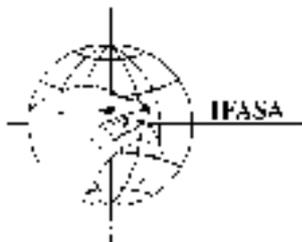
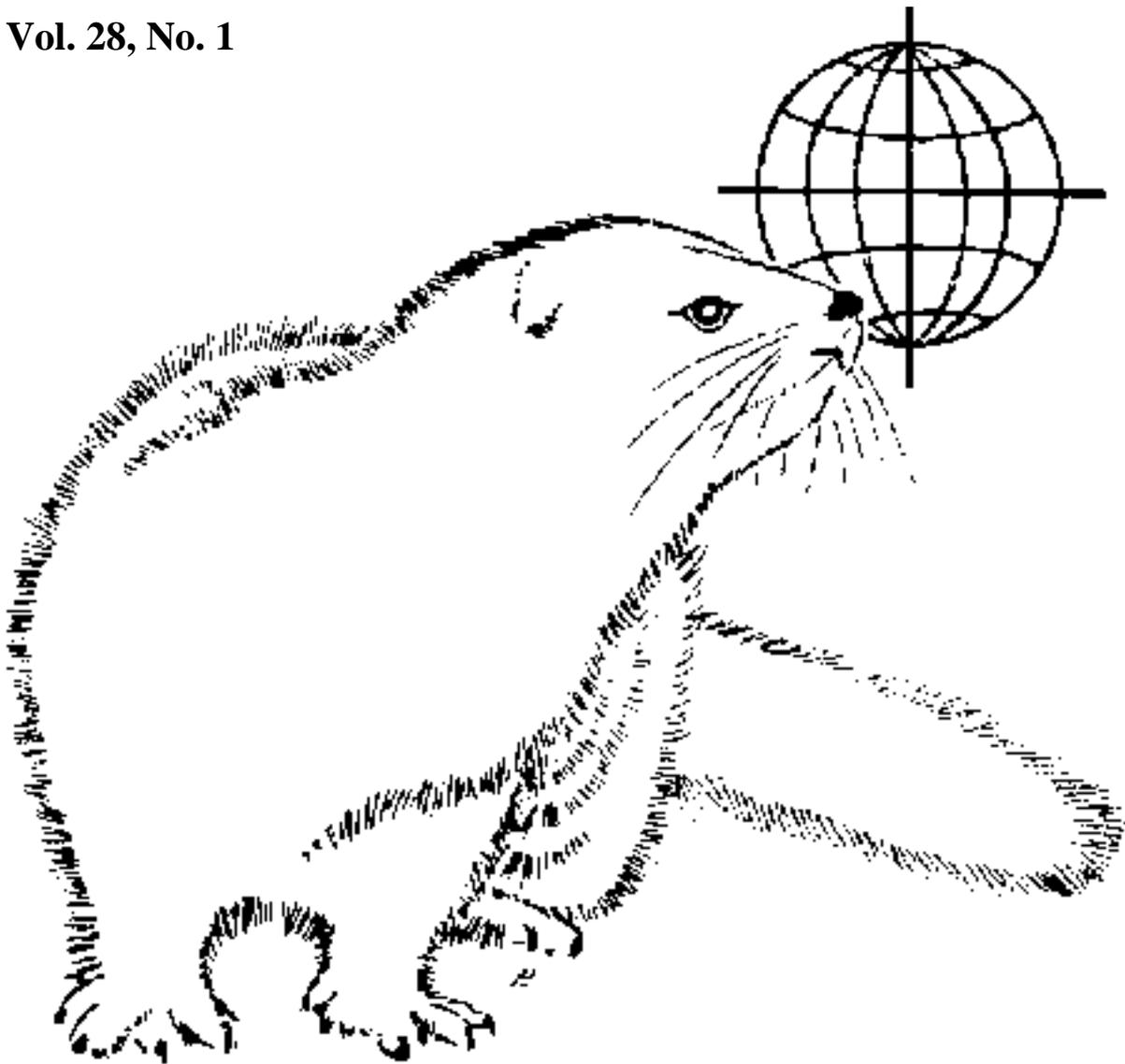


SCIENTIFUR

SCIENTIFIC INFORMATION IN FUR ANIMAL PRODUCTION

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INTERNATIONAL FUR ANIMAL SCIENTIFIC ASSOCIATION

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Birthe M. Damgaard
SCIENTIFUR
P.O. Box 14
DK-8830 Tjele, Denmark

Tel: +45 89991512
Fax: +45 89991500

E-mail: Scientifur@agrsci.dk

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Steen H. Møller
IFASA
P.O. Box 14,
DK-8830 Tjele, Denmark

Tel: +45 89991346
Fax: +45 89991500

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International Fur Animal Scientific Association (IFASA). Board of directors:

Dr. Bruce D. Murphy (president): E-mail: murphyb@MEDVET.Umontreal.CA

Dr. Steen H. Møller (vicepresident, treasurer): E-mail: IFASA@agrsci.dk

Dr. Ilpo Pölönen. E-mail: ilpo.polonen@stkl-fpf.fi

Ing. Wim Verhagen. E-mail: info@nfe.nl

Dr. Marian Brzozowski. E-mail: brzozowskim@delta.sggw.waw.pl

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Notes from the Group of Editors

This version of Scientifur is the first issue of volume 28. Among other interesting abstracts, this issue contains a number of abstracts concerning chinchillas.

Moreover, a number of abstracts of theses by mainly Danish researchers have been included. We are pleased that we have been permitted to publicize

these theses and to see that so many young researchers take an interest in fur animal production.

We hope that our readers will provide us with more theses and dissertations as well as articles for reviewing, proceedings, short communications, letters etc.

