SCIENTIFUR

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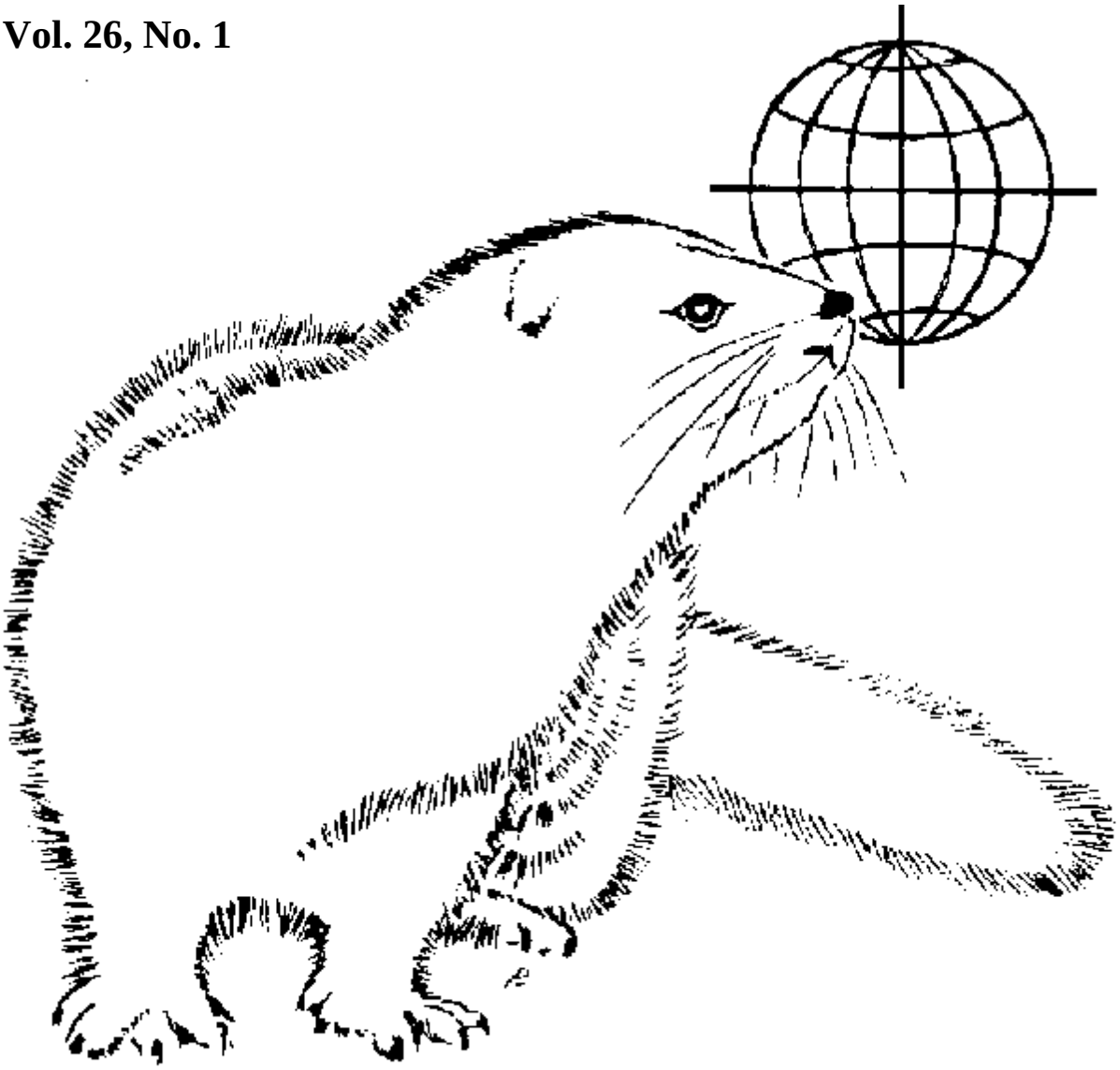

IFASA

INTERNATIONAL FUR ANIMAL SCIENTIFIC ASSOCIATION

SCIENTIFUR - scientific information in Fur Animal Production.

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Notes from the Group of Editors

This version of Scientifur is the first issue of volume 26. As volume 25, this volume will be published electronically as well as in a paper version.

We hope that all our subscribers have received the paper version of volume 25. If not, please, contact our treasurer or one of the members of our Group of Editors. Please note that the issue containing only reviewed articles was printed with a blue front cover whereas the other issues appeared in yellow.

In this issue we bring you – among a number of other abstracts - abstracts from the 7th World Congress on Genetics Applied to Livestock Production, held in Montpellier, France, August 19–23, 2002. These abstracts were all presented at a session at the Congress containing information and scientific results of interest for those involved in fur animal production.

With a view to a brief mention in Scientifur, we would like to invite our readers to submit proceedings from congresses and seminars with relation to fur animal production, and, as always, we also look forward to receiving articles for reviewing, short communications, abstracts and letters on fur animal production.

We hope you will enjoy reading this issue of Scientifur, however, if you have any ideas or suggestions for improvement, we are always open to hear from you.

On behalf of the
Group of Editors

Birthe Damgaard

Prof. Dr. Keiji Kondo

At the age of 63, Prof. Dr. Keiji Kondo retired from Hokkaido University, March 2002. His new address is as follows:

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Multidisciplinary

An assessment of British farmers' and gamekeepers' experiences, attitudes and practices in relation to the European polecat *Mustela putorius*

J.J. Packer, J.D.S. Birks

Postal questionnaires were distributed to farmers and gamekeepers within the Polecat's *Mustela putorius* main range in Britain. Only 11% of responding farmers had ever experienced damage by Polecats; 28% regarded the species as a threat to livestock. Conversely 53% of farmers believed Polecats control Rabbits *Oryctolagus cuniculus*, and 39% believed they control rodents on the farm. Two-thirds of responding gamekeepers had experienced Polecat predation of penned game, with the commonest access routes via 'pop-holes' and beneath the perimeter wire. Most gamekeepers (68%) regarded the Polecat as a minor pest, but ranked it as a less serious threat to game than predators such as the *Fox Vulpes vulpes*, Feral Cat *Felis catus*, Stoat *Mustela erminea*, corvids and Mink *Mustela vison*.

Majorities of both farmers and gamekeepers would be concerned about an increase in the numbers of Polecats, and most wished to be free to control the species. Trapping was regarded as the main defence against Polecat predation of game; 91% of gamekeepers had trapped Polecats over the preceding 5 years. A minority of farmers carried out Polecat control; this activity was more prevalent on farms near the fringe of the species' range. Pest-control practices likely to impact accidentally or indirectly upon Polecats, such as rodenticide use, fumigation ('gassing') of Rabbit burrows and ferreting, were also more prevalent on farms towards the fringe of the species' range.

These findings are discussed in the light of the Polecat's status as a Scheduled species recovering its range in Britain. In anticipation of the species' further spread into areas where game shooting is prevalent, recommendations are made regarding the need to improve game husbandry and to modify trapping practice. In particular, the night-time closure of pop-holes and the effective exclusion of Polecats from tunnel traps are suggested as a means of promoting greater tolerance of Polecats and compliance with the law.

Mammal Rev., 1999: 29, 75-92, 2 figs, 10 tables, 49 refs.

Clarcutting and burning of northern spruce-fir forests: implications for small mammal communities

T.P. Sullivan, R.A. Lautenschlager, R.G. Wagner

1. This study was designed to test the hypotheses that (i) abundance and related demographic parameters of small mammal populations would decline after clear-cutting of northern spruce-fir forest, and (ii) prescribed burning, following clear-cutting, an approach to emulating natural disturbance, would enhance the species richness and diversity of the small mammal community relative to unharvested and clearcut forests.
2. Intensive live-trapping of small mammal populations was conducted in replicated forest (uncut), clearcut and clearcut-burned sites from 1988 to 1992 in west-central British Columbia, Canada.
3. Mean abundance of southern red-backed volves *Clethrionomysgapperi* was significantly higher on forest sites (11.74 ha^{-1}) than on clearcut (0.60 ha^{-1}) or clearcut-burned (0.02 ha^{-1}) sites. Mean numbers of deer mice *Peromyscus maniculatus* were significantly higher on the clearcut-burned sites (16.88 ha^{-1}) than on forest sites (9.04 ha^{-1}). Demographic parameters of reproduction, survivial and body weight of deer mice were similar across all sites.
4. The long-tailed vole *Microtus longicaudus*had a strong annual fluctuation in abundance, particularly on clearcut sites (14.04 ha^{-1}), where there were significantly more animals than on either forest (1.53 ha^{-1}) or clearcut-burned (2.67 ha^{-1}) sites. Meadow voles *M. pennsylvanicus* were relatively uncommon but occurred more often on clearcut and clearcut-burned sites than on forest sites.
5. The north-western chipmunk *Tamias amoenus* occurred at significantly higher numbers on clearcut (4.16 ha^{-1}) and clearcut-burned (3.88 ha^{-1}) sites than on forest sites, where it was rarely captured. Shrews *Sorex* spp. Were at similar numbers across forest, clearcut and clearcut-burned sites. Weasels *Mustela*spp. Were captured more often on clearcut and clearcut-burned sites than on forest sites. A rare species, the western jumping mouse *Zapus princeps*,

was captured on clearcut and clearcut-burned sites only.
6. Mean species richness of small mammals was significantly higher on clearcut sites (3.51) than on forest (2.73) or clearcut-burned (2.72) sites. Species diversity was similar over all sites. Although species composition was altered by clearcutting, abundance of all species, except *C. gapperi*, was the same or higher than that in uncut forest.
7. Prescribed burning of clearcuts may not be necessary to mimic natural disturbance regimes. Clearcutting of northern spruce-fir forest may provide diverse habitats for small mammals through different stages of succession (along with old growth forest) much as wildfires formerly did.

