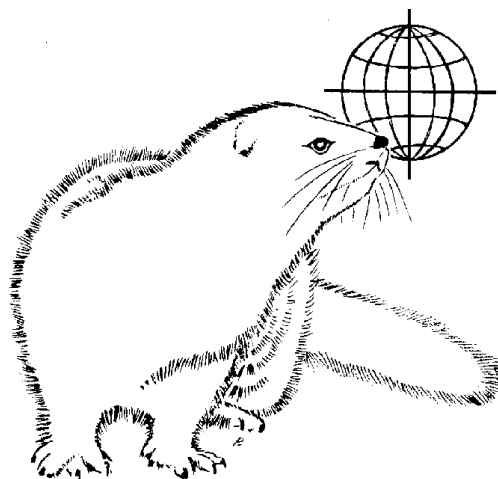


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**Proceedings of the VIIth International Scientific Congress
in Fur Animal Production**

Volume I: Scientific Program and Abstracts

Volume I : Scientific Program and Abstracts

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September 13, 2000

To the Delegates of the VII IFASA Congress, Kastoria, Greece

On behalf of the International Fur Animal Scientific Association (IFASA), I am most pleased to welcome you to the VII IFASA Congress, held in the beautiful Greek city of Kastoria. This city has a long history of importance to the fur industry, dating back several centuries, and, as you can easily discern, production of fur garments here remains an important part of the local economy. Thus, it is a fitting venue for our Congress.

The goal of the Congress is to bring together scientists from around the world to present new data, and to discuss the scientific aspects of the production of fur animals. As can be seen from the program, this goal has been met. We have manuscripts and presentations from Europe, the Americas, Asia and New Zealand, and we can look forward to lively scientific interaction at the Congress. A second goal of the Congress is to provide a forum for discussion of the social issues that are associated with the fur industry, and we expect that the program will promote this sort of discussion. Thirdly, IFASA, as an organization, is only as strong as its membership, and it is our hope that the members will actively participate in the decisions made at this Congress which will shape the future of the Association.

This Congress is the culmination of an organizational process that began in 1999, and it came to fruition as the result of the coordinated efforts of the Organizing Committee, the Scientific Committee, the Technical Committee and Symvoli Conference Organizers. I am certain that you will find the arrangements to your liking. Please participate in the scientific and social discussions, express your views about the future of IFASA, and, most important, enjoy your stay in beautiful Kastoria.



Einar J. Einarsson
President, IFASA


PREFACE TO THE PROCEEDINGS

These six volumes comprise the Proceedings of the VII IFASA Congress held in Kastoria, Greece, 13-15 September 2000. They can also be found in PDF format at the IFASA website (IFASANET.ORG). The proceedings are printed in black and white for budgetary reasons, nonetheless, color graphics, where present, can be viewed in the PDF versions of the manuscripts on the website. These manuscripts represent the original submissions of the authors, which were received and forwarded by the staff at Symvoli Conference Organizers, Kaitie Papadimitriou, Vicky Papadimitriou, and Alexia Tsiranidou. These articles were then sent to experts in each field for critical evaluation, then further edited before being printed.

I am grateful to the following individuals who reviewed manuscripts and provided their valuable editorial comment: Øystein Ahlstrøm, Birthe M. Damgaard, Vivi Pedersen, Niels Enggaard Hansen, Leif Lau Jeppesen, Leena Blomstedt, Steen H. Møller, Hans Henrik Dietz, Jan Elnif, Hilmer Sørensen and Outi Lohi. The Aleutian Disease Workshop volume was edited by the workshop moderator, Marshall Bloom, and the Workshop on Health and Disease in Mink production by the moderators, Steen H. Moller and Hans Henrik Dietz.

After review and editing, Micheline Sicotte made the revisions in the manuscripts, and Outi Lohi successfully undertook the enormous task of layout of more than 500 pages of text. Odette Hélie then converted the manuscripts into print format, which were transmitted back Symvoli, then to the printer. All this was completed in a relatively brief period, and thus it was not usually possible to return the manuscripts to the authors, either for editorial revision or for proofreading of the penultimate version. Many of the manuscripts required little or no editorial correction. Where extensive editing was required to meet the standards of form and syntax, I endeavored, to the best of my ability, to maintain the integrity of the text and figures as presented by the authors.

I am most grateful to all those who aided in this endeavor. The responsibility for the scientific content of the Proceedings lies with the authors. I accept the responsibility for any errors or omissions in the text.



Bruce D. Murphy
August 29, 2000

Scientific Program in the:

VIIth International Scientific Congress in Fur Animal Production

Kastoria, Greece 13 - 15 September 2000

Date and time	Session and lecture	Room
	Plenary lectures	
13.09 11:30	Effect of Housing Environment on Fur Animal Welfare <i>Mikko Harri</i>	A
13.09 14:00	Balancing Response to Selection and Rate of Inbreeding <i>Peer Berg</i>	A
14.09 09:00	Development and Maintenance of Fertility in the Mink Testis <i>R.-Marc Pelletier, Suk Ran Yoon, Ouafae Kabbaj and, María L. Vitale</i>	A
15.09 09:00	Nutrient Management in Carnivore Fur Bearers <i>Kirsti Rouvinen-Watt</i>	A
15.09 10:30	The Diversity of Mammalian Pelage <i>Keiji Kondo</i>	A
13.09.2000	Reproduction I: <i>Chairman: Anastasios Kovatsis</i>	B
11:30	Developmental and Seasonal Changes in Testicular Structure and Function in the Nutria (<i>Myocastor coypus</i> Mol.) Male <i>Olga Szeleszczuk, Piotr Niedbala</i>	
11:45	Prediction of American Mink Male Productivity (<i>Mustela vison</i>) <i>Tatiana M. Demina</i>	
12:00	The Hormonal Status in Mink and Fox during the First Year of Life <i>Nikolai N. Tyutyunnik, Lyudmila N. Sirotkina, Nikolai L. Rendakov</i>	
12:15	Embryo Technological Approach to the Problem of <i>ex situ</i> Preservation of Endangered Mustelidae Species <i>S. Amstislavsky, H. Lindeberg, J. Aalto, K. Piltti, M. Järvinen, E. Kizilova, G. Zudova, Yu. Ternovskaya, and M. Valtonen</i>	
13.09.2000	Reproduction II: <i>Chairman: Ludmila Osadchuk</i>	C
16:00	Social Competition Capacity and Reproduction in Blue Fox <i>Anne Lene Hovland, Bjarne O. Braastad and Morten Bakken</i>	
16:15	Reproductive Peculiarities of Marmots (<i>Marmota bobac</i>) Bred in Cages <i>Nikolay A. Balakirev, Tatiana I. Kazakova, Elena A. Tinaeva</i>	
16:30	Some Indicators of Reproduction Performance of Foxes Having Different Distance from an Observer <i>Ryszard Cholewa</i>	
16:45	Study of Freezing Semen Technology in Arctic Fox <i>Xiaomin Wu, Defei Li, Baochan Li, Xiaoyuan Geng</i>	
17:00	Prevention of Weaning Stress in Farm Mink by Injection of Mobicar <i>Lia K. Kozhevnikova, Nikolai N. Tyutyunnik, Victor M. Oleinik, Vjacheslav A. Berestov</i>	