On behalf of the
Group of Editors

Birthe Damgaard

Expression of vascular endothelial growth factor isoforms and receptors Flt-1 and KDR during the peri-implantation period in the mink, *Mustela vison*

F.L. Lopes, J. Desmarais, N.Y. Gévry, S. Ledoux, B.D. Murphy

Expression of vascular endothelial growth factor (VEGF) isoforms and its receptors, Flt-1 and KDR, was investigated during the period of peri-implantation in mink, a species that displays obligate embryonic diapause. Uterine samples were collected during diapause, embryo activation, and implantation from pseudopregnant and anestrous animals and analyzed by semi-quantitative reverse transcription polymerase chain reaction and immunohistochemistry. The abundance of mRNA of VEGF isoforms 120, 164, and 188 was highest during late embryo activation and at implantation. VEGF protein was localized to the glandular epithelium at all stages of peri-implantation, whereas the luminal epithelium lacked VEGF reactivity during diapause. Endometrial stroma and luminal and glandular epithelia were positive for VEGF in implanted uteri. The invasive trophoblast cells of the implanting embryo were intensively stained. High levels of VEGF mRNA in pseudopregnant uteri indicates that VEGF upregulation leading to implantation is dependent upon maternal rather than embryonic factors. The abundance of the two receptors, KDR and Flt-1, increased in the uterus during implantation. Low levels of the receptors in pseudopregnant uteri compared with those containing activated or implanted embryos indicates that the embryo regulates receptor expression. These results demonstrate VEGF and VEGF receptor expression during early gestation in mink and suggest that maternal and embryonic input regulates different aspects of the angiogenic process.

Biology of Reproduction, 2003: 68, 1926-1933, 4 figs, 2 tables, 46 refs.

The escape of the mink embryo from obligate diapause

J.A. Desmarais, V. Bordignon, F.L. Lopes, L.C. Smith, B.D. Murphy

The obligate embryonic diapause that characterizes gestation in mink engenders a development arrest at the blastocyst stage. The characteristics of escape from obligate diapause were investigated in embryos reactivated by treatment of the dams with exogenous prolactin. Protein and DNA synthesis showed marked increases within 72 h after the reinitiation of development, and embryo diameter increased thereafter. Trophoblast cells from embryos at Day 5 after activation proliferated more readily in vitro than trophoblasts from diapause or from Day 9 after activation, while in Day 9 embryos, cells from the inner cell mass (ICM) replicated comparatively more readily in vitro. There was evidence of expression of fibroblast growth factor-4 (FGF4) in both diapause and activated embryos and in ICM, but not the trophoblast. FGF receptor-2 was present in embryos from Day 5 after reactivation in both trophoblast and ICM cell lines. Trophoblast cell lines established from mink embryos proliferated in culture in the presence of FGF4 with a doubling time of 1.4 days, while in its absence, the doubling time was 4.0 days. We conclude that, during reinitiation of embryogenesis in the mink after diapause, embryo growth is characterized by gradual increases in protein synthesis, accompanied by mitosis of the trophoblast and ICM. There appears to be a pattern of differential proliferation between cells derived from these embryonic compartments, with the trophoblast phase of replication occurring mainly in the early reactivation phase, while the ICM proliferates more rapidly nearer to the time of implantation.

Biology of Reproduction, 2004: 70, 662-670, 8 figs, 1 table, 38 refs.

Histological and morphometric changes of the seminal vesicles of *Chinchilla laniger* (Grey) in captivity, induced by seasonal variations

P.C. OrosteGUI, G. Parraguez, H. Víctor, A.L. Adaro, P.G. Peñailillo, R.G. Cepeda

Macroscopic and microscopic structures of the seminal vesicles was described in *Chinchilla laniger* (GREY) under conditions of captivity. The experiments were performed in adults subjects along a period of one year (two to three years old) in order to determine possible seasonal variations. The following parameters were investigated in this South American native roedor: corporal and glandular weight, organo-somatic index (IOS), wall thickness, gland diameter and epithelial tissue high. Highest values were found in winter and lowest values in summer, except corporal weight that displayed no variations along the year ($p > 0.05$). The histochemical analysis of glandular secretion revealed the absence of neutral glycoproteins sulphated and acids glycoproteins (as determined by PAS, Alcian Blue pH1 and pH2,5 respectively), through the period studied. In conclusion, the seminal vesicles of the *Chinchilla laniger* in captivity showed the highest secretory activity in the Fall-Winter seasons. The present results obtained from this period are consistent with the fact that it corresponds with the highest reproductive activity for the specie.

Revista chilena de anatomía, 2000: 18, 1, 89-96, 4 figs, 3 tables, 23 refs.

Water economy in rodents: evaporative water loss and metabolic water production

A. Cortes, M. Rosenmann, F. Bozinovic

Studies on water balance in desert-dwelling granivorous rodents use evaporative water loss (EWL) and metabolic water production (MWP) to evaluate the efficiency of water regulation, expressed by the model $Ta @ MWP = EWL$, defined by an ambient temperature (Ta) value at (@) which $MWP/EWL = 1$. Here we evaluate and apply this model ($1 - r^2$) determining water regulation efficiency, based on the energetic cost (MR) to maintain water balance (WB), that is MR-WB. To test the model, EWL was measured and