Journal of Applied Ecology, 1999: 26, 327-344, 7 figs, 6 tables, 68 refs.

Validation of a cell culture bioassay for detection of petroleum exposure in mink (*Mustela vison*) as a model for detection in sea otters (*Enhydra lutris*)

M.H. Ziccardi, J.A.K. Mazet, I.A. Gardner, W.M. Boyce, M.S. Denison

Objective: To validate a luciferase bioassay, which is based on a recombinant mouse hepatoma cell line, for the detection of exposure to petroleum in mustelid species.

Animals: 122 American mink (*Mustela vison*) and 15 sea otters (*Enhydra lutris*).

Procedures: Mink were exposed to Bunker C fuel oil or Alaska North Slope crude oil externally as a single exposure or internally via low dose concentrations in their ration for 6 months. Serum samples were analysed for cytochrome P450 1A1 induction by quantification of luciferase activity in the bioassay. Mink liver specimens were also evaluated for cytochrome P450 1A1 induction by quantification of ethoxyresorufin-o-deethylase activity. Serum collected from exposed and unexposed sea otters was also analysed using the luciferase bioassay.

Results: Serum samples from mink externally exposed to petroleum had significantly increased luciferase activities at 1 week after exposure. Serum samples taken at later time points or from mink exposed to either product in the ration did not cause significant luciferase induction. Samples from otters exposed to petroleum had significantly higher luciferase induction as compared with samples from otters not exposed to petroleum at 2 and 8 years after the spill. Cytochrome P450 1A1 activity in liver specimens collected from mink that were internally exposed through diet was significantly increased at the conclusion of our study.

Conclusion and clinical relevance: The luciferase bioassay is a sensitive and specific method for determining recent exposure to petroleum in mink. The lack of luciferase activity in serum samples collected from mink greater than 1 week after experimental exposure was likely attributable to lower overall petroleum exposure in our trial, compared with natural exposures.

American Journal of Veterinary Research, 2002: 63, 963-968, 4 figs, 1 table, 37 refs.

Behaviour and welfare

How do adolescents perceive wire floor in fox cages?

M. Harri, T. Rekilä

The wire-mesh netting used as the floor material in cages is often claimed to cause walking problems for foxes. The validity of this claim was tested in 96 15-year-old secondary school pupils. They were shown five separate 2 min fragments of videotapes showing the cage pairs with randomized floor material (solid or wire mesh) but with an obstructed view of the floor. The pupils were asked to evaluate the flooring material based on what they actually saw. The mean proportion of correct answers out of 5 for individuals were slightly more than half correct (0.54), but this did not differ significantly from the random value (0.5). When the pairs of foxes had different flooring material, the pupils answered correctly (0.58, $P < 0.05$). Thus, the pupils were not able to identify a specific floor type (wire-mesh or solid floor) but were able to differentiate between two different types of floor based solely on the behaviour of the foxes.

Acta Agric. Scand., Sect. A, Animal Sci. 2001: 51, 253-256, 2 tables., 10 refs.

The application of a temperament test to on-farm selection of mink

S.W. Hansen, S.H. Møller

The welfare of production animals can be improved by adapting the production system to the needs of the animals and/or by selecting those animals best adapted to the production system. As no documented improvements of mink welfare resulting from altered housing are readily available, a temperament test (the stick test) is now being applied for use under commercial farm conditions. The test, categorising the mink as fearful, exploratory or aggressive when a stick is inserted into the cage, has been developed and used for selection under experimental conditions. It has been demonstrated that the temperaments categorised in the stick test are related to reactions in novel object and intruder tests as well as to cortisone response to handling. In order to facilitate the use of the stick test in practice, it has been simplified and implemented on six Danish mink farms. On average, 60% of adult mink females were characterised as exploratory in August, but the percentage differed between farms. After 30 minutes of training, the farmers were able to perform the stick test with 74-100% agreement in results with an experienced tester. In order to improve welfare at farm level, a selection line of 200 exploratory females is established on each farm for the mating season in March 2000. During the first three years of selection, the effects of the behavioural selection on other welfare indicators, such as health, behaviour and production, will be monitored.

Acta Agric. Scand., Sect. A, Animal Sci. 2001: Suppl. 30, 93-98, 3 figs, 4 tables, 21 refs.

The type of operant response affects the slope of the demand curve for food in mink

S.W. Hansen, M.B. Jensen, L.J. Pedersen, L. Munksgaard, J. Ladewig, L. Matthews

The behavioural priorities of farm animals may be quantified by demand functions generated by use of operant conditioning techniques. However, there are several aspects of this method that still need to be investigated in more detail. The aim of this study was to investigate the effect of operant response type on the demand function for food in mink. The responses examined were pressing a lever and pulling a chain. The experiment was conducted with eight mature female mink. During each of two periods, the mink were tested in four replicates of successively increasing fixed ratio (FR)-values (4, 8, 16, 25, 60, 80 and 100). The rewards were available for 24 h per day and each reward consisted of 0.5 g of food. Half of the animals worked on the lever in the first period and on the chain in the second period, the other half of the animals vice versa. The mink were weighed regularly throughout the experiment. The behaviour of the mink was video recorded continuously for 24 h on the days when they were working on FR levels 4, 40 and 100.

The number of rewards and thereby the amount of food earned decreased as the FR-values increased for all animals. The demand curve for food obtained by chain pulling was steeper than the demand curve obtained by lever pressing ($P<0.001$). The results show that the response type can influence the slope of demand functions. One reason for the difference in slopes of the demand curves could be that the unit price paid on the chain and on the lever at a given FR-value was not the same, even though the minimum force required was 35–40 g for both types of response.

The slope of the demand curve for food in mink was much steeper than previously found in mice, rats, pigs and hens. This is most likely due to the combination of high FR-values and small rewards in relation to the foraging strategy in mink. High levels of stereotypies were related to high workloads on

the chain. The mink had a more restricted food intake and a higher level of stereotypies when working on the chain than when working on the lever. Frustration caused by a combination of high FR-values, small rewards and hunger may explain the significant increase in stereotypies.

Applied Animal Behaviour Science, 2002: 76, 327-338, 5 figs, 26 refs.

Water absorption and the drying and cooling rates in mink (*Mustela vison*) following simulated diving

H.T. Korhonen, P. Niemelä

The aim of the present study was to evaluate water absorbing capacity and the drying and cooling rates of fur in farmbred male mink (*Mustela vison*) following 10 s of simulated diving. Comparisons were made between adult animals with summer and winter fur. The water loss from a swimming pool following diving in summer amounted to 146 (s.e. 14) g and 152 (s.e. 9) g in dry and wet mink, respectively ($P > 0.05$). During winter the corresponding values averaged 148 (s.e. 9) and 125 (s.e. 7) g, respectively (not significant: $P > 0.05$). No significant differences between summer and winter were found for dry mink. In wet-coated mink, on the other hand, water loss from the swimming pool was significantly greater ($P < 0.05$) in summer than in winter. Drying of the fur was slow and significantly ($P < 0.05$) affected by season so that half of the 100 g water absorbed by fur evaporated within 20 min during winter (at -2°C) whereas in summer (at +18°C) it took 60 min. A slower drying rate in summer could be beneficial as it allows long-term body cooling in warm environment. Cooling constants of winter-coated dry mink (0.01955 (s.e. 0.00183) per min) were not significantly different ($P > 0.05$) from those of winter-coated wet mink (0.02091 (s.e. 0.00144) per min) indicating that energy costs of wet fur after diving are not critical for the survival of the mink during winter.

Animal Science, 2002: 74, 277-283, 2 figs, 1 table, 37 refs.

Time budget as related to feeding tactics of European polecat *Mustela putorius*

T. Lodé

The time budget of five male and four female European polecats was studied in western France through radiotracking surveys. Their activity level averaged 7 h and 31 min without any significant differences between males and females. However two phases, foraging and travelling, were not similarly distributed in both sexes. Despite a strong sexual dimorphism, females spent more time foraging than males. Travelling, i.e. time devoted to linear movements was more important in males than females. Variations in activity phase duration were correlated with the proportions of food categories, suggesting that the dispersion of available resources directly influenced polecat activity. The exploitation of prey showing an aggregative distribution such as anurans led to a decrease in general activity whereas the consumption of rodents, which were more regularly distributed, was correlated to the foraging activity. Mating and breeding also affected the activity duration. Thus it seems that the time budget of polecats resulted from a compromise between social organization and trophic constraints.

Behavioural Processes, 1999: 47, 11-18, 4 tables, 43 refs.

The impact of American mink *Mustela vison* on water birds in the upper Thames

P. Ferreras, D.W. MacDonald

1. The effect of mink predation on water birds during the breeding season was studied between March and September 1996 in a 33-km long stretch of the upper Thames river, England.

2. Mink presence significantly affected the density of breeding coots and the number of chicks hatched per pair of coots, as well as the average number of nests per pair of moorhens and the percentage of moorhen clutches hatched.

3. Mink diet during the birds' breeding season (March-September) was studied through scat analysis. Ralliformes (coots or moorhens) represented 10% of the ingested biomass and were

the fourth prey in importance after rabbits (45%), fish (25%) and small mammals (14%). Mink obtained 11% of their energy requirements from coots and moorhens.

4.Impact of predation by mink during the bird breeding season was moderate to high for moorhens (16-27% of adults and 46-79% of broods) and high for coots (30-51% of adults and 50-86% of broods).

5.Although moorhens seem well adapted to withstand predation by mink, nesting behaviour by coots make them very vulnerable to mink predation. We hypothesize that the persistence of coot populations in areas with high mink density requires immigration from surrounding populations with lower mink impact.

Journal of Applied Ecology, 1999: 36, 701-708, 2 tables, 42 refs.

