test and 9063 behavioural scores using Trapezov hand test are analysed for direct and indirect genetic effects. Both direct and indirect genetic effects, i.e. effects of the genotype of the dam and the cage mate, can be modelled and affect the behavioural responses. Confident and timid behaviour in the stick test have intermediate heritabilities (h^2~0.21-0.22), while the heritability in the hand test is slightly higher (h^2~0.28). Heritabilities of the indirect effects of dam and cage mate are low (h^2~0.02-0.12), but significant. This confirms that not only the genotype but also the environment can evolve.

Annual Report 2002, 13-16. Danish Fur Breeders' Research Center, Holstebro, Denmark.

Reports on: Breeding and Reproduction

Objective colour measurement applied on brown mink - Estimation of genetic variation

Hansen, B. K., Rasmussen, P. V. & P. Berg

Traditionally colour intensity and clarity are visually graded. A method for objective measuring of colour on skin is developed on Research Centre Foulum. This article describes a trial to validate this method, by comparing results from measures on the dorsal side of live animals, on kits or adults in December-January, and dorsal and ventral side on dried skins, when measuring is conducted either WITH or AGAINST the guard hair direction.
Results from 1103 animals and 858 skins are included from the period 1997 to 1999. The animals represent a large range of the subjective grading scores of clarity. The objective method results in four parameters: lightness, red colour and yellow colour and croma (saturation). Each colour is measured 10 times per animal per round. The repeatability coefficients are based on the 10 repeated measurements. Heritabilities, genetic and phenotypic correlations are estimated on the basis of the means of each trait per animal or skin, respectively. Red and yellow colour and croma, respectively, can be measured with high repeatability on live animals and on dried skins (r^2 ~ 0.32-0.80). In all four objective traits the measuring results are higher on the ventral side of the skin. Intermediate to high heritabilities (h^2 ~ 0.25-0.58) were found for red and yellow colour and for croma. Heritability of lightness on skin was also intermediate to high (h^2 ~ 0.30-0.56), but low for measures on live animals (h^2 ~ 0.10-0.12), where environmental effects are more pronounced.
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It is concluded that the presented objective method has reliable repeatability both when used on live animals and on the dried skin. The objective traits for colour show high heritabilities when measured on skin and medium high heritabilities when measured on live animals.

Annual Report 2002, 17-22.Danish Fur Breeders' Research Center, Holstebro, Denmark.

Reports on: Nutrition and Feeding

Reduced protein for scanblack mink females during winter- and lactation periods

Clausen, T.N. & C. Hejlesen

To the investigation we used tree groups each consisting of 155 standard black females per group. The control group (61) was feed a high amount of protein (50% of the metabolizable energy) in the entire investigation period from January until day 42 in the lactation period. Group 62 and 63 were feed 30% of the metabolizable energy from protein until February 25 from thereon group 62 was feed like the control group and group 63 was feed 40% of the metabolizable energy from protein.
Feeding standard black female mink with 30% of the metabolizable energy from protein until February 25 and thereafter 40% of the metabolizable energy from protein, gave the same litter size and kit weights as feeding 50% of the metabolizable energy from protein in the entire period.

Annual Report 2002, 23-25. Danish Fur Breeders' Research Center, Holstebro, Denmark.

Carbohydrate sources for mink in the nursing period

Clausen, T.N., Hejlesen, C., Sørensen, H., Bjergegaard, C., Mortensen, K. & C. Christiansen

Eight groups each consisting of 125 scanblack female mink, were used in an investigation on different carbohydrate sources in the nursing period. Investigation feed was used in the period from Feb 22 until day 42 in the lactation period. The feed to group 2 contained 40 % of the metabolizable energy (ME) from protein, feed to the other groups contained 45 %. The amount of ME from carbohydrates was 15 % in the groups 1 and 2, versus 20 % in the other groups. The carbohydrate sources to groups 1, 2 and 3 were heat treated barley and wheat (1:1). To groups 4, 5, 6, 7 and 8, heat treated barley or wheat, wheat starch, crumbled maize and maize starch were used.
Between groups feed 40 or 45 % of ME from protein and half barley half wheat as carbohydrate source there were no difference in reproduction results and kit weights. Using different carbohydrate sources in the nursing period, had no significant effect on the number of kits per litter at birth and day 42. The weight of the kits day 42 differed, the group feed crumbled maize had significant lower kit weights at day 42 than the other groups. The composition of the starch fraction (especially amylopectin) is a possible explanation to the lower growth results.