MWP estimated in nine species of rodents from different localities of northern and north-central Chile (II and IV Regions): *Octodon degus* (Od) and *O. lunatus* (Olu) (Octodontidae), *Abrothrix olivaceus* (Ao), *A. longipilis* (Al), *A. andinus* (Ad), *Phyllotis darwini* (Pd), *P. rupestris* (Pr), *P. magister* (Pm), *Oligoryzomys longicaudatus* (Ol) (Muridae) and *Chinchilla lanigera* (Cl) (Chinchillidae). Literature information on rodents from xeric and mesic habitats was also analyzed. Results indicate that: 1) Cl has the lowest EWL (0.58 mg H₂O/g h), followed by $Od < Olu < Ao < Pd < Pm < Pr < Ad < Al < Ol$. 2) EWL and body mass (M) are related through independent equations considering two distinctive habitats: $EWL (xeric) = 5.968 M - 0.416$ ($r = -0.89$; $P < 0.001$) and $EWL (mesic) = 17.272 M - 0.532$ ($r = -0.85$; $P < 0.001$). 3) MWP and M are related through the equation: $MWP = 14.256 M - 0.539$ ($r = -0.98$; $P < 0.001$). 4) At the intraspecific level, MWP/EWL and Ta are related through a negative exponential equation: $MWP/EWL = a 10^{-bTa}$ ($r = -0.95$; $P < 0.001$). 5) $Ta @ MWP = EWL$ and M are related through the equation: $T @ (MWP = EWL) = 26.799 M - 0.142$, ($r = -0.49$, $P < 0.02$). 6) MR-WB and M, are related through independent equations according to the prevailing animal's habitat: $MR - WB (xeric) = 34.627 M - 0.339$ ($r = -0.93$; $P < 0.001$) and $MR - WB (mesic) = 68.132 M - 0.381$ ($r = -0.86$; $P < 0.001$). These last two equations have comparative advantages to the previous ones because they include rodents with different dietary habits, are able to discriminate patterns in the water regulation efficiency as a function of different habitats (xeric and mesic), and enable to evaluate the energetic cost of water balance.

Revista chilena de historia natural, 2000: 73, 2, 311-321, 5 figs, 4 tables, 42 refs.

Anatomo-radiographic study of the seminal vesicles of chinchilla (*Chinchilla laniger*, Grey) in captivity.

A.L. Adaro, A.J. Mendoza, C.R. Cepeda, C.P. OrosteGUI

Anatomic and radiographic characteristics of seminal vesicles in 5 adult, males, chinchillas (*Chinchilla laniger* Grey) in captivity is described using the retrograde cystography technique. This

shows good definition images of seminal vesicles, urinary bladder and urethra. Seminal vesicles were dorsal and cranial to the urinary bladder and urethral axis and their dimensions were 73 mm long and 3mm wide. The further anatomic analysis agrees with the radiographic images.

Revista chilena de anatomía, 2001: 19, 3, 297-300, 4 figs, 9 refs.

Nasopharyngeal colonization with nontypeable *Haemophilus influenzae* in chinchillas

Y.-P. Yang, S.M. Loosmore, B.J. Underdown, M.H. Klein

Colonization of the nasopharynx by a middle ear pathogen is the first step in the development of otitis media in humans. The establishment of an animal model of nasopharyngeal colonization would therefore be of great utility in assessing the potential protective ability of candidate vaccine antigens (especially adhesions) against otitis media. A chinchilla nasopharyngeal colonization model for nontypeable *Haemophilus influenzae* (NTHI) was developed with antibiotic-resistant strains. This model does not require coinfection with a virus. There was no significant difference in the efficiency of NTHI colonization between adult (1- to 2-year-old) and young (2- to 3-month-old) animals. However, the incidence of middle ear infection following nasopharyngeal colonization was significantly higher in young animals (83 to 89%) than in adult chinchillas (10 to 30%). Chinchillas that had recovered either from a previous middle ear infection caused by NTHI or from an infection by intranasal inoculation with NTHI were completely protected against nasopharyngeal colonization with a homologous strain and were found to be the best positive controls in protection studies. Systemic immunization of chinchillas with inactivated whole-cell preparations significantly protected animals not only against homologous NTHI colonization but also partially against heterologous NTHI infection. In all protected animals, high-molecular-weight (HMW) proteins appear to be promising candidate vaccine antigens to prevent nasopharyngeal colonization and middle ear infection caused by NTHI.

Infection and Immunity, 1998: 66, 5, 1973-1980, 4 figs, 5 tables, 31 refs.

Morphological study of the larynx of chinchilla (*Chinchilla laniger*)

M. Martinez, H.L. Guida, R.J.S. Domingues, F.D. Cassel, E.P. de A. Filho, F.E. Martinez

The study was undertaken to collect data on morphological features of the larynx of the chinchilla. This larynx is composed by cartilaginous, membranous and muscular portions and has 9 mm of medium length. In the lateral wall there are the vestibular and vocal folds; the laryngeal ventricle are present in the region between the vestibular and vocal folds consisting in a moderate depression. The laryngeal epithelium was studied by light and scanning microscopic methods: the surface of the supraglottic space is covered predominantly by stratified epithelium with cobblestone appearance while it may be seen a typical pseudostratified epithelium composed by ciliated and non-ciliated cells on the subglottis area. However, near to the caudal part of the vocal fold the epithelium gradually changes through the stratified squamous to the intermediated type demonstrating paving-stone appearance. The subepithelial layer was composed by elastic and collagen fibers constituting an intricated meshwork.

Revista chilena de anatomía, 1999: 17, 1, 39-45, 12 figs, 36 refs.

Cost-benefit relationship in thermoregulation of *Chinchilla laniger*.