The use of trapping records to monitor populations of stoats *Mustela erminea* and weasels *M. nivali*: the importance of trapping effort

R.A. McDonald, S. Harris

1. Trapping and hunting records are frequently used as an index of animal abundance. This study demonstrates that these records can be misleading if sampling effort is not controlled for.

2. Mean numbers of stoats Mustela erminea and weasels M. nivalis trapped by British gamekeepers have been decreasing since 1975 and 1961 respectively, giving rise to concern that populations of both species may be declining. However, trapping effort has not been quantified over this period.

3. A total of 203 gamekeepers in England were questioned about the trapping effort they expended and the number of stoats and weasels they trapped in 1997. The most significant factor affecting the number of stoats and weasels trapped was trapping effort.

4. Gamekeepers that relied on hand-rearing game birds for shooting regarded stoats and weasels as a less serious problem, and made substantially less trapping effort, than gamekeepers that relied on wild game birds.

5. The national decline in the numbers of stoats and weasels trapped may be the result of a decline in stoat and weasel populations. However, the decline is equally consistent with a reduction in trapping effort, corresponding to a national increase in reliance on hand-rearing game birds for shooting.

6. When the effect of trapping effort was controlled for, the number of weasels trapped by gamekeepers in 1997 was significantly lower in the south-west than in other regions of England and was unusually low in some local areas.

7. Trapping records can be used effectively to monitor populations of stoats and weasels, as long as gamekeepers record the number of traps set in each month and monthly totals of animals killed. Ideally, the sex of each animal and whether it was trapped or shot should also be recorded. Similar modifications should also be made to other wildlife monitoring schemes based on trapping and hunting records.

Journal of Applied Ecology, 1999: 36, 679-688, 5 figs, 4 tables, 44 refs.

Breeding, reproduction, genetics

Testicular mitosis, meiosis and apoptosis in mink (*Mustela* vison) during breeding and non-breeding seasons

S. Blottner, H. Roelants, A. Wagener, U.D. Wenzel

Testes of mink were compared between the breeding (March) and non-breeding seasons with the start (November) and cessation (May) of spermatogenic activity. Testicular mass and spermatozoa per gram testis were assessed. Percentages of haploid (1C), diploid (2C) and tetraploid (4C) cells were monitored using DNA flow cytometry and the proportions of somatic and spermatogenetic cells were determined after selective labelling of somatic cells with a vimentin antibody. Apoptosis was examined by cell death detection ELISA, and testosterone concentrations were measured with an enzyme-immunoassay. The significantly higher testis mass during the breeding period coincided

with higher numbers of testicular spermatozoa per gram testis and peak of testicular testosterone concentration in comparison with non-breeding periods. The proportions of 1C, 2C and 4C cells showed corresponding strong differences between these periods with the maximum of 1C cells during breeding. The proportions of testicular cells in G2-M phase of mitosis were very low during the period of peak spermatogenesis; they were markedly increased in the time of autumnal resumption in November but were even higher during testis involution in May. However, the meiotic transformation (1C:4C ratio) is maximal in March. The total as well as the relative proportions of spermatogenic and somatic cells differed significantly not only between breeding and non-breeding periods but also between the periods at the start and at the end of active spermatogenesis. The intensity of apoptosis was also seasonally dependent. The highest level in March indicates a stimulated apoptosis even during the breeding period. In conclusion, the production of spermatozoa in mink is intensified by enlargement of gonads as well as enhanced efficiency of spermatogenesis during breeding. In this time, the testosterone concentration and the meiotic transformation show high levels, but the mitotic activity of spermatogenic cells is already significantly diminished and an intensified apoptosis seems to precede the forthcoming testis involution after breeding. The results suggest that the regulation of seasonal testicular activity is characterised by co-ordinated shifts in the relationships between mitosis, meiosis, apoptosis and testosterone production.

Animal Reproduction Science, 1999: 57, 237-249, 6 figs, 43 refs.

Geographical variation in genet (*Genetta genetta L.*) diet: a literature review

E. Virgós, M. Llorente, Y. Cortés

The geographical variation in the Genet *Genetta genetta* L. diet was analysed from 12 locations covering its entire range. Data were obtained from the available literature on food studies in this species. We studied the general food spectrum of this species and compared the importance of different prey items in each area through PCA analysis. The possible influence of some large-scale environmental factors (latitude, altitude, Mediterraneity) on diet were studied by means of regression analysis and ANOVA. The study assessed the frequency of occurrence of each prey group and diet diversity. Results show the existence of two 'food' groups: (i) Genets which feed on a wide food spectrum, especially arthropods and (ii) Genets which feed on small mammals at a high frequency, while the remaining prey items are scarce or absent. At the intraspecific level, Genets behave as generalist species, with the small mammals (especially, the Woodmouse) as the most outstanding prey item. However, when compared with the diet of other medium-sized Palaearctic carnivores, we can say that the Genet is intermediate between typical generalists (Martens *Martes* spp., Red Foxes *Vulpes vulpes* and Badgers *Meles meles*) and specialists (Otters *Lutra lutra*, Stoat *Mustela erminea* and Weasel *Mustela nivalis*). Finally, ANOVA shows the existence of a relationship between diet diversity and Mediterraneity (associated with taxa such as arthropods, reptiles and amphibians), but no relationship was found for latitude or altitude. The importance of interspecific competition, based on island data, is discussed.

Mammal Rev., 1999: 29, 119-128, 1 fig, 3 tables, 48 refs.

Microsatellite markers for American mink (*Mustela* vison) and ermine (*Mustela erminea*)

M.A. Fleming, E.A. Ostrander, J.A. Cook

The North Pacific coast of North America is a region of high mammalian endemism. There is concern about the conservation of many insular taxa because of limited distributions and the potential impact of disturbances such as clear-cut logging and introductions of exotic species (MacDonald & Cook, 1996). Among these endemic taxa are American mink (*Mustela vison*) and ermine (*Mustela erminea*) subspecies that are considered 'potentially threatened' by the IUCN due to limited information available on their population status and taxonomic validity (Schreiber et al., 1989).

Microsatellite markers are useful tools for assessing genetic variability within and among populations (Haig, 1998). We report here on the development of

microsatellite markers to assess genetic differentiation among mink and ermine populations in southeast Alaska and coastal British Columbia.

Molecular Ecology, 1999: 8, 1352-1354, 2 tables, 7 refs.

Estimation of genetic parameters and genetic trends for litter size components using Bayesian inference in rabbits

J.A. Ortega, A. Blasco, M. Piles, L. Varona

A divergent selection experiment on uterine capacity was realized with unilaterally ovariectomized does. Ovulation rate (OR) and implanted embryos (IE) were counted in the second gestation by using laparoscopy technique. Uterine capacity (UC) as litter size at birth was recorded up to fourth parity in most does. Multivariate Bayesian framework was used to estimate the genetic responses. Heritability of OR, IE and UC were 0.36, 0.21 and 0.10. Genetic correlation between OR-IE was 0.93, OR-UC 0.55 and IE-UC 0.68. Selection on UC was effective (1.4 rabbits) and a correlated response for OR and IE was founded (0.7 ova and 1.0 embryos). The genetic determination of OR suggests that, in rabbits, litter size can be improved through selection on ovulation rate.

7th World Congress on Genetics Applied to Livestock Production, August 19-23, 2002, Montpellier, France, Session 04. Poultry and rabbit breeding, Abstract of No 04-09.

Analysis of litter size traits in a three line diallel cross in rabbits

M. Baselga, M.L. García, J.P. Sánchez, J.S. Vicente, R. Lavara

A complete diallel cross has been carried out involving three rabbit maternal lines, A, V and H, selected for litter size. The experiment, carried out in a commercial farm involved 1119 does, approximately equally distributed between the nine types of does. The recorded traits were the total number of young born, the number of born alive and the number of still born per litter, and the interval between kindlings (3759 records). A repeatability animal model was used and minimum square contrasts of the solutions of the effects of the type of doe were used to get estimates of differences between direct genetic effects and maternal genetic effects of the lines, and individual heterosis between the lines. Favourable heterosis (4-10%) has been found for prolificacy traits in the crosses of line A with line V and H, being the heterosis very dependent of the performance and history of the lines involved.

7th World Congress on Genetics Applied to Livestock Production, August 19-23, 2002, Montpellier, France, Session 04. Poultry and rabbit breeding, Abstract of No 04-10.

Inventory, characterisation and conservation of European rabbit genetic resources

G. Bolet, M. Monnerot, U. Besenfelder, S. Bösze, S. Boucher, N. Ferrand, G. Hewitt, T. Joly, S. Lechevestrier, M. Lopez, G. Masoero, W. Van Der Loo, J. Vicente, G. Virag

In Europe, more than 60 breeds are registered by the associations of rabbit breeders. A European program aimed at a comprehensive description of these breeds and at evaluating ten of them (Argenté de Champagne, Belgian Hare, Chinchilla, English, Fauve de Bourgogne, Flemish Giant, French Lop, Himalayan, Thuringer, Vienna White) based on both genetic diversity and zootechnical characteristics. A data bank has been created (http://www.tihohannover.de/einricht/zucht/eaap/).

Characterisation of genetic diversity indicated a strong genetic differentiation between breeds together with some structuring within the breeds. Reproductive performances were generally low. A large diversity with respect to growth, carcass and meat traits was evidenced. A cryobank of about 1900 embryos was initiated.

7th World Congress on Genetics Applied to Livestock Production, August 19-23, 2002, Montpellier, France, Session 04. Poultry and rabbit breeding, Abstract of No 04-11.