14.09.2000	Reproduction III <i>Chairman: Maija Valtonen</i>	A
09:00	Development and Maintenance of Fertility in the Mink Testis <i>R.-Marc Pelletier, Suk Ran Yoon, Ouafae Kabbaj and, Maria L. Vitale</i>	
09:45	Photoperiodic Conditions, Sexual Maturation and Fertility in Mink (<i>Mustela vison</i>) <i>Klotchkov D.V.</i>	
13.09.2000	Genetics I <i>Chairman: Outi Lohi</i>	A
14:00	Balancing Response to Selection and Rate of Inbreeding <i>Peer Berg</i>	
14:45	Allometric Analysis of Body Measurements in Mink from Two Selection Lines <i>Kristin Sørensen and Wiebe J. Koops</i>	
15:00	Effects of Genetic Selection for Domestic Behaviour on Hormonal Control of Reproduction in the Silver Fox <i>Ludmila V. Osadchuk.</i>	
15:15	Genetic Trends in Population of Pastel Fox <i>Andrzej Jakubczak, D. D•browska, G.Jeóewska, S. Socha, G. Zi“ba</i>	
13.09.2000	Genetics II <i>Chairman: Kai-Rune Johannessen</i>	A
16:00	Genetics of Kit Growth and Maternal Weight Changes during Lactation in Mink <i>B.K. Hansen & P. Berg.</i>	
16:15	Penetration of Red Hairs in the Coat of Silver Foxes <i>Dag Inge Våge, Elin B. Stavdal & Helge Klunland</i>	
16:30	Selection Scheme and Genetic Improvement of <i>Orylag</i>® for Fur Production <i>R.G. Thébault, D. Allain , H. de Rochambeau and J.L. Vrillon</i>	
16:45	The Influence of Heterozygosity for “Black crystal” Mutation on Cranial Size and Shape in Mink <i>Kharlamova A.V., Faleev V.I., Trapezov O.V.</i>	
17:00	Some Anomalies in the Axial Skeleton of the Sable (<i>Martes zibellina</i> L) <i>Tatyana N. Petrina</i>	
17:15	Practical Utilisation of Picture Digital Analysis for Estimation of Polar Fox Body Size <i>Andrzej Jakubczak, Graóyna Jeóewska, Tomasz Sakowski, Grzegorz Zi“ba</i>	
14.09.2000	Genetics III <i>Chairman: Kerstin Smeds</i>	A
16:00	Live Grading as a Tool in Pelsdyrkontrollen <i>Kai-Rune Johannessen, Ejner Børsting & Helen Kristiansen</i>	
16:15	Selection for Increased Confidence in Foxes, and Possible Consequences for Production Economy <i>Nina V. Nordrum, U. T. Brenøe, Kai-Rune Johannessen and M. Bakken</i>	
16:30	Confident Behaviour and Production Traits - Results from a Field Study of Foxes <i>Sanna Nikula, K.Smeds, H.Hietanen, H. Kenttämies and Matti Ojala</i>	
16:45	What May Be the Consequences of Mink Selection for Aggressive and Domestic Behaviour ? <i>O.V. Trapezov</i>	
17:00	Genetic Change in Confidence and Some Production Traits in Blue Foxes (<i>Alopex lagopus</i>) Selected for Confident Behaviour <i>Hilkka Kenttämies and Kerstin Smeds</i>	