A. Cortes, M. Rosenmann, F. Bozinovic

Chinchilla lanigera, is an endemic rodent inhabiting desert areas of northern Chile. We postulated that wild chinchilla should have a cost-benefit relationship in thermoregulation to cope with desert habitats. We evaluated the energy metabolism in air and He-O₂, evaporative water loss (EWL) and body temperature (T_b) at different ambient temperatures (T_a). The most relevant results indicated that the basal metabolic rate (BMR) was 0.66 mlO₂/g h and a thermal conductance (C) of 0.0376 mlO₂/g h°C;

representing a 80.4% and 72.5% of expected values for eutherian mammals respectively. Thermal conductance in He-O₂ was 0.089 mlO₂/g h°C, being the ratio CHe-O₂ /C = 0.089/0.038 equal to 2.34, the highest value recorded in rodents, indicating that *C. lanigera* exhibit the higher thermal insulation reported so far. Besides, the evaporative water loss (EWL) was a 95% of the expected value for heteromiyds. *Chinchilla lanigera* presents a clear cost-benefit relationships or trade-off in thermoregulation. In fact, the low C and EWL values implicate thermoregulatory costs at high temperatures (risk of hiperthermia), mainly when its desert habitats has temperatures $\geq 30^{\circ}\text{C}$. At the same time these low C, EWL and BMR values represent physiological benefits that allow energy and water economy in a xeric and unproductive habitat.

Revista chilena de historia natural, 2000: 73, 2, 351-357, 2 figs, 37 refs.

Scanning electron microscopic study of the tongue of chinchilla (*Chinchilla laniger*)

M. Martinez, F.E. Martinez, P.F.F. Pinheiro, C.C.D. Almeida, T.M. Segatelli, I.-S. Watanabe

The three-dimensional structure of the lingual papillae and the connective tissues of the tongue of chinchilla were observed by scanning electron microscopy. The NaOH cell maceration method were used to remove the epithelial layer to visualize the connective tissue architecture. The dorsum of the tongue is covered by keratinized stratified squamous epithelium and possessed four types of papillae: filiform, fungiform, foliate and vallate. SEM images demonstrated the epithelial cell surfaces with microridges, distinct intercellular borders and taste pores. The connective tissue core of filiform papillae of the anterior and intermediate part of the tongue consisted of two or three rod-like protrusions while on the posterior part demonstrated large base with several apical protrusions. The lamina propria of the fungiform papillae were columnar and vallate papillae presented a central groove surrounded by numerous connective tissue papillae; the foliate papillae demonstrated elliptical holes surrounded by small connective tissue papillae.

Revista chilena de anatomía, 2000: 18, 1, 53-59, 11 figs, 44 refs.

Specific distribution pattern of nerve fibers containing catecholamine-synthesizing enzymes, neuropeptide Y (NPY) and C-terminal flanking peptide of NPY (CPON) in the pineal gland of the chinchilla (*Chinchilla laniger*) – an immunohistochemical study

M. Nowicki, J. Wojtkiewicz, B. Seremak, M. Sulik, J. Ostaszewski, B. Lewczuk, M. Majewski, B. Przybylska-Gornowicz

The sympathetic nerve fibers originating from the superior cervical ganglia and supplying the pineal gland play the most important role in the control of the pineal activity in mammals. NPY and CPON are also present in the majority of the pinealopetal sympathetic neurons. In this study, immunohistochemical techniques were used to demonstrate the existence and coexistence of tyrosine hydroxylase (TH), dopamine beta-hydroxylase (DBH) as well as NPY and CPON in the nerve fibers supplying the chinchilla pineal gland. Ten two-year-old female chinchillas housed in natural light conditions were used in the study. The pineals were fixed by perfusion. ABC immunohistochemical technique and immunofluorescence labelling method were employed. TH-immunoreactive (TH-IR) varicose nerve fibers were observed in the pineal gland as well as in the posterior commissural area. Within the chinchilla pineal gland, TH-IR nerve fibers were located in the capsule and connective tissue septa. Numerous varicose TH-IR branches penetrated into the parenchyma and formed a network showing the highest density in the proximal region of the gland. In the central and distal parts of the pineal parenchyma, a subtle network, composed of thin varicose nerve branches, was observed. Double immunostaining revealed that the majority of TH-IR nerve fibers was positive for DBH or NPY. TH- and D β H-positive neuron-like cells were observed in the proximal region of the gland. The pattern of pineal innervation immunoreactive to CPON was similar to the innervation containing NPY, TH and DBH. The chinchilla intrapineal innervation containing TH, DBH, NPY and CPON is characterized by the higher density in the proximal part of the gland than in the middle and distal ones. The specific feature of

the chinchilla pineal is also the presence of single TH/DBH-immunoreactive neuron-like cells in the proximal part of the gland.

Folia Histochemica et Cytobiologica, 2003: 41, 4.

Determination of histologic changes in the uterus of Zearalenol implanted chinchillas (*Eryomys laniger*)

S.F. Aragón, R.F. Román, S.R.A. Arce, M. Pérez-Martínez

In order to determine histologic changes in the uterus of Zearalenol subcutaneously implanted chinchillas (*Eryomys laniger*) (12 mg/animal), 30 animals divided in two groups were used. One group included virgin females (12-15 months old), and the other one, adult females (24-30 months old). Each group was treated with Zearalenol with a corresponding control ones. Animals were sacrificed, and the uterus was immediately separated for histological analyses. Studies revealed that Zearalenol induces an intense vascular congestion in the endometrium resulting in important changes in the histological organization of the uterus. Increase in the organ size, abundant mitosis or apoptosis in epithelial cells and extensive proliferation of endometrial glands in the older animals was evident. The uterus of control animals did not show vascular changes similar to the treated ones. Mitosis and apoptosis processes were observed in 20% of non treated animals (24-30 months old).

Veterinaria México, 2001: 32, 1, 7-12, 1 fig, 2 tables, 30 refs.

Arterial trunks of male reproductor apparatus of chinchilla (*Chinchilla Laniger*, Grey) in captivity

L. Adaro, C. Orostegui, R. Cepeda, R. Olivares, M. Soto

The irrigation of male genital system of chinchilla has been described. Were used 10 animals, which were anesthetized and slaughtered with an overdose of sodium tiopental. The objective was to identify the origin of arterial circulation of reproductive system. For that, natural latex stained

with red pigment of disperse was injected via abdominal aorta.