Crossbreeding effects for post-weaning growth, rectal and ear temperatures and respiration rates in crossing Saudi Gabali with Spanish V-line rabbits

M.H. Khalil, K. Al-Sobayel, I.H. Hermes, A.H. Al-Homidan

Direct (HI) and maternal (HM) heterosis, direct (GI) and maternal (GM) additive effects and direct recombination effects (RI) were estimated for body weights (BW), rectal (RT) and ear (ET) temperatures and respiration rates (RR) in crossbreeding project involving V-line (V) and Saudi Gabali (G) rabbits. Six genetic groups (V, G, ½G½V, ½V½G, ¼V¾G and ¾V¼G) were produced. ¼V¾G rabbits had higher BW compared to other crossbreds. No significant differences were observed between the six genetic groups regarding RT, ET and RR. The estimates of GI and GM for BW were in favour of V-line rabbits. The estimates recorded for physiological parameters were very low. HI and HM were positive and significant for some BW, while non-significant estimates were recorded for physiological parameters.

7th World Congress on Genetics Applied to Livestock Production, August 19-23, 2002, Montpellier, France, Session 04. Poultry and rabbit breeding, Abstract of No 04-12.

Effect of selection on body size at fixed age on muscle characteristics in rabbit

F. Gondret, C. Larzul, S. Combes, L. Cauquil, B. Darche, H. de Rochambeau

A divergent selection experiment on body weight at 63 days of age was carried out over 5 generation in rabbit. Differences between heavy (HW) and low (LW) lines were studied on 40 males per line for growth traits, carcass composition and muscular characteristics. A large influence of selection was found for body weight at 63 days of age (+16%) in HW compared with LW, carcass weight (+14%) and perirenal fat percentage (+23%). It was found that selecting weight at fixed age influenced fibre hypertrophy, without changing fibre hyperplasia. No significant differences between lines were found for intramuscular fat, ultimate pH or mechanical toughness measured on a single muscle. It was concluded that at the same age, heavy or light animals had similar properties, and meat quality at fixed age should be lowly affected by weight selection.

7th World Congress on Genetics Applied to Livestock Production, August 19-23, 2002, Montpellier, France, Session 04. Poultry and rabbit breeding, Abstract of No9 04-39.

Estimation of crossbreeding parameters for average daily gain, feed intake and feed conversion ratio in five rabbit lines

E.A. Gómez, M. Piles, J. Orengo, O. Rafel, J. Ramon.

Crossbreeding parameters of average daily gain (ADG), collective feed intake (FI) and feed conversion rate (FCR) were estimated in a diallel crossbreeding plan concerning five selected lines of rabbits. Direct genetic effects for ADG were clearly different between sire and dam lines (R (3.03 g/d) and C (2.26 g/d) vs. A (-3.28 g/d), and R vs. V (-1.49 g/d)). With respect to FI, differences on direct genetic effects were observed between lines A (-5.39 g/d) and V (2.67 g/d). Posterior distributions of maternal genetic and individual heterosis effects were distributed around zero, being insignificant the differences between lines for almost all the parameters. Therefore, differences between crossbreeding genetic types for these traits in rabbits are mainly explained in terms of direct genetic effects.

7th World Congress on Genetics Applied to Livestock Production, August 19-23, 2002, Montpellier, France, Session 04. Poultry and rabbit breeding, Abstract of No 04-40.

Characterisation of a local population of rabbits in Algeria: Reproductive performance of the does

N. Zerrouki, M. Berchiche, G. Bolet, F. Lebas

A total of 159 females and 30 males of an Algerian local population was studied at the University of Tizi-Ouzou over 4 years. The females were put in

reproduction at the age of 4.5 months in natural mating with a theoretical rhythm " 42 days ". The females are characterized (average ± standard deviation) by a rather low prolificacy at birth and weaning (7.3±2.5 born of which 5.6±3.0 born alive and 5.5±2.3 weaned), with receptivity and fertility rates of 80±38% and 70±45% respectively. The adult weight of the females at mating (at the 2nd or 3rd litter) was 2890±377g. The hot summer season did not seem to affect the fertility and litter size at weaning of the females. Together with growth data, these results will provide a definition of the objectives to be sought for creating and improving a breed of rabbit for meat.

7th World Congress on Genetics Applied to Livestock Production, August 19-23, 2002, Montpellier, France, Session 04. Poultry and rabbit breeding, Abstract of No 04-41.

Relation between litter size and kappa casein genotype in inra rabbit lines

Zs. Bõsze, G. Bolet, Z. Mészár, Gy. Virág, E. Devinoy

The relation between κ-casein genotype (2 alleles A and B) and litter size was explored in 809 births of 223 crossbred rabbit does, daughters of AB dams and AA sires. 83 of them were AA and 140 AB, this ratio was unbalanced and differed from the expected 1:1. There was a significant effect of κ-casein genotype of does on litter size at birth, in favour of AB females. The total number of young was higher by 0.75 ($P<0.016$) and the number of young born alive was higher by 0.82 ($P<0.008$). After standardisation of litter size at birth, there was no significant effect of κ-casein genotype on litter size at weaning. The casein genes are located close to each other and have been recently assigned to chromosome 15 in rabbits. Since it is not probable that κ-casein *per se* does influence prolificacy, comparative genome mapping experiments are in progress to identify a gene(s), which could be located in a nearby locus.

7th World Congress on Genetics Applied to Livestock Production, August 19-23, 2002, Montpellier, France, Session 08. Reproduction, Abstract of No 08-10.

Breeding for wool quality in apparel wool sheep

I.W. Purvis, A.A. Swan

This paper focuses on those quality traits for which there have been technological developments in the last decade, for which new price signals have emerged, or which show promise as new goals for breeding programs for apparel wool sheep. Increased production of fine wool has been accompanied by developments in on-farm testing which has had a major impact on breeding goals and strategies. Current breeding programs focussed on fibre diameter and fleece weight need to also consider staple strength. There are exciting new opportunities to develop new niche markets through the use of variation in novel quality attributes. Molecular technologies also offer the potential for genetic change that is not currently possible. The challenge for scientists is to develop the capability to link new technologies so that they become an integrated system using common technical language and focussed on commercial outcomes.

7th World Congress on Genetics Applied to Livestock Production, August 19-23, 2002, Montpellier, France, Session 12. Fibre and fur, Abstract of No 12-01.

Estimation of additive and dominance variances in wool production traits of Western Australian merino sheep

K.V. Konstantinov, F. D. Brien, J.C. Greeff

Additive and dominance genetic variances were estimated for greasy fleece weight (GFW), clean fleece weight (CFW), yield (Y) and fibre diameter (FD) in Western Australian Merino sheep. Additive heritability estimates were 0.34 ±0.02, 0.42 ±0.03, 0.54 ±0.05 and 0.55 ±0.08 for GFW, CFW, Y, and FD, respectively. Dominance effects explained 0.28 ±0.08 0.34 ±0.09 0.18 ±0.08 and 0.05 ±0.01 of the total variance for GFW, CFW, Y and FD, respectively. Common environmental variances were close to zero for all traits studied. These results suggest that most of the nonadditive genetic variance in the traits studied is accounted for by dominance genetic effects.

7th World Congress on Genetics Applied to Livestock Production, August 19-23, 2002, Montpellier, France, Session 12. Fibre and fur, Abstract of No 12-02.

Genetic variation of merino wool felting

J.C. Greeff, A.C. Schlink.

The inheritance of felting of wool and the genetic and phenotypic correlations with novel fibre traits were studied in a Merino resource flock. Felting is a complex trait and is significantly ($P<0.001$) influenced by average fibre diameter, fibre curvature, standard deviation of fibre diameter, standard deviation of fibre curvature, yield, blob percentage and standard deviation of fibre diameter along the fibre. The heritability of felt density was 0.62 ± 0.07 and when it was adjusting for the above mentioned traits it still had a heritability of 0.38 ± 0.07. These results confirm that felting, independent of the other wool traits, has a heritable component that implies selection for reduced wool felting should be possible without affecting the other wool traits.

7th World Congress on Genetics Applied to Livestock Production, August 19-23, 2002, Montpellier, France, Session 12. Fibre and fur Abstract of No 12-03.

Genetic parameters for reproduction and fleece traits for South Australian merino sheep

V.M. Ingham, R.W. Ponzoni

Phenotypic and genetic correlations between number of lambs weaned per ewe joined (NLW), clean fleece weight (CFW) and fibre diameter (FD), were estimated using REML. Data used were from the Turretfield Merino Resource Flock in South Australia. Different models were fitted to determine the effect of adjusting fleece records for lambing status. Phenotypic correlations were close to zero for all combinations of NLW, CFW and FD. Adjusting for lambing status reduced them further. Genetic correlations were low and negative between NLW and CFW, and decreased as age increased. Genetic correlations between NLW and FD were low and positive and changed little with age. Adjusting for lambing status generally decreased the estimates. Our results do not agree with assumed parameters in genetic evaluation services. We suggest that selection for CFW or FD could be detrimental to NLW.

7th World Congress on Genetics Applied to Livestock Production, August 19-23, 2002, Montpellier, France, Session 12. Fibre and fur, Abstract of No 12-04.

The use of weaning weight to adjust for pre-weaning environmental effects on bodyweight, fleece weight and fibre diameter in merino hoggets

D. J. Brown, A. Reverter

Weaning weight has been used as a proxy to adjust hogget performance records for the pre-weaning environmental effects of age, dam age, birth type and rearing type in experimental flocks. This study examines the accuracy of estimated breeding values produced from industry recorded data for hogget bodyweight, greasy fleece weight and fibre diameter using different models to adjust for pre-weaning environmental effects. These results support that hypothesis for fleece weight. However for the traits of hogget body weight and fibre diameter it appears that there may be some effects of birth type that are being over corrected. While pre-weaning effects do not explain a large proportion of the variation in these hogget traits they have a significant influence on the genetic parameters estimated.

7th World Congress on Genetics Applied to Livestock Production, August 19-23, 2002, Montpellier, France, Session 12. Fibre and fur, Abstract of No 12-05.