13.09.2000	Fur Properties I <i>Chairman: Daniel Allain</i>	C
14:00	Expression and Activity of Mink Skin Tyrosinase during Autumn Molt <i>Shigeharu Fukunaga, K.Kohno, K. Takenouchi, F.Nakamura, Keiji Kondo</i>	
14:15	Capillary Electrophoresis Analysis of Glycosaminoglycans in Mink and Fox Skin and its Potential for Predicting Quality of Pelt and Tanning <i>Bent Riis</i>	
14:30	The Beauty of Mink Pelage Observed with SEM <i>Keiji Kondo and Milan Vanek</i>	
14:45	Relationship between Feed Intake, Body Mass and Skin Length in Blue Foxes <i>Teppo Rekilä, Hannu Korhonen, Ilpo Pölönen and Mikko Harri</i>	
15:00	Effect of Steroids on Ferret Winter Pelage Growth <i>A.J. Pearson</i>	
15.09.2000	Fur Properties II <i>Chairman: Leena Blomstedt</i>	A
10:30	The Diversity of Mammalian Pelage <i>Keiji Kondo</i>	
11:15	Phenotypic Colour Relationship in Brown Mink (<i>Mustela vison</i>) Characterised by Sensory and Colorimetric Methods <i>Palle V. Rasmussen</i>	
14.09.2000	Nutrition I <i>Chairman: Spyros Tsitanmis</i>	B
09:00	Effect of Feed Extrusion Temperatures on Digestibility of Protein, Amino Acids and Starch in Mink <i>Kari Ljøkjel and Anders Skrede</i>	
09:15	Effect of Dietary Protein Level and Quality on Growth Rate and Fur Parameters in Mink <i>M.Kerminen-Hakkio, T. Dahlman, Niemelä, Jalava, Rekilä, Syrjälä-Qvist</i>	
09:30	Effect of Feed Protein Level on Fur and Skin of the Blue Fox <i>Dahlman, Tuula & Blomstedt, Leena</i>	
19:45	Effects of Dietary Protein and Carbohydrate Supply on Feed Consumption, Growth performance and Blood Parameters in Mink Dams during the Nursing Period <i>Birthe M. Damgaard, Christian F. Børsting and Rikke Fink</i>	
14.09.2000	Nutrition II <i>Chairman: Øystein Ahlstrøm</i>	C
16:00	¹⁴CO₂ Breath Test in Fed and Fasted Mink (<i>Mustela vison</i>) Using Methionine, Leucine and Valine as Substrates <i>Børsting, C.F. & Riis, B.</i>	
16:15	Effects of Dietary Mineral Content on Mineral Metabolism and Performance of Growing Blue Foxes <i>Jarmo Valaja, Ilpo Pölönen, T. Jalava, S. Perttilä and P. Niemelä</i>	
16:30	Effect of Dietary Folic Acid Supplementation on Formate Metabolism in Blue Foxes (<i>Alopex lagopus</i>) <i>Ilpo Pölönen, J.Valaja, T.Jalava, S.Perttilä, R. Sauna-Aho, S.Kariluoto</i>	
16:45	Effects of Lactic Acid Fermentation and Heat Treatment of Wheat and Barley on Digestibility in Mink <i>Anders Skrede, Grete Skrede and Stefan Sahlström</i>	
17:00	Detailed Study of Digestive Enzyme Activities in Fur-Bearing Animals during Postnatal Ontogeny <i>Oleinik V. M., Svetchkina E. B.</i>	
17:15	Thiamine Status in Farmed Mink <i>Petrova Galina, Ilyina Tatyana, Tyutyunnik Nikolay</i>	

15.09.2000	Nutrition III <i>Chairman: Anders Skrede</i>	A
09:00	Nutrient Management in Carnivore Fur Bearers <i>Kirsti Rouvinen-Watt</i>	
09:45	Metabolic Antagonisms in Mink: a Review <i>J.E. Oldfield</i>	
15.09.2000	Nutrition IV <i>Chairman: Birthe Damgaard</i>	B
10:30	Preservation and Storage Stability of Poultry Silage Feedstuffs <i>Kirsti Rouvinen-Watt, Margot White, Lori Longmire and Michael Johnson</i>	
10:45	Water Requirement of Farmed Foxes <i>Randi Oppermann Moe, Liv Lønne Dille, Morten Bakken</i>	
11:00	Effect of Succinic Acid on Hypotrophic Kits of Farm Mink <i>Unzhakov Alexei R., Kondrashova Marija N., Kozhevnikova Lia K., Tyutyunnik Nikolai N., Meldo Hilda I.</i>	
11:15	Measurement of Milk Production in Blue Fox Dams with Different Litter Size Using an Isotope Dilution Technique <i>Øystein Ahlstrøm, S. Wamberg, Gorm Sanson and Anne-Helene Tauson</i>	
13.09.2000	Behaviour / Welfare I <i>Chairman: Niels Agergaard</i>	A
11:30	Effect of Housing Environment on Fur Animal Welfare <i>Mikko Harri</i>	
12:15	Alternative Housing and Reproduction in Silver Foxes (<i>Vulpes vulpes</i>) <i>Vivi Pedersen</i>	
14.09.2000	Behaviour / Welfare II <i>Chairman: Vivi pedersen</i>	A
14:00	A Family Housing Experiment in Raccoon Dogs <i>Kasanen Sari, Mononen J., Harri M., Ahola L. & Pyykönen T.</i>	
14:15	A Family Housing Experiment in Mink <i>Jaakko Mononen, S.Kasanen, Harjunpää, Harri, Pyykönen, Ahola</i>	
14:30	Stress-Induced Responses in Farmed Blue Foxes <i>Mikko Harri, Heli Karhunen, Jaakko Mononen & Sari Kasanen</i>	
14:45	Information Value and Applicability of Mink Welfare Indicators for on Farm Assessment <i>Steen H. Møller & Steffen W. Hansen</i>	
15:00	Fifteen Years of Otter Breeding <i>O.V. Trapezov, L.I.Trapezova</i>	
15:15	The Effect of Response Type on the Demand for Food in Mink <i>Steffen W. Hansen, Margit B. Jensen, Lene J. Pedersen, Jan Ladewig and Lindsay Matthews</i>	
15.09.2000	Behaviour / Welfare III <i>Chairman: Jaakko Mononen</i>	B
09:00	Do Silver Foxes Become Feral when Housed in Outdoor Enclosures? <i>Leena Ahola, Mikko Harri, Jaakko Mononen, Teija Pyykönen</i>	
09:15	Peculiarities of Keeping, Feeding and Breeding of Steppe Marmots (<i>Marmota bobak</i> Mull.) and Black-capped Marmots (<i>M. camtschatica</i> Pall.) <i>Igor A. Plotnikov, Yuri S. Zabolotskikh</i>	
09:30	Behavioral Traits and Adrenal Function in Mink Selected for Tameness and Aggressiveness <i>Gulevich R. G., Kharlamova A. V., and Trapezov O. V.</i>	
09:45	What is the Attitude towards Protection of Animal Rights? <i>O.V.Trapezov, L.I.Trapezova, A.L.Simanov, E.M.Koldaeva</i>	