The vessels dissection revealed that testicles and epididymis arterial irrigation proceed from testicular arteries, which emerge from renal arteries. The accessory sexual glands and ductus deferens irrigation arise from external iliac artery.

Revista chilena de anatomía, 1998: 16, 2, 225-228, 4 figs, 11 refs.

Seasonal morphological variations of bulbourethral glands of *Chinchilla laniger* (grey) in captivity

R. Cepeda, L. Adaro, P. Peñailillo, C. Orostegui

The morphology of bulbourethral glands was described in *Chinchilla laniger* (GREY) under conditions of captivity. The experiments were performed in adult subjects along a period of one year (two to three years old) in order to determine possible seasonal variations. The following parameters were investigated in this South American native rodent: corporal and glandular weight, organo-somatic index (IOS), wall thickness, mucous membrane diameter and epithelial tissue height. Highest values were found between May and July and lowest values between November and February, except corporal weight that displayed no variations along the year (p 0.05). The histochemical analysis of glandular secretion revealed the presence of neutral glycoproteins and the absence of glycogen (as determined by PAS and Diastase ? PAS, respectively). Neutral glycoproteins showed an intense PAS reaction (+++) between October-April and light-moderate (+ / ++) between May-September. Besides, sulphated and acidic glycoproteins showed no changes (+ / ++) through the period studied (as determined by Alcian Blue pH 1 and pH 2,5 respectively). In conclusion, the bulbourethral glands of the *Chinchilla laniger* in captivity showed the highest secretory activity in the Fall-Winter seasons (a time characterized by short periods of light). The present results obtained from May to July are consistent with the fact that it corresponds with the highest reproductive activity for the species.

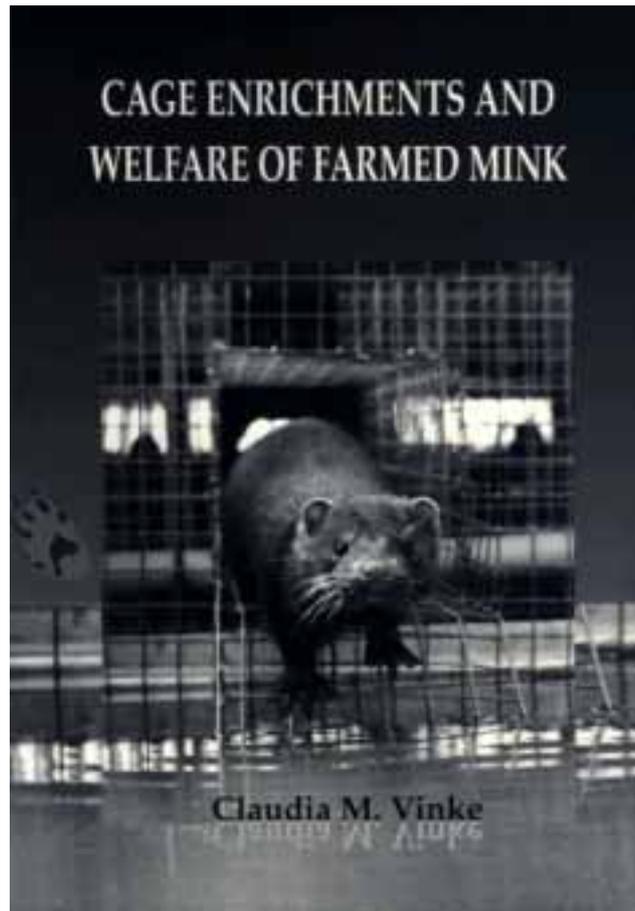
*Revista chilena de anatomía, 1999: 17, 1, 59-66, 2
figs, 3 tables, 32 refs.*

Cage enrichment and welfare of farmed mink

Doctoral dissertation

by

Claudia M. Vinke



University of Utrecht

2004

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The studies presented here give insight into the effects of the presence, absence and the removal of different kinds of cage enrichments on the welfare of farmed mink (*Mustela vison*) as measured by juvenile (play) behaviour, abnormal behaviour (i.e. stereotypical behaviour and tail biting), a

physiological parameter (stress hormone cortisol in urine samples) and anticipatory behaviour (“reward-sensitivity”). The studies serve a practical and a general purpose. Firstly, to give insight into the possibilities of enrichment of housing conditions in order to improve the welfare of farmed mink and,

secondly, to contribute to the scientific discussion on behavioural needs of animals, as swimming water is often discussed as (in)dispensable for farmed mink.

As explained in the introduction three statements form the main approach of the studies, namely: 1) that sensitivity and insensitivity to challenges are related to the state of the animal in terms of welfare, 2) it is assumed that aversive stimuli can (partly) be compensated (counteracted) by the consequences of exposure to rewarding stimuli and 3) that the absence of essential stimuli and/or the impossibility to perform essential behaviours can result into long-term behavioural and/or physiological pathology.

Brief summary per chapter

Chapter 2 describes the results of a field study to assess the welfare situation of farmed mink in a “traditional” and in an “improved” Dutch husbandry system. The findings indicate that a combined regime of later weaning, larger cages (per individual and/or family group), no food restriction and the introduction of cage enrichments such as nest boxes with straw, cylinders and platforms decrease the occurrence of stereotypical behaviour in farmed mink.

Chapter 3 presents the effects of access to swimming water on the occurrence of play behaviour in mink pups. The study shows that juveniles with access to swimming water played more frequently in the main cage than pups reared and housed without swimming water. The results suggest that swimming water may present relevant stimuli that increase the occurrence of play. It was found that juvenile play behaviour was negatively correlated with the occurrence of stereotypical behaviour in adulthood: subjects reared in a family with high frequencies of play had less stereotypical behaviour in adulthood.