Annual Report 2002, 27-31. Danish Fur Breeders' Research Center, Holstebro, Denmark.

Meat and bone meal to mink during the growing period

Clausen, T.N., Sandbøl, P. & C. Hejlesen

Five groups each consisting of 162 male- and 162 female mink kits were fed increasing amounts of meat and bone meal (0 – 3 – 6 – 9 and 12 percent). Addition of more than 3% meat and bone meal in the feed caused a decreasing body weight gain with increasing amount of meat and bone meal in the period from July to September 3. From September to pelting the weight increase was greatest in the groups with the highest meat and bone meal content. When the content of meat and bone meal in the feed was above 3%, skin length was reduced with increasing content of meat and bone meal. The colour of the skins turned reddish when there was 12 percent meat and bone meal in the feed perhaps due to a relatively low content of Phenylalanin and Tyrosin in the feed. The results indicate that we can not use more than 3 percent meat and bone meal in the feed from July to the start of September, thereafter we can probably increase the content without negative consequences for the animals.

Annual Report 2002, 33-37. Danish Fur Breeders' Research Center, Holstebro, Denmark.

Poultry offal combined with swine pulp and meat and bone meal during the growing- furring period

Clausen, T.N. & C. Hejlesen

To the investigation in the growing- furring period we used 6 groups of scanblack mink kits, each group consisting of 156 males- and 156 females. Poultry offal imported form Germany was used in the feed in amounts of 0, 10, 20, 30, 40 and 50%. The amount of fish in the feed was reduced with increasing amount of poultry offal, and in the group with 50% poultry offal there were no fish offal, industrial fish or fish silage. All diets contained 3% meat and bone meal and 6% swine pulp.
The results showed that body growth, skin length and skin quality were reduced with high amounts of poultry offal in the feed. It is possible to use 30% of poultry offal in the feed in the growing- furring period without reducing the skin length. However the skin quality was reduced with more than 20% of poultry offal in the feed, when the feed at the same time contained 3% meat and bone meal and 6% swine pulp.

Annual Report 2002, 39-42. Danish Fur Breeders' Research Center, Holstebro, Denmark.

The influence of the essential to non essential amino acids ratio to mink during the growing period – production results

Clausen, T.N. & P. Sandbøl

To the investigation we used 7 groups each consisting of 138 male- and 138 female wildtype mink. The control group (K25) meet the requirements of essential amino acids for growth and pelt formation with 25% of the Metabolizable Energy (ME) from protein. The proportion between essential (EAS) and total amino acids (TAS) EAS/TAS was 0.52. From the K25 feed mixture we made two other mixtures with 29% and 33% of ME from protein, with the same feed raw materials as in K25 and where the EAS/TAS were also 0.52. To the K25 feed we made two other groups by adding a mixture of essential amino acids up to a content of 29% of ME from protein (EAS29) and up to 33% of ME from protein (EAS33). The increase in EAS/TAS in these groups was 0.58 to 0.62. To the K25 feed we also made two groups by adding a mixture of non essential amino acids up to a content of 29% of ME from protein (IEAS29) and up to 33% of ME from protein (IEAS33). The decrease in EAS/TAS in these groups was from 0.46 to 0.41.
There was in this investigation no positive effect on skinlength and fur quality of increasing the amount of ME from protein from 25 to 29 or 33 percent. Addition of non essential amino acids to the K25 feed mixture had a positive effect on the growth of the animals. Fur quality was reduced by addition of essential and non essential amino acids.

Annual Report 2002, 43-49. Danish Fur Breeders' Research Center. Holstebro, Denmark.

Digestibility of feed ingredients at mink kits and adults – a comparison
Hejlesen, C.