14.09.2000	Aleutian Mink Disease Workshop I <i>Chairman. Marshall Bloom</i>	B
14:00	Perspectives on Aleutian Disease <i>John R. Gorham</i>	
14:30	Aleutian Mink Disease Parvovirus Infections: Practical Insight from Basic Research	
15:00	<i>Marshall E. Bloom</i> Mink Plasmacytosis Vaccines <i>Bent Aasted</i>	
14.09.2000	AD Workshop II <i>Chairman. Marshall Bloom</i>	B
16:00	Impact of Outbreaks of Acute Aleutian Disease in Danish Mink Farms <i>Mariann Chriél</i>	
16:15	Aleutian Disease: Current Thought on Eradication <i>Gary R. Durrant</i>	
16:30	Cleansing and Disinfection Procedures in Connection with the Danish Aleutian Disease Eradication Programme <i>J. Østergaard, M. Chriél and C.M. Willadsen</i>	
16:45	Effect of <i>Mytilus</i> Hydrolyzate in the Mink at Reproduction and Viral Plasmacytosis <i>Nikolai Tyutyunnik, Ludmila Uzenbaeva, Victor Ilukha, Hilda Meldo</i>	
17:00	Prevalence of Genital Microorganisms in Aleutian Mink Disease Parvovirus (ADV)-Infected Female Mink <i>Pablo Martino, Nestor Stanchi and Juan Jose Martino</i>	
17:15	Modified Dot Immunoenzyme Assay of Antibodies against Mink Aleutian Disease Virus <i>Taranin A.V., Faizulin R.Z., and Miroshnichenko S.M.</i>	

13:09.2000	Health Status Workshop I: Health and Diseases in Mink <i>Chairman: Hans Henrik Dietz</i>	B
14:00	Current Infectious Disease Problems in United States Mink Distemper <i>Robert Westlake, DVM; John R. Gorham, DVM; PhD; Gary Durrant, DVM, PhD</i>	
14:15	Specific Prophylaxis of Salmonellosis, Carnivore Distemper and Adenovirus Infections in Caged Fur-Bearing Animals <i>Domski I.A., B.M. Zhitkov, Ulasov V.I., Malakhov Yu.A., Zakharova Ye.D.</i>	
14:30	Mortality in Ranch Raised Mink: A Year in Review <i>Gary R. Durrant</i>	
14:45	Health Surveillance in Danish Mink Farms - a Prospective Study <i>Hans Henrik Dietz, Thomas Holmen Andersen & Mariann Chriél</i>	
15:00	Outbreaks of Mink Distemper in Denmark during 1999: Epidemiological Observations <i>Claus. M. Willadsen</i>	
15:15	Lipogranulomatous Lesions in Mink with Hyperlipoproteinemia/Typ.I <i>Knut Nordstoga, Bjørnar Ytrehus, B. Christophersen, Gunilla Olivecrona</i>	
13.09.2000	Health Workshop II: Health, Management and Welfare in Mink <i>Chairman: Steen H. Møller</i>	B
16:00	Disease and Production Management in Mink Farming. <i>Bert Urlings, Haiko Koenen</i>	
16:15	Medication in Danish Mink Farms <i>Mariann Chriél and Hans Henrik Dietz</i>	
16:30	Health Effects of Feeding Strategies in the Pre-Mating and Gestation Periods of Mink <i>S. H. Møller & M. Chriél</i>	
16:45	Some Aspects of Feeding and Welfare of Mink <i>Eva Aldén</i>	
17:00	Indicators of Health and Welfare Observed at Pelting of Mink <i>Steen H. Møller</i>	
17:15	Reflections on the Relationship between Genetics, Nutrition and Health in Modern Mink Production <i>Lena Englund</i>	

Poster Program

VIIth International Scientific Congress in Fur Animal Production

Kastoria, Greece 13 - 15 September 2000

Poster session I

Wednesday 13.09.2000 12:30 - 14:00

Genetics

- 1. Characteristics of Selected Morphological and Chemical Blood Indices of Polish Ring Neck Fox**
Czerkas R., Frindt A., Grogowski R., Majewska B, Winnicka A., Kluczyński W.
- 2. Heritability of Motion Activity in Ferrets (*Mustela putorius*) under Open Field Conditions**
Ján Rafay
- 3. Genetic Diversity of Farmed Finnish Silver Fox (*Vulpes vulpes*)**
Minna Rintamäki & Jaana Tähtinen
- 4. Phylogenetic Aspects of Study on Variability of Alpha-Macroglobulins of the American Mink among Closely Related Species of the *Mustelidae* Family and some Other Taxons**
Margarita A. Savina, Ivan G. Gorelov, Victor I. Yermolaev
- 5. The Heritability and Correlation Coefficients of Selected Traits in Common Silver Foxes (*Vulpes vulpes* L.)**
Stanislaw Socha, Grażyna Jeżewska, Aldona Gontarz
- 6. Effect of Behaviour on the Expression of Coat Colour Mutations in American Mink**
O.V. Trapezov
- 7. Mink Domestication and Homologous Coat Colour**
O.V. Trapezov
- 8. Behaviour and Expression of White Piebaldness in Mink**
O.V. Trapezov
- 9. Selection of Mink for Behaviour Affects the Reproductive Function and Time of Eye Opening**
O.V. Trapezov
- 10. Asymmetry in the Expression of White Piebaldness in Mink and its Relation to Reproductive Function**
O.V. Trapezov