Predicted response to multiple trait selection when crimp frequency is included in a breeding objective for merino sheep

J.L. Smith, I.W. Purvis, A.A. Swan

Merino breeders are becoming more interested in crimp frequency (CF) as evidence increases for CF effects on wool processing. However, little is known about variation in CF, particularly in superfine sheep. Response to multiple trait selection was predicted for CF price premiums ranging from –20 to +20 %. Two selection strategies were examined, reflecting objectives where moderate and high emphasis was placed on decreasing mean fibre diameter (MFD) and maintaining staple strength (SS) while increasing clean fleece weight (CFW). There were no major adverse consequences for the rate of genetic gain in MFD and CFW if CF is included in the breeding objective. However, the potential for genetic change in CF is greater when there is relatively less selection emphasis on MFD and if the price premium for CF is negative.

7th World Congress on Genetics Applied to Livestock Production, August 19-23, 2002, Montpellier, France, Session 12. Fibre and fur, Abstract of No 12-06.

Genetics of furs and special fibres

O. Lohi

The paper will summarise the knowledge of genetic parameters of fur traits for most common fur animals and angora rabbits. Fur animals species *Mustela vison, Vulpes vulpes, Alopex lagopus, Chinchilla lanigera, Myocastor coypus* and the angora breed and fur breed *Castor rex* of the species *Oryctolagus lagopus* are included. Information is given about the heritabilities and genetic correlations between traits. The reliability of information from different sources, the information about the economic value of traits and possibilities to improve selection for fur traits are discussed.

7th World Congress on Genetics Applied to Livestock Production, August 19-23, 2002, Montpellier, France, Session 12. Fibre and fur, Abstract of No 12-07.

Inheritance of down hair and live weight for Inner Mongolia cashmere goats in China

H. Zhou, D. Allain

Inheritable potentials of down hair weight and live weight traits in Inner Mongolia cashmere goat were analyzed including heritability, genetic and phenotypic correlations and repeatability. Heritabilities were estimated with single trait model and the values were 0.28, 0.23, 0.32 and 0.10 for cashmere weight (CW), fiber length (FL), fiber diameter (FD) and live weight (LBW), respectively. Genetic correlation was assessed with multitrait model. There were low genetic and phenotypic correlation between CW, FL, FD and LW each other, ranging from the top of 0.44 between FD and LBW to the bottom of -0.19 between FL and FD, respectively. Repeatabilities estimated were 0.44, 0.40, 0.39 and 0.40, respectively. These genetic values provide a better basis or desirable predictor for selection schemes of stock animals, genetic improvement progress and breeding programs.

7th World Congress on Genetics Applied to Livestock Production, August 19-23, 2002, Montpellier, France, Session 12. Fibre and fur, Abstract of No 12-08.

Genetic variability of night melatonin blood levels in relation to coat changes development in rabbits

D. Allain, B. Malpaux, F. Puechal, R.G.Thebault, H. de Rochambeau, P. Chemineau

To assess the genetic contribution of variability in both the nocturnal increase pattern of melatonin levels (ML) and photoresponsiveness in coat changes, an experiment on 422 rex rabbit (from 23 males) raised under a constant light program from birth onwards was performed. Animals were sampled at 12 weeks of age, according to 4 periods over a year. Blood samples were taken 7 times over the night up to 1h after dawn. Fur maturity (FM) was assessed at pelting. Heritability estimates of ML (0.42, 0.17 and 0.13 at mid-night, 3 and 1h before dawn respectively) and strong genetic correlations between FM and ML at the end of the night indicate that variability of the night pattern of ML is under genetic control, and that duration of the night ML

increase is a genetic component of photoresponsiveness in coat changes.

7th World Congress on Genetics Applied to Livestock Production, August 19-23, 2002, Montpellier, France, Session 12. Fibre and fur, Abstract of No 12-09.

Favourable genetic correlations between maternal traits and dam weight changes during lactation exist in mink

B.K. Hansen, P. Berg.

Mink kits are born physiologically immature and are completely dependent of the dam during the first weeks of the suckling period. The objective of this study was to estimate the (co) variance for early growth of mink kits, for weight changes of the dam during lactation. Records of 9612 kits and 1296 yearling dams were included. The genetic variance of traits and the genetic correlations between traits were estimated using REML under an Animal Model. Heritability estimates for additive direct and additive maternal effects on early growth were
$h^2_d \approx 0.10$ and $h^2_m \approx 0.27$, respectively and $h^2_d \approx 0.36$ for dam weight changes from 1 to 4 weeks *post partum*. A genetic correlation between maternal effect on kit body weight and dam weight changes from 1 to 4 weeks *post partum* at $r_{md}=0.39$ was found.

7th World Congress on Genetics Applied to Livestock Production, August 19-23, 2002, Montpellier, France, Session 12. Fibre and fur, Abstract of No 12-10.

Relationship between feltability and other greasy wool traits and the association with the processing performance of fine/superfine merino wool

S.A. Barton, I.W. Purvis

Felt ball diameter (FBD), an indicator of a wool's propensity to felt, was determined for 269 animals. The mean FBD of wool with a mean fibre diameter of 17.8 ìm was 21.4 mm. The variation in FBD in fine/superfine Merinos wool is examined between bloodlines and within bloodlines. Bivariate analyses were carried out between FBD and greasy wool traits. The genetic correlation between mean fibre diameter and crimp frequency was moderate however, with a large standard error. If confirmed, these findings suggest that breeding programs focused on reducing MFD, may show correlated increases in propensity to felt. Weak positive, relationships were exhibited between FBD and processing characteristics. This is consistent with a hypothesis that a lower propensity to felt will be associated with longer tops.

7th World Congress on Genetics Applied to Livestock Production, August 19-23, 2002, Montpellier, France, Session 12. Fibre and fur, Abstract of No 12-11.

Microsatellite variation and population genetic structure of selected merino sheep flocks

R. Al-Atiyat, W.D. Flood, I. Franklin, B.P. Kinghorn, A. Ruvinsky

Genetic variation at 22 microsatellite loci was analysed in control, low (LR) and high parasite resistance (HR) merino sheep flocks. The control had the highest number of alleles per locus, expected heterozygosity and polymorphism, whereas HR showed the lowest values for the same parameters. A number of interallelic LD coefficients were positive and had significant χ_2 values particularly in the LR population. Five haplotypes of loci pairs *CSRD2105-CSRD254* located on Chromosome 2 were highly over represented in LR. The same pairs of loci have not shown significant deviations in the others populations. Less pronounced observations but with the opposite sign were found for pairs of loci *CSRD2108-McM058*, *McM147-CSRD2105* and *McM147-CSRD254* on chromosomes 1 and 2 respectively. Overall LD results support interallelic LD in the populations and may be caused by selection pressures.

7th World Congress on Genetics Applied to Livestock Production, August 19-23, 2002,

Montpellier, France, Session 12. Fibre and fur, Abstract of No 12-12.

Studies on breeding method in high quality Nei Mongol Cashmere goat

J. Li , W. Zhang, H. Zhou, Y. Zhang

For evolving cashmere breed, performance of Nei Mongol Cashmere goat was investigated and genetic parameters were estimated based on the records of 7138 goats at Albas Cashmere Goat Breeding Farm, located southwest of Nei Mongol, China. The BLUP breeding system in Nei Mongol Cashmere goat was introduced, applied and compared with the commonly used breeding system in terms of genetic progresses and breeding benefit. Traits involved are cashmere yield, body weight and litter size. The results show that for the current population structure and conditions of production and market, the BLUP breeding system would give the greatest genetic progress and breeding benefit. Authors suggest that the important problem demanding prompt solution is whether union breeding of Cashmere goat is handled well.

7th World Congress on Genetics Applied to Livestock Production, August 19-23, 2002, Montpellier, France, Session 12. Fibre and fur, Abstract of No 12-13.

Breeding scheme for Angora goat production in North Patagonia

M. Abad, J. Arrigo, A. Gibbons, M. Lanari, G. Morris, H. Taddeo

The implementation of an improvement program in a system of Angora goat production in
Argentina is described. A dispersed open nucleus scheme to evaluate and to produce males was adopted. Further a strategy of dissemination by controlled mating and artificial insemination was utilized. At present, as a consequence of this program, approximately 400 farmers are improving their profitability by cooperative marketing, new shearing systems, classification and conditioning of mohair.

7th World Congress on Genetics Applied to Livestock Production, August 19-23, 2002, Montpellier, France, Session 12. Fibre and fur, Abstract of No 12-14.

Congenital hypotrichosis in the Sicilian Valle del Belice sheep

R. Finocchiaro, G. Sironi, C. Domeneghini, B. Castiglioni, B. Portolano, G. Madonia, P. Giaccone

Male and female Valle del Belice lambs can be born without any hair development. These affected individuals are called hypotrichotic sheep. Apparently this hypotrichotic trait seems to be inherited as a simple Mendelian recessive character. With the aim to exclude any chromosomal structural anomalies, the karyotype of 15 affected and 2 apparently normal individuals was analysed. The karyotype made of 54 chromosomes of all analysed individuals was normal. In order to present a cytological and anatomic description of these animals, skin biopsies of 17 sheep and a necropsy of a two months old lamb were also conducted. Affected individuals showed a clear malformation easy to be recognised limited to the skin, and the necropsied lamb was organically healthy.

7th World Congress on Genetics Applied to Livestock Production, August 19-23, 2002, Montpellier, France, Session 12. Fibre and fur, Abstract of No 12-15.

Segregation analysis of coat colour phenotypes in Llama

C. Renieri, E.N. Frank, M.V.H. Hick, V. La Manna, C.D. Gauna, J.J. Lauvergne.

Llama (*Lama glama L.*) fibre is appreciated because of the high quality of undercoat and of the large number of natural colours. The phenotypic segregations PEE (pheomelanic with eumelanic extremities) *vs.* W (wild) and PEE *vs.* EB (eumelanic black) have been analysed thanks to the crossing : PEE x PEE, PEE x W, W x W, PEE x PEE, PEE x EB and EB x EB.