Chapter 4 presents two experiments on the value of swimming water for farmed mink by measuring tail biting, stereotypical behaviour and anticipatory activity in the presence, absence and after the removal of swimming water. The experiments involved two designs for the removal of swimming water: 1) blocking the entry to the water bath and 2) removal of swimming water, but leaving the access to the empty bath intact. The major findings of the experiments are that: 1) no clear differences were found in tail biting and stereotypical behaviour

between subjects housed in the presence (water-experienced subjects) or absence of swimming water (water-naïve subjects), suggesting that swimming water does not prevent the display of abnormal behaviours; 2) more tail biting and more stereotypical behaviour were observed when the entry to the swimming bath was blocked as compared to subjects that still had access to an empty bath, suggesting that blocking the access to, rather than the removal of swimming water was stressful. The results on anticipatory activity confirmed these main findings.

Chapter 5 presents a study on the effects of three housing systems differing in the degree of enrichments on juvenile behaviour of farmed mink and the occurrence of anticipatory activity and stereotypical behaviour in adulthood. The results show 1) that mink juveniles in the most enriched system had more variable behaviour and 2) that mink, just as rats, can be trained to anticipate. However, in contrast to the behavioural results on enrichment of the juveniles, no altered sensitivity of the additional enrichments was found as measured by anticipatory activity and stereotypical behaviour. This suggests no differences between the experimental housing systems in terms of stress.

Chapter 6 presents a study on the effects of the removal of cage mates and/or enrichments on the behaviour and physiology of juvenile female mink reared and housed in the presence and absence of cage enrichments and family peers. The results showed: 1) increased levels of play behaviour in the enriched group-housed subjects as long as the cage enrichments were present, 2) reduced tail biting in enriched pair-wise systems even after the treatments and 3) relative high levels of urinary cortisol in the non enriched pair-wise housed females versus enriched and non enriched group-housed subjects and enriched pair-wise housed subjects. The results suggest a welfare-enhancing effect of the presence of cage enrichments and probably of the presence of family peers as long as the stimuli are present. The removal of family peers and cage enrichments affected the group-housed subjects most as shown by their increased level of cortisol, whereas, stereotypical behaviour increased most in the group where the family peers as well as the cage enrichments were removed; thus, the subjects that “loose the most”.

In conclusion, this thesis clearly shows that the presence of cage enrichments resulted into more variable (play) behaviour in juvenile mink (chapter 3, 5 and 6). In adulthood, the combined presence of cage enrichments and improved management (“Dutch procedures”) seemed to decrease stereotypical behaviour as compared to traditional management and poor housing conditions where cage enrichments were absent (chapter 2). However, other studies on a further improvement of the housing systems and in which the improved systems of the first study were used as the standard controls, showed no further significant reductions in abnormal behaviours as measured by stereotypical behaviour and tail biting (chapters 4 and 5). Neither did we find differences in anticipatory behaviour between subjects reared and housed in the presence and absence of enriching objects or stimuli (chapters 4 and 5, Box 2). Furthermore, mink appeared to respond differently to the way the access to swimming water appeared to affect the animals

when the access to the water bath was prevented by blocking, as measured by increased levels of stereotypical behaviour and tail biting. No effects, however, were observed when the water was removed and the empty bath was left (see chapter 4). Furthermore, the removal of once experienced objects appeared to affect the subjects most at the moment that more stimuli were removed from the cage, i.e. removal of cage enrichments and family peers, as indicated by higher levels of urinary cortisol and stereotypical behaviour (chapter 6).

The following topics are addressed in the general discussion: 1) swimming water as essential or as highly attractive stimulus?; 2) the relevance of the measurements, e.g. stereotypical behaviour, tail biting, play behaviour, urinary cortisol, that were used to assess the effects of cage enrichments and 3) practical considerations on the welfare of farmed mink.

Population ecology of free-ranging American mink

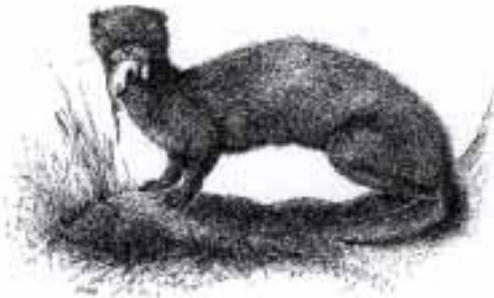
Mustela vison in Denmark

PhD Thesis

By

Mette Hammershøj

Population ecology of free-ranging
American mink *Mustela vison* in
Denmark



PhD Thesis
Mette Hammershøj

National Environmental Research Institute
Department of Wildlife Ecology and Biodiversity

and

University of Copenhagen
Department of Population Ecology

2003

The present work represents three years of studying the free-ranging mink *Mustela vison* in Denmark in order to obtain the PhD degree at the University of Copenhagen, Denmark. The thesis consists of a synopsis which reviews the back-ground, summaries and discussions of six scientific articles, and

furthermore presents some of the results that were too scant to warrant a separate publication. Four of the scientific articles have been submitted for publication, one has been accepted, and one is present as a manuscript.

The American mink *Mustela vison* is not a native species in Denmark. It was imported to Danish mink fur farms in the early 1930s. Since then, an unknown number of mink have escaped from these farms. According to the Danish Game Bag Record the annual mink bag has increased from less than 1,000 in the 1970s to 7-8,000 in the past five years. It is likely that this increase reflects an increase in population size of free-ranging mink.

Essential knowledge about the fundamental biology and population ecology of free-ranging mink in Denmark is lacking. Increasing concern has arisen about the damage that free-ranging mink may cause the native fauna – both in relation to prey populations and to populations of other mustelids/predators, especially polecats *M. putorius* and otters *Lutra lutra*.