Poster session I

Wednesday 13.09.2000 12:30 - 14:00

Reproduction

11. **The Evaluation of Selected Reproductive Parameters of Mink in Relation to the Coat Colour Variety**
Felska Lidia, Sulik Małgorzata
12. **Vitamins A and E in Mink Blood during Reproduction**
Ilyina Tatyana, Ruokolaynen Tatyana, Petrova Galina.
13. **Early Embryonic Development of Standard Dark and Sapphire Mink whose Parents Were Exposed to Reduced Daylight**
Galina K. Isakova, Rimma G. Gulevich, and Dmitry V. Klochkov
14. **October hCG Challenge of Estrus Cyclicity as a Predictor of Folliculogenesis and Fertility in Mink**
Klotchkov D.V., Eryuchenkov P.A
15. **Effect of an Empty Cage between Female Ranch Mink (*Mustela vison*) in the Reproduction Period**
Lise Overgaard
16. **The Analysis of the Seasonal Character of the Chinchilla (*Chinchilla velligera* M.) Reproduction**
Stanislaw Socha, Agnieszka Wrona
16. **Development of Assisted Reproductive Techniques in Farmed Fur Animals**
M. Valtonen, H. Lindeberg and M. Järvinen
17. **Folliculo-stellate Cells of the Mink Anterior Pituitary and the Control of Anterior Pituitary Hormone Secretion**
María L. Vitale and Julie Cardin
18. **Ultrastructural and Cytochemical Study of the Cleavage of the Mink Embryo**
Helen A. Kizilova, Alevtina N. Golubitsa, Antonina I. Zhelezova, Sergey I. Baiborodin, Oleg L. Serov

Poster session I

Wednesday 13.09.2000 12:30 - 14:00

Behaviour and Welfare

19. **Activity and Stereotypic Behaviour in Mink Dams Fed *Ad Libitum* or Restricted during the Winter**
Birthe Houbak & Steen H. Møller
20. **Relationship between Weather Conditions and Cub Losses in Farmed Blue Foxes**
Ilukha, V., Harri, M., Rekilä, T.
21. **Stress-Induced Hyperthermia in Confident and Fearful Mink**
H. Korhonen, S.W. Hansen, J. Malmkvist and B. Houbak
22. **Measuring Maternal Care in Mink: Kit Retrieval Test**
Jens Malmkvist and Birthe Houbak
23. **Raising of Young Muskrat (*Ondatra zibethicus*) in Cages of an Industrial Type**
Mukhamedvail M. Mukhamedyanov
24. **Reaction of the European Polecat to the American Mink Introduction in Experiments**
Andrey A. Petrin
25. **Characteristic and Optimization of Husbandry Conditions of Herbivorous Fur-bearing Animals**
Igor A. Plotnikov, Oleg Yu. Bespyatyh, Victor Z. Gazizov, Igor A. Donski
26. **How to Farm Sables**
O.V.Trapezov, L.I.Trapezova, A.V.Sajdinov
27. **Measuring the Essentiality of Swimming Water for Farmed Mink by a Classic Conditioning Technique**
C.M. Vinke and B.M. Spruijt

Poster session II

Thursday 14.09.2000 12:00 - 14:00

Fur Properties

- 28. The Concentrations of Selected Elements (Ca, Cu, Zn, Mg, P) in Mated Polar Fox Female Hair.**
Danuta Dzierżanowska-Góry & Robert Gągowski
- 29. The Effect of Melatonin Treatment on Feed Intake, Body Weight, Fur Maturation Period and Fur Length in Growing Chinchillas**
József Lanszki, Daniel Allain, René-Gérard Thébault, Zsolt Szendrő
- 30. The Effect of Melatonin Treatment on Hair Follicle Activity in Growing Chinchillas**
József Lanszki, Daniel Allain, René-Gérard Thébault, Zsolt Szendrő
- 31. Effect of Biostimulator Mival on the Quality of Mink Hair-coat Covering**
Pavel P. Orlov, Nelya A. Shulyatyeva
- 32. Assessment of Selected Quality Parameters of Chinchilla Pelts Offered by Polish Breeders on the CFC (Copenhagen Fur Center) Auction**
Małgorzata Sulik, Lidia Felska, Grzegorz Mileżuk

Poster session II

Thursday 14.09.2000 12:00 - 14:00

Nutrition

33. **Meat-and-bone Meals from Different Animal By-products as Protein Sources for Fur Animals**
Øystein Ahlstrøm, Anders Skæde, Ole Sylte Heggset, Oddvar Mikkelsen and Sissel Frogner Tangen
34. **Comparison of Feed Digestibility Determined *in vivo* in Nutria and *in vitro* by Laboratory Methods**
Bogusław Barabasz
35. **The Decrease of Food Losses in Feeding Nutria**
Oleg Yu. Bespyatykh, Igor A. Plotnikov
36. **Different Energy Distribution in the Feed for Mink Females in the Winter and Reproduction Period.**
Carsten Hejlesen and Tove N Clausen
37. **Body Length and Pelt Length Relationship**
William L. Loeschke and Mark Michels
38. **Determination of Body Composition in Mink (*Mustela vison*) Kits Using Hydrogen Isotope Dilution and Direct Carcass Analysis**
Heather N. Layton, Kirsti I. Rouvinen-Watt and Sara J. Iverson
39. **Effects of a New Generation Feed Supplement on Some Performance Indices and Health State in Mink**
Lorek M. O., Gugołek A., Szarek J., Przeździecka D.
40. **Nutrient Excretion and Manure Management in the Mink Industry**
Cory W. Newell, Kirsti I. Rouvinen-Watt, Derek M. Anderson and Michael A. Johnson
41. **Effects of Different Fat Supplements on Liver Lipids and Fatty Acids and Growth of Mink**
Ilpo Pölönen, Reijo Käkelä, Maija Miettinen and Juha Asikainen
42. **Use of Culled Hens and Hen Silage in Growing-Furring Diets for Mink**
Kirsti Rouvinen-Watt, Margot White, Tanya Morse, Daphne Boudreau and Michael Johnson
43. **Potato Industry By-products as Feed Ingredients for Mink during the Growing-Furring Period**
Kirsti Rouvinen-Watt, Margot White, and Michael Johnson