Only the families containing at least one proband (the "recessive" phenotype) were included in this study. Monofactorial hypothesis of inheritance explains the genetic relationships observed (PEE *vs*. W and PEE *vs*. EB): PEE appears as autosomal dominant on W; PEE appears as autosomal dominant also on eumelanic black, (EB pattern is completely recessive). In the first case the genetic hypothesis is the dominance of the A_Y on *A*+ allele at the *Agouti* locus, while in the second is the dominance of the A_Y on A_s allele (recessive allele) at the *Agouti* locus.

7th World Congress on Genetics Applied to Livestock Production, August 19-23, 2002, Montpellier, France, Session 12. Fibre and fur, Abstract of No 12-16.

Segregation analysis of irregular spotting and full white in Llama

E.N. Frank, C. Renieri, M.V.H. Hick, V. La Manna, C.D. Gauna, J.J. Lauvergne

The phenotypic relationship between SC (self coloured) and FW (full white) and between IS (irregular spotted) and SC animals on llamas, has been observed in the SC x SC, SC x IS, IS x IS and FW x FW, FW x SC and SC x SC segregations. Only the families with at least one proband were included in this study. Monofactorial hypothesis of inheritance could be accepted to explain the relationship between SC and IS. SC is autosomal dominant to IS. The disagreement between this hypothesis and the results of SC x IS and IS x IS segregations could be explained in term of misclassification of some "spotted" parents, probably included in the IS parental group. White appears dominant on no white conditions. Spotted animals appeared in this segregation could be the result of epistasy of FW on hypostatic IS phenotype, and the incomplete penetrance of dominant FW.

7th World Congress on Genetics Applied to Livestock Production, August 19-23, 2002, Montpellier, France, Session 12. Fibre and fur, Abstract of No 12-17.

Genetic and environmental variation of the effective radiative properties of the coat in Holstein cattle

A.S.C. Maia, E.C.A. Bertipaglia, R.G. Silva.

Genetic parameters of the coat color and of the effective radiative properties of coat according to the wavelength were estimated,. The method of Restricted Maximum Likelihood (REML) was used to estimate (co) variance components under the Animal Model. The effective transmission values of the black coat were higher than of the white coat. The estimates of h2 for the radiative properties were low, and those for the effective reflectivity of black coat were zero. This might be due to the low variation observed for the characteristics of the black coat. Selection for predominantly black cows could be a good choice for improving the resistance of Holstein cattle to the strong solar radiation in tropical regions. Such a selection could be easily performed considering the high heritability of the trait (h_2=0.75).

7th World Congress on Genetics Applied to Livestock Production, August 19-23, 2002, Montpellier, France, Session 12. Fibre and fur, Abstract of No 12-18.

RAPD Polymorphism in chinchilla breeding stocks

A. Hidas, M.E. Edvi, L. Potháczky, Á. Tóth

Based on the randomly amplified polymorphic DNA (RAPD) method, 20 markers were developed to compare and analyse chinchilla breeding stocks. Among tested 28 primers and a few of their combination 7 most informative ones were chosen to generate altogether 20 variable fragments. Although stock characteristic fragments were not found, some markers were monomorphic in some populations with complete absence or presence, which may provide some help in identification. Frequency of these markers showed large variations among the stocks.

7th World Congress on Genetics Applied to Livestock Production, August 19-23, 2002, Montpellier, France, Session 12. Fibre and fur, Abstract of No 12-19.

Both direct and indirect genetic effects influence behavioural response in mink

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

Despite evidence that animal behaviour is genetically controlled, the possibility of improving animal welfare by selection is not generally considered an option. It is hypothesised that both direct and indirect genetic effects of conspecifics affect confident and fearful behavioural responses in mink, tested by analysing a 12-year selection experiment for confident and fearful reaction towards humans. A total of 23397 observations for reaction towards humans and 9063 Trapezov hand test scores 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 these behavioural responses. Direct genetic effects account for 21% to 29% and indirect effects of dam and cage mate each account for 2% to 12% of the variation. With indirect genetic effects not only the genotype but also the environment can evolve.

7th World Congress on Genetics Applied to Livestock Production, August 19-23, 2002, Montpellier, France, Session 14. Behaviour and welfare, Abstract of No 14-02.

Correlated responses in litter result, body size, fur quality and colour clarity in Blue Foxes (Alopex lagopus) selected for confident behaviour

H. Kenttämies, K. Smeds.

Correlated responses in Finnish blue foxes selected for 3 generations (SL) or not selected (C) for confident behaviour (CB) gained 0.34 cubs and 0.33, 0.05 and 0.22 points, respectively, in litter result (LR), graded body size (BS), fur quality (FQ) and colour clarity (CC) within the SL line and 0,10 cubs, 0.80, 0.83 and 0.50 points, respectively within the C line. Data comprised 3317 cubs with CB, BS, FQ, and CC and 660 mated females of which 545 with CB tested as a cub. CB denoted the mean of 4 successive tests with a scale from 1 to 2 points. LR denoted the number of cubs at two weeks per mated female. BS, FQ and CC were graded using an ascending scale from 1 to 5 points. (Co)variances for breeding values were estimated with REML and multitrait animal models using VCE4 and Pest programs.

7th World Congress on Genetics Applied to Livestock Production, August 19-23, 2002, Montpellier, France, Session 14. Behaviour and welfare, Abstract of No 14-21.

Nutrition and nutritional physiology

Mink dam weight changes during the lactation period. II. Energy consumption and plasma concentrations of thyroid hormones and insulin

B. Krogh Hansen

Consumption of metabolizable energy (ME) and plasma concentrations of triiodothyronine (T_3) and thyroxine (T_4) were studied in lactating scanblack mink in the period from 1991 to 1994. In 1994, the plasma concentrations of insulin were also investigated. The objectives of the study were to describe the daily ME consumption and the plasma concentrations of T_3, T_4 and insulin. The factors included were dam age, dam body weight, litter size and litter weight. The daily consumption was recorded from 72 dams in 85 lactations. Blood samples were collected at weekly intervals. Dam body weights were recorded before blood sampling and at days 14, 28 and 42 post partum. Kit body weights were recorded at parturition, and at days 14, 28 and 42 post partum. Between the first and the fourth week post partum, there was a steady increase in daily ME consumption from 1095 kJ to 1796 kJ. During the fifth week of lactation, the concentrations of T_3 and T_4 and insulin were low. In adult dams, ME consumption and concentration of T_3 were lower than in yearlings. Litter weight had a greater influence on dam ME consumption than the number of kits. The results imply that in the lactation period a heavy demand is put on the dam. Despite the increase in ME consumption during lactation, the body weight loss of the dams indicates that they mobilize body reserves, especially in the final part of lactation. During the fourth week of lactation, the dams reach an upper limit for feed consumption. Insufficient feed consumption, and the increased milk production were associated with low concentrations of T_3, T_4 and insulin.

Acta Agric. Scand., Sect. A, Animal Sci. 1999: 49, 65-72, 1 fig, 3 tables, 31 refs.

Effects of different fat supplements on growth and hepatic lipids and fatty acids in male mink

R. Käkelä, I. Pölönen, M. Miettinen, J. Asikainen

Male mink kits (n=10 for each group) were fed diets supplemented with different fats for 12 weeks (September-November). The levels of digestible fat (8%) and energy content (7 MJ kg-1) of the diets were equal. The supplements used were beef pork fat, mink fat, broiler offal, rainbow trout offal, capelin oil, soybean oil and linseed oil. The growth and hepatic lipids (analysed by a thin-layer chromatography- flame ionization detection analyser) and fatty acid composition (analysed by gas-liquid chromatography) were studied. The pattern of weight gain of the mink fed the beef pork diet differed from that of the other mink. These kits reached high but delayed weight maxima compared with the other mink but then during November they lost weight rapidly. In liver, both the capelin oil- and linseed oil-fed mink had large concentrations of total lipids and triacylglycerols. The mink fed capelin oil were significantly heavier. The fatty acid analyses of hepatic total lipids and phospholipids revealed that the α-linolenic acid (18:3 n-3) of linseed oil was not efficiently metabolized to longer chain and more unsaturated fatty acids important for cellular membranes. It is discussed that 18:3 n-3 may not be as valuable for growing mink kits as the polyunsaturated fatty acids of the fish oils.

Acta Agric. Scand., Sect. A, Animal Sci. 2001: 51, 217-223, 3 figs, 3 tables, 21 refs.

Fatty fish and defatted fish products for male mink (*Mustela vison*) in the growing – furring period. II. Effects on haematological and clinical – chemical parameters, vitamin E status and fatty acid composition

B.M. Damgaard, T.N. Clausen, S.K. Jensen, R.M. Engberg

The effects of different dietary levels of marine lipids in the diets with a constant distribution of metabolizable energy (ME) on protein, fat and carbohydrate were investigated in male mink kits in the growing – furring period during 2 consecutive year. The physiological investigations included 15 males per experimental group, each consisting of about 75 males. Fat herring and mackerel scrap were used in amounts resulting in levels of marine lipids of 30, 50 and 70 % of total dietary lipid, respectively. Defatted herring scrap was used in proportions of 12, 23 and 32 % in the diets. Haematocrit value, haemoglobin concentration, number of erythrocytes, leucocytes and platelets, plasma activities of alanine aminotransferase (ALAT), aspartate aminotransferase (ASAT) and creatine kinase (CK), concentrations of tocopherols in plasma, liver and adipose tissue, composition of fatty acids (FA) in liver and adipose tissue, body weight, weight of liver and heart in relation to body weight, and liver fat content were studied. The number of platelets decreased with an increasing proportion of marine lipids of total content of dietary lipids. A high intake of fatty fish products had no influence on the health status of the animals evaluated by haematological and clinical – chemical analyses, vitamin E status and FA composition in growing – furring male mink. No negative effects on the health of the animals were demonstrated when feeding with defatted herring scrap.