The aim of the trials reported herein, was to examine the age (7-10 week) dependant development in digestibility of feed ingredients (Fish Offal, Swine Pulp and Meat and Bone Meal) having different adult levels of nutrient digestibilities.
The age dependant ability to digest protein seemed to be dependant of the adult level of digestibility. Data were too limited to be conclusive, but it suggested that the ability increased linear from week 7 to week 9 of age, when the adult level was high (85%). At a low level of adult digestibility (65%), the kits ability to digest protein was constant in this period.
The lower adult ability to digest fat from Meat and Bone meal compared to fat from Swine Pulp was strengthened at 7 weeks of age. From week 7 to 9 of age the ability increased linear, most radical for fat from Meat and Bone Meal. From the linearity the adult level of fat digestibility was calculated to be reached at the age of about 11 weeks.
It is concluded that the mink kits ability to digest protein and fat at 7 and 9 weeks of age is inferior to the level of adults.

Annual Report 2002, 51-57. Danish Fur Breeders' Research Center, Holstebro, Denmark.

Digestibility trials on feed in vivo on mink

Hejlesen, C. & H. N. Lærke

In a project co-operated between Danish Fur Breeders Research Center (DFBRC) and Danish Institut of Agricultural Sciences (DIAS), DFBRC has carried out several digestibility trials on feed ingredients used in the danish production of mink feed. Most ingredients were representative, but not all. The ingredient content of dry matter, crude

protein, fat, ash and carbohydrate, amino acids, and relevant apparent digestibilities is presented.
The results is to be used when updating the "Råvaretabel", which is used by the danish central feed kitchens producing mink feed.

Annual Report 2002, 59-64. Danish Fur Breeders' Research Center, Holstebro, Denmark.

Reports on: Physiology and analytical techniques

An in vitro method for estimating protein digestibility in mink feed

Lærke, H. N., Boisen, S. & C. Hejlesen

An *in vitro* method for estimating protein digestibility in mink feed has been developed. The method simulates the degradation of the feed in the stomach and small intestine during incubation with pepsin at pH 3.0 for one hour and pancreatic enzymes at pH 6.8 during 24 hours, respectively. The incubations are performed with small samples of about 1 g dry matter and with physiologically relevant enzyme concentrations at 37^0C and with constant stirring. After N analyses of the sample and the undigested residue, respectively, the content of digestible crude protein in the sample is calculated. The final incubation conditions were settled after systematic analyses of samples from representative feedstuffs, all determined for their *in vivo* digestibility in mink experiments.
On the basis of statistical analyses of the determined *in vitro* enzyme digestibility of N (EDN) and the chemical composition of the feedstuffs the following prediction equation for the apparent protein digestibility in the mink was determined:
Protein digestibility (%) = 0,853 x EDN (%) - 0,523 x ash (% of dry matter) + 0,865 x N (% of dry matter) + 4,58 (n = 35; r^2 = 0,91; rsd = 3,1).
A corresponding equation for the concentration of apparent digestible crude protein from enzyme digestible crude protein (EDP) was also determined:
Digestible crude protein (% of dry matter) = 0,933 x EDP (% of dry matter) - 0,285 x ash (% of dry matter) + 0,082 x CP (% of dry matter) - 1,27 (n = 35; r^2 = 0,99; rsd = 1,7).
The equations given above demonstrate a good general relationship between *in vivo* and *in vitro* determined values for digestible protein across the most conventional feedstuffs. Further analyses of a number of samples from former digestibility experiments revealed that the method was also suitable for determining the variation within the the groups of feedstuffs.
A table including all investigated feedstuff samples from new as well as old digestibility experiments with mink was generated. The table include chemical composition and values of protein digestibility determined *in vivo* and predicted from *in vitro* analyses, respectively.

Annual Report 2002, 65-75. Danish Fur Breeders' Research Center, Holstebro, Denmark.

Measurement of Particle Size on Humid and Dried Cereal Samples

Hejlesen, C.

Particle size fractionation were performed in 27 samples of ground cereals (wheat, winter- and spring barley). Differences in dry matter content of the samples were caused by processing (moisturing and heat treatment).
The investigation showed, that a fractionation analysis performed on humid ground samples of cereals gave an erroneous measurement of particle size compared to analysis performed on dried up samples
In investigations, where size of ground cereal particles is relevant, fractionation should consequently be performed in dried up samples.

Annual Report 2002, 77-80. Danish Fur Breeders' Research Center, Holstebro, Denmark.