PLENARY SESSION ABSTRACTS

Effect of Housing Environment on Fur Animal Welfare

Mikko Harri

The idea that fur animals have poor welfare and that this poor welfare is causally related to their housing environment sounds attractive. However, this idea is both trivial and naive: i) Current housing systems are based on long-term developmental work. In them, animals remain healthy, grow and reproduce well and produce a high-quality skin. These goals are not contrary to good welfare, rather the opposite holds true. ii) Animal welfare is largely an ethical issue. The relative importance that individuals attach to different elements of animal welfare is, by the very nature of the issue, not a purely factual matter, nor can it be made a purely factual matter by any known type of scientific research. iii) Selection for or against a trait and positive man-animal contacts can improve the welfare of fur animals more than even large modifications in their housing design. iv) The positive welfare effects of any new system should be weighed against the negative effects of the system. For example, larger space, or a possibility for concealment provides animals with a more complex environment, but also prevents contacts with human resulting in more stressed and more fearful animals. Research has shown that a resting platform, a concealment screen and a gnawing block may have more positive than negative effects on fox welfare, whereas a solid floor, a possibility to dig or a larger cage do not. A nest box with a tunnel entrance or a nest box mounted on the roof of the cage may improve reproductive success of primiparous vixens. Mink need a nest box, but not a larger cage. Recent research has been focused on need for swimming water for mink, on social environment in foxes and raccoon dogs, and on group housing in mink, foxes and raccoon dogs. Both positive and negative results have been obtained and still more research is required before conclusions can be drawn.

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Balancing Response to Selection and Rate of Inbreeding

Peer Berg

In a finite population, inbreeding increases with time. In selected populations, the rate of inbreeding is further increased by increased variation in the contribution of individual families to future generations. There are two major decisions influencing the progress of a breeding scheme, which animals to select for breeding and how to mate them. Strategies to reduce the rate of inbreeding or increase response to selection at a given rate of inbreeding are based on changing systems of mating, selection methods or both. Constraining the rate of inbreeding or penalising selected animals for their effect on the rate of inbreeding reduces response to selection in the short term. But as a lower rate of inbreeding results in a smaller reduction in genetic variation, larger response to selection is obtained in future generations. An example is given for the short-term trade-off between response to selection and rate of inbreeding in mink. Effects of current selection decisions on inbreeding should be taken into account in order to maximise response to selection in the longer term.

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Development and Maintenance of Fertility in the Mink Testis

R.-Marc Pelletier, Suk Ran Yoon, Ouafae Kabbaj and, María L. Vitale

It has been estimated that up to 20-30% of male mink experience some form of reproductive disturbances including primary or secondary infertility. Puberty is indefinitely delayed in primary infertility. In the secondary infertility, males spontaneously develop pathological features consistent with an inflammation of the testes called auto immune orchitis (AIO) that leads to infertility. The present study assesses the relation between the changes in the permeability status of the blood-tissue barriers of the male reproductive system to

vascularly infused tracers and 1) the content of the germ cell and 2) the serum levels of anti-sperm antibodies (Ab) measured by ELISA and immunofluorescence microscopy during post natal development and during the annual reproductive cycle of the adult mink. The results show that periods of transient permeability of the barrier are not accompanied by significant increase in serum anti-sperm Ab. Infertile adult mink showed significant transient increase of their serum anti-sperm Ab. In addition, serum testosterone levels were significantly lower in infertile than in fertile mink. There was no significant difference in the intratubular levels of Fas ligand between fertile and infertile mink. Fas intratubular levels were significantly higher in fertile than in infertile mink. Apoptosis measured by cell death detection ELISA was maximal coincidentally with the disappearance of the spermatocytes and round spermatocytes. The result show that the blood-tissue barrier is not an immunological barrier.

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Nutrient Management in Carnivore Fur Bearers

Kirsti Rouvinen-Watt

This plenary paper will summarize selected topics in the area of nutrient management in carnivore fur bearers over the past decade, using primarily the mink as a model animal. It will apply a "head to tail" approach and will focus in areas of digestive development, nutritional requirements, nutrient digestion, absorption and metabolism, as well as nutrient excretion and manure nutrient management. Nutrient management in conditioning of breeding and nursing females and in prevention of urinary calculi are highlighted. Some of the topics covered are excerpts from Rouvinen (1996) and are used here with the permission of the Canadian Feed Industry Association.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. II, 25-35

The Diversity of Mammalian Pelage

Keiji Kondo

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 Mesozoic era ruined the dinosaurs, and resulted in their replacement by mammals. One of the factors that made mammalian survival possible under the drastic environmental changes was their covering of hair.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. II, 36-41

REPRODUCTION ABSTRACTS

Developmental and Seasonal Changes in Testicular Structure and Function in the Nutria (*Myocastor coypus* Mol.) Male

Olga Szeleszczuk, Piotr Niedbala

Studies on characterisation of seasonal and growth changes in spermatogenic and steroidogenic activities were carried out on 34 males which were, at the beginning of experiment, aged: Group I -10 months; Group II -6 months; Group III -2 months. Blood and sections for histological and histochemical investigations were collected from May 1995 to April 1997 at the beginning of each month. Testosterone level was determined in blood sera using RIA method. Functional status of testes was defined based on spermatogenic index, as well as on diameter measurements and wall thickness of seminal ducts. Steroid activity in male testes was examined by activity measurement of $\Delta^5 3\beta$ steroid dehydrogenase (HSD).

The presence of all developmental stages of spermatogenesis was observed in nutria males throughout the year. During the period of increased sexual activity, the number of seminal ducts containing spermatids transformed into spermatozoa was increased. The highest spermatogenic index occurred during winter months, with a decreasing tendency in spring and summer. HSD and diaphoresis activities were present all year round and were significantly higher during the period of increased breeding activity. The highest testosterone level was observed in September and October (1190 and 1149.6 pg/ml respectively), with lower values in the summer months (149-268 pg/ml).