Acta Agric. Scand., Sect. A, Animal Sci. 2000: 50, 19-29, 6 tables, 35 refs.

Quantitative glucose metabolism in lactating mink (*Mustela vison*) – Effects of dietary levels of protein, fat and carbohydrates

R. Fink, C.F. Børsting

Glucose metabolism was measured during two consecutive years, 4 weeks postpartum, in a total of 36 yearling female mink, fitted with jugular vein catheters and raising litters of six to seven kits. The dams were fed *ad libitum* from parturition on diets with different ratios of metabolizable energy (ME) derived from protein:fat:carbohydrates (experiment 1: 61:37:2, 46:37:17, 31:37:32; experiment 2: 61:38:1, 47:52:1, 33:66:1). After 3 h fasting the dams were fed 210 kJ ME of the experimental diets. Two hours postprandially a single dose of 50 µCi U-

^{14}C- and 2-^{3}H-labelled glucose was administered to each dam and blood samples were drawn 5, 10, 20, 30, 45 and 60 min after the tracer administration. Glucose turnover rates were 4-5 % min $^{-1}$ in all dams, and the approximate daily glucose flux was 12-17 g day $^{-1}$; however, these were not significantly affected by dietary treatment. In conclusion, the mink is able both to synthesize large amounts of glucose *de novo* and to utilize high levels of dietary digestible carbohydrates, and thereby to tolerate large variations in dietary carbohydrate supply.

Acta Agric. Scand., Sect. A, Animal Sci. 2002: 52, 34-42,2 figs, 3 tables, 33 refs.

Glucose metabolism and regulation in lactating mink (*Mustela vison*) – effects of low dietary protein supply

R. Fink, C.F. Børsting, B.M. Damgaard, A.K.L. Rosted

Eighteen lactating mink raising litters of 6 to 7 kits were fed *ad libitum* from parturition on diets with 32% of ME derived from protein and decreasing fat: carbohydrate ratios [high fat: low carbohydrate (HFLC): 67:1, medium fat: medium carbohydrate (MFMC): 52:16, low fat: high carbohydrate (LFHC): 37:31]. Four weeks *post partum* the dams were fitted with a jugular vein catheter, and the experiment started with a 3 hours fasting period, after which the dams were fed 210 kJ ME of the experimental diet. Blood samples were collected 10 and 5 min before feeding and 30, 60 90, 120, 150 and 180 min postprandially. Two hours postprandially a single dose of 50 µCI U-^{14}C-labelled glucose was administered to each dam and blood samples were collected 5, 10, 20, 30, 45 and 60 min after the tracer administration. Plasma concentrations of glucose and insulin 30 to 120 min postprandially were higher in dams fed the LFHC diet, than in dams fed the HFLC diet, values for dams fed the MFMC diet being intermediate, Plasma glucagon concentrations were not significantly affected by dietary treatment. Plasma FFA concentrations tended to increase postprandially in dams fed the HFLC diet. Glucose turnover rates were approximately 4.0% per min in all dams, irrespective of dietary treatment. However, the daily glucose flux was lower in dams fed the HFLC diet than in dams fed the LFHC diet, and tended to be lower than in dams fed the MFMC diet. In conclusion, a dietary protein supply of 32% of ME simultaneously with a carbohydrate supply of 16% or 31% of ME had no adverse effects on glucose homeostasis or glucose metabolism in lactating mink.

Arch. Anim. Nutr., 2002: 56, 155-166, 2 figs, 2 tables, 35 refs.

Pathology and diseases

An evaluation of the efficiency of rabies control strategies in fox (*Vulpes vulpes*) populations using a computer simulation program

T. Selhorst, T. Müller

A computer simulation program is set up to predict the population dynamics of the red fox Vulpes vulpes with time, the intake of vaccine-laced baits and the resulting time course of the immunization rate. Using the simulation program we are able to analyse the influence of the partial effects of the bait density, the attractiveness of the baits, the timing of the vaccination campaigns and the population densities of the fox and the bait competitors on the immunization rates. The analysis of the simulation results allows to formulate the following statements: Increasing the immunization rate by means of distributing a larger amount of baits is always limited by the attractiveness of the baits to the fox population. Increasing fox population densities result in decreasing immunization rates. But a 3-fold increase in population density of foxes within 6 years only results in a slight decrease of the immunization rate, if 20 baits ¯ showing high attractiveness to the foxes ¯ are distributed per square kilometre. The time course of the immunization rate of foxes is highly influenced by the exact timing of the vaccination campaign in spring. In order to achieve a constantly high immunization rate, in spring the bait distribution has to be carried out when nearly all of the newborns are able to take in vaccine-laced baits.

Ecological Modelling, 1999: 124, 221-232, 4 figs, 2 tables, 32 refs.

Replication of Aleutian mink disease parvovirus in vivo is influenced by residues in the VP2 protein

J.M. Fox, M.A. McCrackin Stevenson, M.E. Bloom

Aleutian mink disease parvovirus (ADV) is the etiological agent of Aleutian disease of mink. Several ADV isolates have been identified which vary in the severity of the disease they elicit. The isolate ADV-Utah replicates to high levels in mink, causing severe Aleutian disease that results in death within 6 to 8 weeks, but does not replicate in Crandell feline kidney (CrFK) cells. In contrast, ADV-G replicates in CrFK cells but does not replicate in mink. The ability of the virus to replicate in vivo is determined by virally encoded determinants contained within a defined region of the VP2 gene (M. E. Bloom, J. M. Fox, B. D. Berry, K. L. Oie, and J. B. Wolfinbarger. Virology 251:288-296, 1998). Within this region, ADV-G and ADV-Utah differ at only five amino acid residues. To determine which of these five amino acid residues comprise the in vivo replication determinant, site-directed mutagenesis was performed to individually convert the amino acid residues of ADV-G to those of ADV-Utah. A virus in which the ADV-G VP2 residue at 534, histidine (H), was converted to an aspartic acid (D) of ADV-Utah replicated in CrFK cells as efficiently as ADV-G. H534D also replicated in mink, causing transient viremia at 30 days postinfection and a strong antibody response. Animals infected with this virus developed diffuse hepatocellular microvesicular steatosis, an abnormal accumulation of intracellular fat, but did not develop classical Aleutian disease. Thus, the substitution of an aspartic acid at residue 534 for a histidine allowed replication of ADV-G in mink, but the ability to replicate was not sufficient to cause classical Aleutian disease.

Journal of Virology, 1999: 73, 8713-8719, 6 figs, 1 table, 48 refs.

Host range relationships and the evolution of canine parvovirus

C.R. Parrish

Canine parvovirus (CPV) is an example of an unusual class of emerging virus¯those that gain an altered host range through genetic variation and subsequently become widespread pathogens of their new and previously resistant host species. CPV was first detected in 1978 as the cause of new diseases in dogs throughout the world, when it rapidly spread throughout domestic populations, as well as becoming widespread in wild dogs. CPV was soon shown to be a variant of the long recognized feline panleukopenia virus (FPV), from which it differed in less than 1% at the nucleotide sequence level. Genetic analysis showed that virtually all of the biological differences between CPV and FPV, including the canine host range, were determined by three or four sequence differences in the viral capsid protein gene. Analysis of the atomic structures of the CPV and FPV capsids showed that the differences controlling host range were located within two different structural regions and were exposed on the capsid surface. The CPV which first emerged in 1978 appeared to be derived from a single ancestral sequence, which has allowed the ready analysis of the subsequent evolution of the virus in nature. Sequence analysis has also revealed that CPV strains have undergone a series of evolutionary selections in nature which have resulted in the global distribution of new virus variants. This was first seen in the global replacement between 1979 and 1981 of the original (1978) strain of the virus by a genetically and antigenically variant strain, and the subsequent widespread selection of other variants which have also become globally distributed. The genetic and antigenic variation in the virus strains was also correlated with changes in the host range of the virus, in particular in the ability to replicate in cats, and in canine host range differences seen in tissue culture cells.

Veterinary Microbiology, 1999: 69, 29-40, 9 figs, 26 refs.

Morbillivirus infections, with special emphasis on morbilliviruses of carnivores

T. Barrett

Morbilliviruses infections cause significant mortality in human beings and animals. Measles virus is responsible for up to two million childhood deaths annually in the developing world, while rinderpest and peste des petits ruminants cause

severe epizootics in domestic and wild ruminants in areas of the world where they remain endemic. Canine distemper virus (CDV) is a cause of fatal disease in many species of carnivores. Distemper is controlled by vaccination in domestic dogs and farmed mink, but it may be impossible to eradicate the virus because of its global distribution and wide variety of susceptible host species, which includes both freshwater and marine seals. Research is currently under way to develop new recombinant vaccines, since the currently available live attenuated vaccines for CDV are not safe for use for all species and many valuable zoo animals need to be protected from CDV. New morbilliviruses with potentially disastrous ecological consequences for marine mammals have been discovered in the past decade; phocid distemper virus (PDV) in seals and the cetacean morbillivirus (CMV) has been found in dolphins, whales and porpoises. Reverse transcription, coupled with the polymerase chain reaction (RT/PCR) and nucleic acid sequencing, has been used to characterise the morbilliviruses and has given insights into the evolution of this virus genus.

Veterinary Microbiology, 1999: 69, 3-13, 3 figs, 1 table, 49 refs.