Application of RT-PCR for diagnosis of distemper in mink and foxes

Hammer, A. S., Andersen, T. H. & H. H. Dietz

The application of new molecular techniques for routine detection of distemper virus at the Danish Veterinary Institute may reduce analysis time in future distemper outbreaks without loss of sensitivity and specificity. The application of reverse transcriptase polymerase chain reaction (RT-PCR) for detection of morbillivirus nucleic acid in internal organs of Danish fur animals with suspected distemper infection was the aim of this study. 149 mink and three foxes with suspected canine distemper infection were subjected to macroscopic,

histological and virologic examination. Immunofluorescence testing, S3-staining and RT-PCR were applied to biological samples collected from all of the mink and foxes. The diagnosis of mink distemper was assigned to 53 mink. 53 mink were found positive for distemper virus antigen by the immunofluorescence method, 51 mink were found positive by S3-staining for distemper virus inclusion bodies. 54 mink were found positive for morbillivirus nucleic acid (the phosphoprotein (P9 gene of canine distemper virus) by the RT-PCR method. No foxes were diagnosed with distemper. All foxes were found negative by both immunofluorescence, S3-staining and RT-PCR methods. Under the assumption that a true diagnosis was determined on the basis of anamnestic information, pathologic examination, immunofluorescence and S3-staining, we determined the sensitivity (98,1 %) and specificity (98,0 %). of the RT-PCR method. Furthermore, the specificity was confirmed by the sequencing of genetic material obtained from PCR products from 22 mink. All sequenced products showed close genetic homology with canine distemper virus (CDV). We conclude that the RT-PCR is a sensitive and specific method for detecting the phosphoprotein (P) gene of CDV in internal organs of Danish fur animals, and a potential alternative or supplement to the diagnostic methods currently applied to suspected distemper cases at the Danish Veterinary Institute.

Annual Report 2001, 133-139. 5 figs, 5 tables, 11 refs. Danish Fur Breeders' Research Center, Holstebro, Denmark.

Reports on: Health

Investigation of Pulvex (permethrin, 1%) to new borne mink kits

Clausen, T.N.

This investigation was made to assess the safety of 1 % permethrin (Pulvex) dusting powder to mink kits at the age of less than one day. 1 % permethrin dusting powder was administered in the nest to 20 litters at dose rates of 5 g per litter (2 x recommended use dosage). A further group of 20 litters were left untreated as control. There was no negative effect on the number of kits 1 day, one and three weeks after the treatment, and no signs of linical toxicity were seen in any of the treated animals.
It is concluded within the limits of this trial that 1 % permethrin dusting powder should be safe for use on new borne mink kits (less than one day old).

Annual Report 2002, 85-86. Danish Fur Breeders' Research Centre, Holstebro, Denmark.

Molecular typing and antimicrobial resistance testing of *Pseudomonas aeruginosa* isolated from clinical infections in mink

Hammer, A. S., Pedersen, K., Dietz, H. H. & T. H. Andersen

Isolates of *Pseudomonas aeruginosa* from clinical infections in mink were subjected to serotyping and pulsed-field gel electrophoresis (PFGE) using *Spe*I as restriction enzyme to assess the discriminatory power of molecular typing for epidemiological studies of *P. aeruginosa* infections in this species. A total of 168 isolates from mink obtained from 74 farm outbreaks of haemorrhagic pneumonia during the years 1998-2001 were included in this study. Isolates were separated into 34 distinct clones by PFGE typing. All isolates from mink infected during the same farm outbreak were identical, except in one case where two different sero- and PFGE types were isolated. *P. aeruginosa* of specific PFGE types were found to cause clusters of outbreaks on several farms during a short time span of a few weeks. PFGE types of strains causing such clusters of farm outbreaks changed from year to year. These results support a hypothesis that outbreaks of haemorrhagic pneumonia are caused by pathogenic strains of *P. aeruginosa* being spread between farms and animals either mechanically or feed- or waterborne from a common source, rather than by random nosocomial infections with strains from the farm environment.
Furthermore, antimicrobial resistance testing was performed on isolates obtained from the same 74 farm outbreaks of haemorrhagic pneumonia and 45 isolates obtained from infections in dogs and poultry during the years 1998-2001. The isolates showed multiresistency towards 10 of 13 tested antimicrobials. There was a tendency towards larger sensitivity among isolates from mink compared to isolates from other species. This tendency was obvious in two antimicrobials: enrofloxacin and gentamicin. There was no development in the pattern of resistance through the 4 year period.