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Prediction of American Mink Male Productivity (*Mustela vison*)

Tatiana M. Demina

The aim of the present research was to search for signs that characterize future male reproductive ability. Every month, body mass of 248 males (from 3 to 6 months old) was determined to find out

termination date of body mass increase. Termination of mink growth was defined by body mass increase during a month. If it was equal to 0, growth was finished. Then reproductive ability of males, whose growth was finished at different age, was analyzed. Males with prolonged growth (increase of mass finished in October and later) had lower productivity indices in comparison with rapidly grown mink (that ceased growth in August-September): 21 cubs against 26, $P < 0,001$.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. III-A, 9-10

The Hormonal Status in Mink and Fox during the First Year of Life

Nikolai N. Tyutyunnik, Lyudmila N. Sirotkina, Nikolai L. Rendakov

The endocrine function of thyroid gland, adrenal cortex and gonads in dark-brown and colored mink and arctic foxes in relation to physiological events (mating period, pregnancy and lactation), stage in the postnatal ontogenesis period, influence of the season and species were investigated. Radio-immunoassays were used to investigate the hormonal status (thyroxine, triiodothyronine, cortisol, testosterone, progesterone and oestradiol) in the serum of peripheral blood of the animals on various fur farms. High thyroid, cortisol and oestradiol hormone levels were recorded in kits, aged two - four months. The peak of triiodothyronine, cortisol and testosterone activity coincided with the beginning of mating period.

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Embryo Technological Approach to the Problem of *ex situ* Preservation of Endangered Mustelidae Species

S. Amstislavsky, H. Lindeberg, J. Aalto, K. Piltti, M. Järvinen, E. Kizilova, G. Zudova, Yu. Ternovskaya, and M. Valtonen

A number of Mustelidae species are nowadays endangered and even threatened to be extinct. The

European mink (*Mustela lutreola*) is a high priority species for European *ex situ* conservation programs. Different approaches for mustelidae embryo transfer and embryo cryobanking have been compared within the framework of this study using polecats (European polecat, steppe polecat and domestic ferret) as the model species. Embryo transfers from European polecat to the conspecifics or domestic ferret were successful in the majority of the cases when pseudopregnant females mated in advance to surgically or genetically sterilized males were used as the embryo recipients. Cryopreservation technology was adapted to mustelid embryos. Effectiveness of different cryoprotectants was compared and viability of frozen-thawed embryos was investigated. Prospects of European mink *ex situ* preservation are discussed.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. III-A, 14

Social Competition Capacity and Reproduction in Blue Fox

Anne Lene Hovland, Bjarne O. Braastad and Morten Bakken

Social status is previously shown to be related to reproduction in silver fox vixens. In this study 40 primiparous blue fox vixen cubs were selected for high (n=20, H-group) or low (n=20, L-group) social competition capacity based on previous food-competition tests. The vixens were housed singly in standard wire cages with food and water *ad libitum*, and given access to a breeding box with tunnel at delivery. Development of heat, mating date, litter size at delivery and at weaning were recorded for all vixens. The results showed that 60% of the vixens in the H-group delivered and successfully weaned cubs compared to 15% of the vixens in the L-group.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. III-A, 15

Reproduction Peculiarities of Marmot (*Marmota bobac*) Bred in Cages

Nikolay A. Balakirev, Tatiana I. Kazakova, Elena A. Tinaeva

The present research was conducted on the State pedigree farm "Pushkinskiy" situated in Moscow region. Its aim was to create a highly productive marmot population adapted to cage breeding. The peculiarities of marmot reproduction were studied on 54-60 pairs of marmots annually for 3 years. Influence of age structure of the population on reproductive success was estimated in some experiments. Percentage of females bearing litters, number of males effective in insemination, and fertility were taken into account. Possibilities for marmot reproduction with a level of polygamy of 1:2 were established. Characteristics of reproductive organs were studied by histological methods. A cohort of 30 % young females successfully reproduced. The greatest proportion of females with young (66.7 - 50 %) were found among 4-5 year old cohort.

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Some Indicators of Reproduction Performance of Foxes Having Different Distance from an Observer

Ryszard Cholewa

Tests on foxes representing two species suggested that behavioral differences in the animals can also have an influence on their reproductive performance. These influences may be manifested in various ways, depending on the species and/or sex. For a better understanding of those issues, experiments were carried out to define the effects of distance from observer to nest box. An attempt was made to determine if there is a correspondence between the distance - fox and observer, and indicators of reproduction performance in the fox. A smaller distance between a fox and an observer was tolerated by polar foxes, compared to silver foxes. During subsequent observations (carried out monthly) the distance between the animal and the

observer became smaller. Conditions of accommodation (type of box) were of little importance and did not influence the animal reaction to man.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. III-A, 20

Study of Freezing Semen Technology in Arctic Fox

Xiaomin Wu, Defei Li, Baochan Li, Xiaoyuan Geng

During the 1999 breeding season, we obtained the sperm of arctic fox by electroejaculation. We studied freezing sperm. We determined a prescription of semen freezing diluent at the ShaanXi Institute of Zoology No. 01. By added egg yolk, citrate and glycerol, the sperm was preserved until thawing. Its motility was preserved after thawing. We also determined the rate of lowering the temperature, and the time required for semen freezing. The thawing temperature and effect of freezing were further studied.

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Prevention of Weaning Stress in Farm Mink by Injection of Mebicar

Lia K. Kozhevnikova, Nikolai N. Tyutyunnik, Victor M. Oleinik, Vjacheslav A. Berestov

With the use of spectrophotometry methods the activity of blood serum enzymes – lactate dehydrogenase (LDH), alkaline phosphatase (AP), aspartate-aminotransferase (ASAT), alanine-aminotransferase (ALAT) and level of plasma corticosteroid hormones were determined in the period when the young mink were weaned from their mothers. The high level of corticosteroids, ASAT, ALAT and decline of LDH activity was observed in kits and females under weaning stress. The injection of Mebicar had a pronounced antistress effect – normalizing the level of plasma corticosteroids and activity of serum enzymes. Mebicar addition at a dose of 250 mg per kg body

weight to daily ration had no negative effect on mink metabolism, fertility or fur quality.

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Photoperiodic Conditions, Sexual Maturation and Fertility in Mink (*Mustela vison*)

Klotchkov D.V.