The purpose of this PhD project was to provide basic knowledge about the biology and population ecology of free-ranging mink in Denmark, including interactions between the species and its surroundings, and especially to answer the following questions:

- How large a population of the free-ranging mink population consists of escaped farm animals?
- Can the free-ranging mink sustain viable populations via reproduction in nature or is it dependent on a continuous supply of escaped farm animals?
- What are the survival rates and how is the state of health of free-ranging mink?
- What effects do free-ranging mink have on prey populations and on native predators?

Our studies have shown that a major part of the free-ranging mink population in Denmark consists of fur farm escapees. A large proportion of the newly

escaped farm mink die within the first two months of escape. However, the ones that do survive, soon become behaviourally adapted to living under natural conditions.

We were not able to determine to what degree free-ranging mink reproduce in nature, but other data strongly suggests that mink do breed in the wild. It is still uncertain whether the mink population can survive in nature without a continuous supply of escapees from fur farms. Our general model on invasive species suggested that the continuous supply of genetically poorly adapted farm mink may, somewhat counter-intuitively, prevent the establishment of a truly feral population, but our more detailed mink model lent only some support to this. One of our ‘best guess’ parameters proved to have a major influence on the model results, and we were therefore unable to make any firm conclusions.

Without a common strategy based on detailed population biological knowledge, there may not be any major effects of controlling mink. Besides improving our model, obtaining better data on reproduction will also enable us to build matrix population models and perform elasticity analyses that can help identify critical life-history stages during which control will be most successful. Detailed population biological research is thus likely to aid in fine-tuning control, and it may even lead to new control methods.

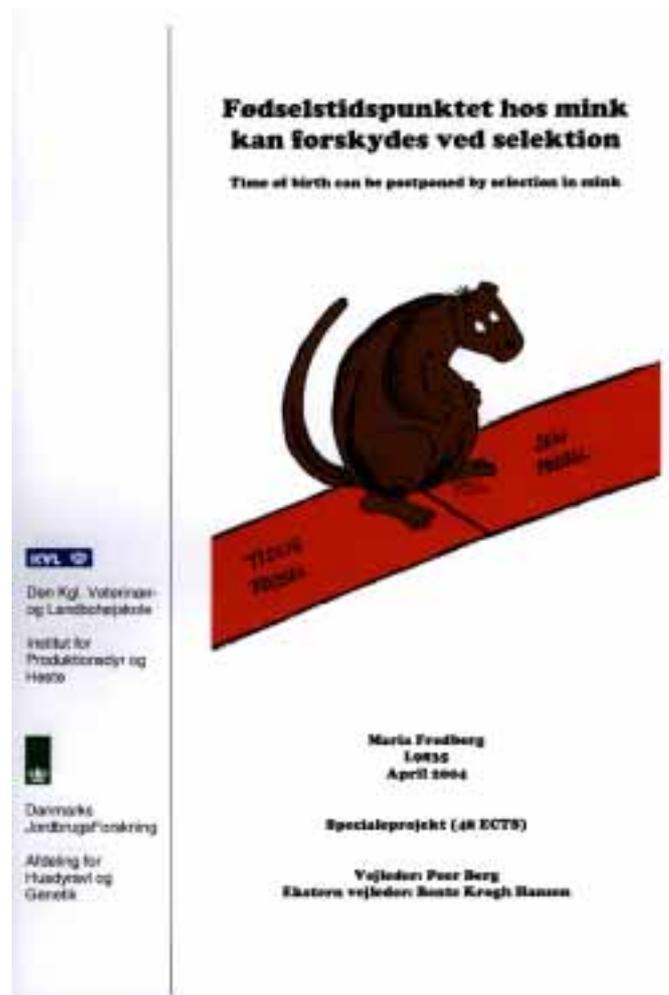
As yet, there are no management plans for mink in Denmark. The work presented in this thesis will hopefully be a first step in helping wildlife managers make informed decisions about strategies for the management of free-ranging mink in Denmark.

Time of birth can be postponed by selection in mink

M. Sc. Thesis

by

Maria Fredberg



Royal Veterinary and Agricultural University

2004

In mink production the main goal is to have a profitable production and to decrease the production cost. The feed constitute about 40% of the production cost. A way to reduce the production cost is to reduce the feed consumption by shorten

the growth period. A way to shorten this period though breeding is to select for later time of birth. "Selection for later time of birth" is a project in three parts; reproduction, growth and autumn moult. This master thesis concerns the part about

reproduction. The aim is to investigate the selections influence on the reproduction. So this study tested the premise that time of birth can be postponed by selection in mink and secondly that late time of birth will shorten pregnancy length and increase litter size. Beside this the selections influence on the females' willingness to mate was investigated.

Data from a selection experiment for changing time of birth in mink was used in this project. In the experiment two lines of mink were divergently selected for time of birth. Flushing and mating were started one week later in the line selected for late time of birth. Variance components were estimated using univariate and bivariate animal models and an AI-REML algorithm. The models included direct genetic and maternal genetic effects of the traits; time of birth, pregnancy length and litter size. The females willingness to mate were analysed by using a threshold model. The results show that time of birth can be postponed by selection. Time of birth is

a hereditary character with a moderate maternal heritability (0.26) and a low direct heritability (0.06). Furthermore genetic variation in pregnancy length exists with a high maternal heritability (0.42). We found a high positive maternal genetic correlation (0.95) between time of birth and pregnancy length, indicating that postponed time of mating will prolong the pregnancy length. The estimated heritabilities revealed a tendency of a direct genetic effect on litter size. Genetic correlations between time of birth and litter size are subjects to uncertainty. Females' willingness to mate was higher in the line selected for later time of birth compared to the line selected for early time of birth. The increased willingness to mate is a result of the postponed time of mating and the selection. The willingness to mate increased when the date of the first mating attempt was postponed.