Annual Report 2002, 87-92. Danish Fur Breeders' Research Center, Holstebro, Denmark.

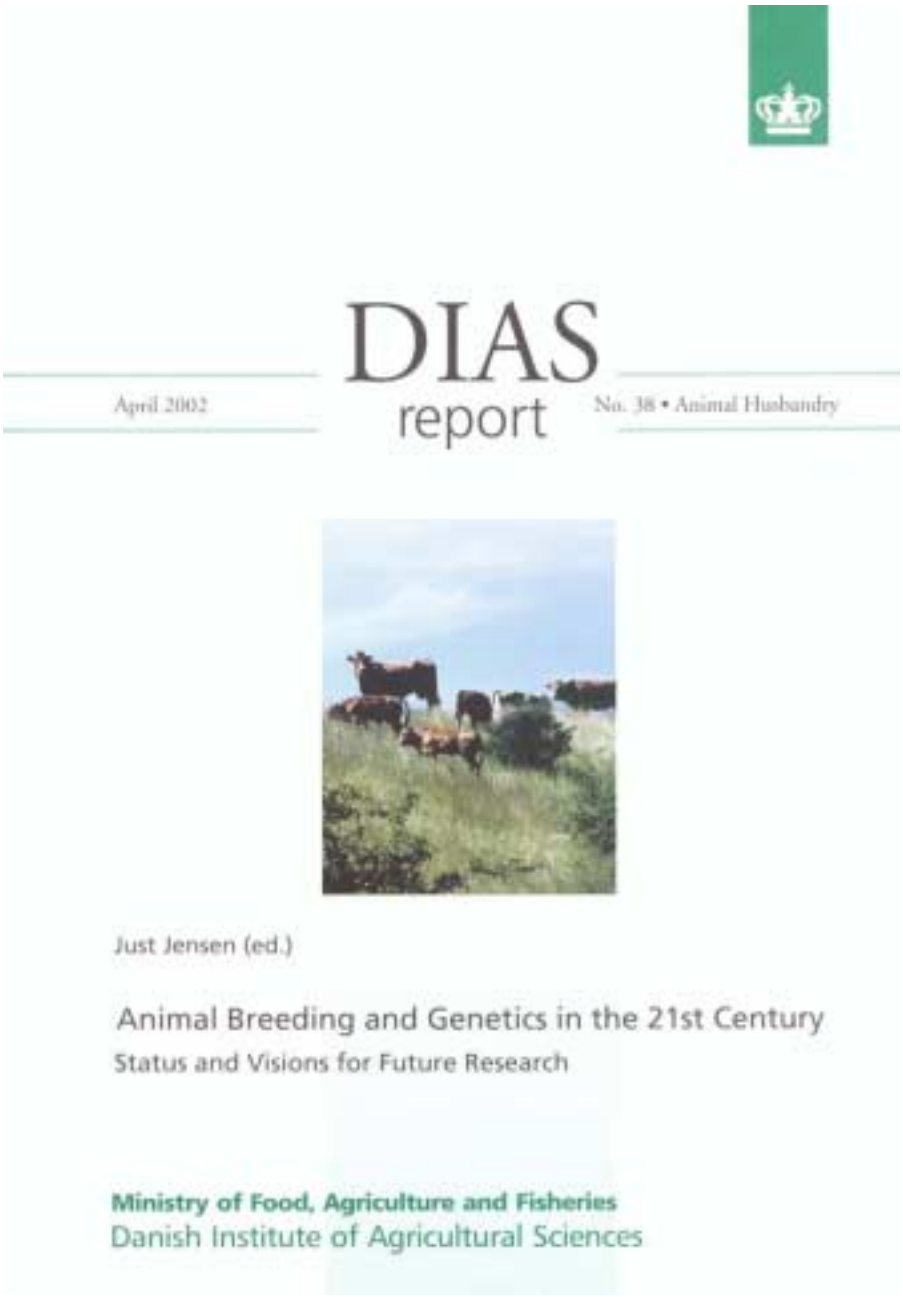
Molecular characterisation of a novel astrovirus associated with disease in mink