The nucleotide sequence of the high-leukemogenic murine retrovirus SL3-3 reveals a patch of mink cell focus forming-like sequences upstream of the ecotropic envelope gene

A.H. Lund, F.S. Pedersen

We report the complete nucleotide sequence of the potent Tlymphomagenic murine retrovirus SL3-3. The non-LTR regions of the virus show 98% sequence identity to the endogenous ecotropic Akv murine leukemia virus. While the region encoding the surface envelope protein is completely identical to that of Akv, a ~ 200 nucleotide stretch in the integrase encoding region upstream of *env* is similar to the sequence of mink cell focus forming (MCF) viruses and shows a complete match with the mouse retrovirus 10A1. The history of SL3-3 may therefore include recombination involving an Akv-like virus and a virus with MCF-like sequences.

Arch Virol, 1999: 144, 2207-2212, 3 figs, 1 table, 23 refs.

Fur properties

Visual colour shades in pelts from brown mink (*Mustela vison)* explained colourimetrically

P.V. Rasmussen

Microspectrophotometric methods were used to provide objective correlates to the visually judged colour shade (CS) of the underfur in scanbrown mink pelts. The study included 21 scanbrown mink pelts (winter coat), representing a larger group of 87 mink pelts coming from a feeding trial with experimental and control animals. The pelts were visually graded from 1 (blue-greyish) to 5 (reddish), primarily in respect of the CS (in auction classification = clarity of colour) of the underfur seen on the edge of the pelt. Prepared samples of underfur fibres showed in visual inspection a gliding change of colour from paler to darker in a proximal-distal direction and were consequently examined at three levels above the skin surface. The means of the dominant wavelengths (hues) were 589.40, 588.00 and 586.70 nm, respectively, indicating that the variation between levels was small. Investigation of the small pelt material concerned showed that CS was significantly correlated with the measured lightness (L^*) and with the yellow chromaticity coordinate (b^*) of the underfur samples. In this investigation it was also shown that the underfur fibres with a visually blue-greyish colour shade were relatively dark and less yellow compared with underfur fibres with a reddish colour shade. However, data and the model estimating the colour shade demonstrated that, for the material concerned, visually very reddish underfur colour shades were not found in the lightest coloured pelts.

Acta Agric. Scand., Sect. A, Animal Sci. 2000: 50, 12-18, 5 figs, 1 table, 13 refs.

Amounts and variation of soluble collagen in mink skin during growth from kits to adult animals

B. Riis

The soluble collagen from mink skin was extracted from 2-week to 6-month-old animals. A total of 14 different age groups, each containing three animals, was studied by using two different buffers for

collagen extraction. The amount of soluble collagen was measured. The various collagen species were characterized using capillary zone electrophoresis, sodium dodecyl sulfate-polyacrylamide gel electrophoresis and protein blotting followed by antibody analysis for type I collagen. The data showed that the amount of soluble collagen declines with age. Using capillary electrophoresis it was also foundthat the distribution of soluble collagen differs in very young kits' skin compared with older animals' skin, whereas the skin from animals more than 2 weeks old was found to contain the same proportions of various collagen species. Antibody analysis of type I collagen found no difference in the relative amount between different age groups, and only the acetic acid-containing buffer extracted type I collagen from the mink skin.

Acta Agric.Scand., Sect. A, Animal Sci. 2000: 50, 225-230, 6 figs, 7 refs.

Effect of weight development, pelting time, colour type and farm on skin length in mink

S.H. Møller

The effects on skin length of pelting time, body weight in October/November and weight change until pelting were studied in four different colour types of young male mink on nine private farms. The skin length was closely related to body size, expressed either as body weight or as body length and condition (weight/length). The regression of skin length on body size differed between farms and colour types. Within the pelting season from mid November to mid December, the time of pelting did not affect the skin length of an average size mink, but the regression of skin length on body size interacted with the time of pelting. The effect of body weight on skin length was 11.8 cm kg^{1} at the usual time of pelting and 14.5 cm kg^{-1} at pelting 16 days later. The effect on skin length of the weight in October/November was 12.6 cm kg^{-1}, while the effect of a weight change between October/November and pelting was 5.5 cm kg^{-1}.

Acta Agric. Scand., Sect. A, Animal Sci. 49: 121-126, 2 figs, 5 tables, 18 refs.

The diversity of mammalian pelage

K. Kondo

Review. The integument plays an important role in the survival of metazoans by separating and protecting them from a hostile environment. Its function ranges from protection against injury and infection, participation in the regulation of the body temperature and water balance, to respiratory activity. The morphology of integument differs among vertebrates, Amphibia are coated by mucus, Reptila by scale, Aves by feather and Mammalia by hair.

The great changes in earth's environment that happened in the Mesozoic era ruined the dinosaurs, and resulted in their replacement by mammal. One of the factors that made mammalian survival possible under the drastic environmental changes was their covering of hair.

J. Fac. Agr. Hokkaido Univ., 2000: 70, 9-17, 5 figs, 34 refs.

The beauty of mink pelage observed with SEM

K. Kondo, M. Vanek, P.V. Rasmussen, L. Blomstedt

This study was done to seek the morphological structure of mink pelage in telogen through the observation with a scanning electron microscope. Hair bundle was observed clearly and beautifully at the position between the skin surface and the upper end of hair follicle. The structure of hair medulla and hair cuticle was observed more in details by using SEM than under a light microscope. The morphological structure of mink pelage through SEM is considered to be natural arts.

J. Fac. Agr. Hokkaido Univ., 2000: 70, 1-8, 4 figs, 7 refs.

Role of prolactin in regulating the onset of winter fur growth in mink (*Mustela vison*): A reconsideration

B. Johnston, J. Rose

The objectives of this study were to determine: (1) if the onset of winter hair growth (anagen) in mink could be delayed or inhibited by elevating endogenous PRL concentrations; (2) if bilaterally adrenalectomy (ADX)-induced winter anagen occurs concomitantly with a reduction in serum PRL concentrations, and (3) if exogenous dehydroepiandrosterone (DHEA), an adrenal steroid or Δ^5-DIOL (a peripherally produced metabolite of DHEA), would delay or inhibit the onset of winter anagen. During early July, while in the resting (telogen) stage of the hair growth cycle, mink were treated with slow release implants containing haloperidol (HAL, a dopaminergic antagonist), melatonin (MEL), deoxycorticosterone (DOC), DHEA and Δ^5-DIOL. In addition, mink were ADX'd and supplemented with DOC and DHEA. MEL reduced PRL levels to basal levels and induced winter anagen 7 weeks earlier than controls. Surprisingly, HAL initiated winter anagen 7 weeks earlier than controls ($P < 0.05$), although serum PRL levels were not different between the two groups. Mink that were ADX'd or ADX + DHEA-treated exhibited winter anagen 6 weeks earlier than controls ($P < 0.05$), but serum PRL concentrations were not different between the three groups. The administration of DHEA or Δ^5-DIOL to mink with intact adrenals had no effect on the time of onset of winter anagen or serum PRL levels. Our findings suggest that a reduction in circulating PRL levels is not essential for onset of winter anagen in the mink and that the apparent inhibitory effects of the adrenal glands on initiation of winter anagen is not mediated through DHEA or its metabolite Δ^5-DIOL.

J. Exp. Zool, 1999: 284, 437-444, 1 fig, 1 table, 32 refs.

Selection for feed efficiency in mink (Mustela vison)

Selektion for fodereffektivitet hos mink

Ph.D. Thesis

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The overall objective of this thesis was to present the results of a selection experiment for feed efficiency in mink (*Mustela vison*). Lines of mink were divergently selected on feed efficiency, defined as weight gain (g) divided by feed intake (g dry matter), from 1989 to 1992 and feed efficiency combined with November weight from 1993 to 2000. Feed efficiency was measured daily on males during four weeks in July Data was analysed using bivariate and trivariate Animal Models.

Heritabilities for feed efficiency and November weight were 0.30 and 0.64, respectively, with a positive genetic correlation of 0.59. Heritabilities of feed intake and weight gain were 0.38 and 0.43, respectively, with a positive genetic correlation of 0.85. For feed efficiency and weight gain the highest increase in breeding values were obtained from 1989 to 1992. For November weight the highest response were from 1993 to 2000. The selection lines diverged in feed efficiency, November weight and weight gain from 1993 to 2000, and the line selected for high feed efficiency reached the highest values. Selection for feed efficiency in mink was possible, but differences in feed efficiency were the result of differences in weight gain, not in feed intake.

Heriltabilities for pelt length, quality, colour and clarity were 0.48, 0.54. 0.68 and 0.40, respectively. Pelt length had positive genetic correlations with both feed efficiency (0.72) and November weight (0.94). Pelt quality had large negative genetic correlations with both November weight (-061) and pelt length (-0.57). Genetic trend for pelt length was higher for the high efficiency than for the low efficiency selection line. Genetic trends for pelt quality, pelt colour and pelt clarity showed no difference between selection lines from 1993 to 2000. Selection for high feed efficiency combined with high November weight resulted in increased pelt length and decreased pelt quality.

Analyses of growth curves of animals born in 1999 showed that growth curves could be described by a multiphasic logistic growth function with three phases. Selection lines differed for time of maximum increase (centre) for each phase; the high feed efficiency line was centred later than the low, the growth curve being shifted to the right Absolute and relative size of mature mink were analysed using data from the growth curve experiment obtained at pelting. The results showed no effect of selection line on absolute or relative size.

Heat production in selection lines were studied on males born in 1991 aid 1998. The results showed that mink selected for low feed efficiency had a higher heat production than mink selected for high feed efficiency.

Activity of the animals was studied in 1999 and 2000. The results showed that mink selected for high feed efficiency were less active than mink selected for low feed efficiency. This difference might explain the observed differences in heat production

Feed efficiency from August to October was studied in both sexes in 1999 and 2000. The results showed that the line selected for high feed efficiency in July also had the highest feed efficiency fromn August to October. Differences in feed efficiency were due to differences in weight gain rather than feed intake.

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