Keywords: Time of birth, pregnancy length, litter size, heritability, direct and maternal genetic effect

Supply of drinking water for ranch mink (*Mustela vison*) in the lactation period

M. Sc. Thesis

by

Lise Kjærgaard Steffensen



Department of Animal Behaviour

Zoological Institute

University of Copenhagen

2003

The lactation period is critical to mink (*Mustela vison*) dams and kits. They experience a decreased water balance, caused by increased output and

insufficient intake. Failing to cope with this situation most likely affects dam and kit welfare negatively. The present study investigated whether

drinking from an open water surface improves water intake, and thereby welfare, compared to drinking from standard valves. Furthermore, a possible effect of the valve placement was evaluated.

Drinking water was supplied in metal bowls, placed approximately 4 cm above the cage bottom (experimental group 1), or standard valve drinkers placed approximately 12 cm (experimental group 2) or 4 cm (experimental group 3) above the cage bottom. To assess the state of welfare, several physiological and behavioural parameters reflecting thirst and water intake were measured in 18 Wildmink dams and litters, a total of 90 animals. Physiological parameters comprised weight gain or loss, erythrocyte and differential leukocyte count, haemoglobin concentration, hematocrit value, plasma concentration of aldosterone, sodium and potassium as well as urine concentration of sodium and potassium. Behavioural parameters included age at onset of eating and drinking in mink kits, feed and water consumption, cage use, activity levels and frequency of saliva licking, eating, drinking and stereotypies.

Comparing these parameters among groups, the present study found that kits supplied with an open water surface (group 1) started drinking water 1-3 days sooner than kits provided with valves. Furthermore, they licked saliva for a shorter period, supporting the hypothesis that saliva licking is motivated by thirst. Consumption measures indicated that intake increased compared to animals drinking from valves (group 2 and 3). Hematocrit values indicated a higher water balance in group 1 dams, but group 3 kits. At the same time they suggested that group 2 animals had the lowest water balance due to the type and placement of the water supply.

Group 3 presented the largest kit weight gain and the lowest dam weight loss at weaning. Results implied that group 3 dams experienced least stress compared to the other groups. Group 2 dams tended to be more active and perform more stereotypies just before kits started drinking, indicating difficulty to cope with demands at that time. Stereotypy frequency increased most in group 1 dams just before weaning, indicating that they were more stressed by kits' presence and changes due to the experimental treatment. This suggests the inferior weight performance in group 1 and 2 to be due to increased stress, interfering with maternal behaviour, and a lower valve placement. Differences in leukocyte frequencies supported the view that group 1 and 2 dams were more stressed.

Initially, animals spent most time in the nest box, but towards weaning more time was spent in the cage, consistent with improving kit mobility. There was a tendency for group 1 kits to be most active towards weaning, which was interpreted positively regarding welfare.

Collectively, measures indicated that welfare in terms of water balance was improved in dams provided with an open water surface. Certain drawbacks, water contamination and stress, limited the presumed positive effect on weight performance and kit water intake. However, results suggested that accelerating the onset of drinking in kits made them more independent of the dam at an earlier age. A large effect of relatively small changes in management practices between groups was evident from the present study. This highlights the importance of good management practice and optimal water supply during the lactation period and of research attempting to improve welfare by new management initiatives.

The effect of parturition and maternal behaviour on perinatal mortality in mink kits (*Mustela vison*)

M. Sc. Thesis

by

Mette Gade

**Betydningen af fødselsforløbet og
yngelplejeadfærden for den tidlige
hvalpedødelighed hos farm mink
(*Mustela vison*)**



Veterinært speciale
Mette Gade
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Vejleder: Ferkalpskik, Birgitte Ivarsen Dams, Institut for Produktionsteori og Helse, Den
Kgl. Veterinære og Landbohøjskole & Ferkal, Jens Madsensvej, Afdeling for
Hesthygiejne og Velfærd ved Danmarks LandbrugsForskning

Royal Veterinary and Agricultural University

2004

In previous studies hypothermia, starvation and stillbirth were found to be the main causes of perinatal mortality in mink kits. The maternal behaviour of the mink female (*Mustela vison*) is of vital importance for the survival of the newborn mink kit. In spite of this maternal behaviour has not previously been studied in detail in this species.

The aim of the study was to identify causes of perinatal mortality in mink kits and to describe parturition in mink. A further objective was to determine behavioural differences between females with no/low kit losses and females with very high kit losses. The data was collected in the whelping periods of 2002-2004. The parturition of 39 females was observed by a special video-recording system allowing recording both in the nest and the cage. The experiment showed both by comparing females with low and high kit mortality and on the whole data material that the duration of birth affects the number of kit dying during the first week of life. As has previously been found, the first day is of tremendously importance because 84% of the kits dying within the first week after birth died on this day. The stillborn kits accounted for 42% of the deaths. At autopsy these kits appeared fully developed. This emphasizes the possibility that they died just before or during parturition.

When comparing females with no/low kit losses and females with high kit losses, no differences in time spent at stereotyping and nest building was found. However, during and after birth the females with no/low kit mortality spent more time licking their kits and they also moved their kits to the abdomen more often (most likely as apart of the nursing behaviour) than the females with great kit mortality. During parturition females with high kit losses spent more time resting with their kits suggesting that an activity at this time may not be a problem. The litters of the females with great kit losses were scattered more often and for longer periods of time than the litters of the females with no/low losses. This suggests that hypothermia and lack of nursing can be important causes of perinatal mortality in mink kits. In this study infanticide behaviour was not observed on the first day after parturition, not even in females with extremely high kit losses (it was however, seen in one female 24-32 h after birth).

Keywords: Mink, parturition, maternal behaviour, perinatal kit mortality

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