Mittelholzer, C., Hedlund, K.O., Dietz, H.H. & L. Svensson

Pre-weaning diarrhoea is a well known problem in mink farming in Europe causing morbidity that varies between farms, regions and season. Recently, we have identified a novel astrovirus as an important risk factor (Englund et al., 2002). Here we describe shortly the molecular characterisation and discuss origin and evolution of this novel astrovirus of mink (detailed analyses are submitted in the form of a manuscript to Journal of Virology). The polyadenylated positive-stranded RNA genome was sequenced and found to contain 6610 nts organized into three open reading frames and two short untranslated regions. The genome contains sequence motifs for a serine protease in ORF1a and a RNA-dependent RNA polymerase in ORF1b. The structural proteins are encoded by ORF2 and presumably expressed as a polyprotein precursor to be cleaved into the mature capsid proteins. These results indicate that mink astrovirus has all features typical for the members of the *Astroviridae*. Phylogenetic analyses revealed that mink astrovirus is distantly related to established astroviruses, most closely related to sheep astrovirus. Sequence analysis of mink astroviruses from geographically distinct Swedish and Danish farms showed much less diversity. This suggests either the spread in the mink population of a virus that has evolved a long time ago, or the recent introduction of an ancient virus into a new host species.

A series of strategies were applied in order to express the capsid as a recombinant protein. Recent results show that the capsid protein was expressed in the baculovirus system and that it could be purified by affinity chromatography. This opens a range of possibilities and represents the first steps towards diagnostic tools suitable for screening and last but not least the highly desired vaccine.

Annual Report 2002, 93-99. Danish Fur Breeders' Research Centre, Holstebro, Denmark.



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The first serious attempts of farming mink and foxes took place in Canada, Russia and USA. The hunters were afraid of eradicating wild fur animals, so the goal was to feed and reproduce them in captivity. The first farmed foxes came to Denmark in the 1920-ies and mink were imported from Canada in the 1930-ies. Because of access to fresh waste products from the fish industries, fur farms were established in the North, West and South of Jutland. Availability of feed and suitable climate have

promoted fur farming and today 2650 Danish farmers produce 12 million of the world production of 28 million mink pelts. Mink have been farmed for around 50 generations, which in human terms is commensurate with going back to the times of the Vikings.

Colour genetics has played a major role in early fur production. In mink production there was a great enthusiasm about new colour types, from the first mutant, silverblue, in 1931. Knowledge about the genetics of colour came from both the farmers' experiences and from the scientists. In the Nordic countries the production of mink mutations was at its highest in the 1960/70-ies and of fox mutations in the 1980-ies (Lohi, 1993).

However, live animal shows drew the breeder's attention also to quantitative traits already in the early times of fur animal farming. Because of induced ovulation, the efforts to use artificial insemination on mink have not been successful and thus the number of offspring per male is limited. This has resulted in breeding within farms with limited exchange of breeding animals between farms. The breeding goal has therefore also been defined at the farm, based mainly on the information from the fur auctions. Traditionally the farmers have considered litter size, body size and overall fur quality as the most important traits in the breeding goal.

Breeding is complicated due to the lack of objective methods to measure especially fur traits and the fact that most important traits are measured on pelts. Farmers grade the live animals and based on breeding values for fur quality, clarity, and colour together with breeding values for body weight and reproduction results, breeding animals are selected.

The Department of Animal Breeding and Genetics on DIAS has participated in several projects regarding fur production both on describing traits and genetic parameters of traits related to the 'income side' and of traits related to the production costs. Better methods for the prediction of breeding values have been developed and implemented and guidelines for optimising breeding schemes have been developed. In the following sections a review of developments in the genetics of mink is presented. First areas related to qualitative genetics, where the former Department for Research in Fur Animals established a population of different colour mutants of mink and foxes. The population was used in testing the inheritance of colours and fur characteristics, and futhermore in establishing a preliminary genomic map of the American mink (Brusgaard, 1998).

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