Physiological aspects of puberty are of great importance for acquisition of reproductive capability. Young standard mink females were taken as a model for experiments. Initiation of early autumn was provided by the two light regimes: 1. Permanent lighting from June 20 to July 20 with subsequent maintenance of animals under a shortened 8 hours of daylight from July 21 to October 10 (Group I); 2. Maintenance of animals under the regime limited to 8 hours of light from July 21 to October 10 (Group II). The dynamics of estrous cycles for the autumn and winter months were studied by vaginal smears.

Long before the reproductive season (March) mink kept under natural light were in the state of estrus. The percentage of mink in estrus corresponded to 3.3, 9.1, 27.0, and 88.4 at Nov. 1, Nov. 15, Dec. 7 and Jan. 11 respectively. The time of appearance of estrus changed significantly in experimental light conditions, 12.5, 44.0, 50.0, 59.4, and 85.0 percent of females of group I were in estrus at Oct. 15, Nov. 1, Nov. 15, Dec. 7, and Jan. 11 respectively. Females of group II experienced an earlier estrus compared to control but this was less evident than in group I. It was shown that mink of group I had earlier and decreased number of matings and increased level of fertility. A study of vaginal smears of mink (n=1411) in December (18-28) showed that the fertility of mink in anestrus in December was 6.78 ± 0.07 , while in those showing signs of estrus in December was 7.09 ± 0.07 ($P < 0.01$). An activation of folliculogenesis in females with signs of estrus in November was revealed by histological analysis.

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The Evaluation of Selected Reproductive Parameters of Mink in Relation to the Coat Colour Variety

Felska Lidia, Sulik Małgorzata

Profitability of farm production depends, in large extent, on the reproductive results such as mating and time of birth, and the number of young delivered per litter. The present study was aimed at analysis of selected reproductive parameters of mink, depending on a variation of conditions of large-scale breeding. The data were collected within 1998-1999 on a large-scale mink farm. In 1998 the brood stock consisted of 3899 females and in 1999 of 4389 females. Three colour varieties of mink were investigated: standard, pearl and wild. All animals were kept under the same nutritional and housing conditions. Females of all colour varieties mated in both reproductive seasons between 9-20 March, according to the system of triple mating 1 + 1 + 7-8. The subsequent analysis of reproduction revealed that in the second year of breeding, females of all colour varieties started to give birth earlier and the percentage of infertility was reduced. According to Venge (1973) pregnancy lasting more than 50 days increases the number of infertile females and lowers the litter size. The best reproductive success was observed for the mink of the pearl and wild varieties. The standard variety females had the shortest pregnancy. Their average size of litter, however, was the lowest and their percentage of infertile individuals was the highest. In the standard variety the length of pregnancy is inversely correlated with the number of the young delivered. Taking into account the highest market demand for the skins of this particular colour variety of mink it should be worth continuing the present study in order to determine the causes of this phenomenon.

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Vitamins A and E in Mink Blood during Reproduction

Ilyina Tatyana, Ruokolaynen T., Petrova Galina.

The concentration of vitamins A and E in the blood serum of mink was studied using high-performance liquid chromatography. The results demonstrate that a significant difference in the vitamin A concentration was observed between females and males during pre-mating and mating periods. At mating, an increase of the vitamin E in the blood of mink females in comparison to males, can be seen. Pregnancy was characterized by the change of vitamin level in response to the stress of gestation.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. III-A, 35-37 (Poster)

Early Embryonic Development of Standard Dark and Sapphire Mink whose Parents Were Exposed to Reduced Daylight

Galina K. Isakova, R.G.Gulevich, D.V. Klochkov

Standard Dark and Sapphire young mink were exposed to natural (control) or reduced (8L: 16D, from July 22 till October 10) daylight. Seven days after single mating in March, all females were examined for their pregnancy state. In Standard Dark mink, a reduced daylight regime was found to cause the more frequent arrest of embryonic cleavage. In Sapphire mink, the experimental subjects showed an increase in the number of eggs per female, a decrease in the proportion of unfertilized eggs, and delay in transition of embryos from oviduct to uterus. The level of progesterone in peripheral blood was on average 1.8 ng/ml both in Standard Dark and Sapphire control females, and 2.6 ng/ml in experimental mink.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. III-A, 38-41 (Poster)

October hCG Challenge of Estrus Cyclicity as a Predictor of Folliculogenesis and Fertility in Mink

Klotchkov D.V., Eryuchenkov P.A

The reactivity of sexual system of mink in October to the intramuscular injection of chorionic gonadotrophin (hCG, Profasi R, Italy) in doses 10, 20, 50, 100 IU was studied. The vaginal smears

were assessed during the two weeks following hCG injections. The stages of the cycle were estimated by traditional method and were classified as anestrus (A), anestrus-proestrus (AP), proestrus (P), proestrus-estrus (PE), estrus (E). Progressive shifts in development of vaginal epithelium begin from day 2 and reach maximal value on day 6 after hCG injection. It was concluded that the dose of 20 IU of hCG (injection in October 10) was useful for assessment of functional polymorphism of mink reproductive function. The females (n=185), on day 6 after injection of this hCG dose, displayed the following estrous cycle characteristics : A-71(38.4%), AP-37(20.0%), P-30 (16.2%), PE-14(7.6%), E-33(17.8%). A statistically significant increase of fertility was registered in groups AP and P, with mean litter sizes of 6.8 ± 0.4 and 6.3 ± 0.4 respectively. The level of fecundity in control and groups A, PE, E were 5.4 ± 0.1 , 5.4 ± 0.3 , 4.7 ± 0.9 , 5.6 ± 0.5 respectively.

A histological investigation of ovary in November showed that potential fertility of mink females can be determined by assessment of the capability to generate maximal number of vesicular follicles. The overall number of follicles was less informative.

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Effect of an Empty Cage between Female Ranch Mink (*Mustela vison*) in the Reproduction Period

Lise Overgaard

The aim of this study was to evaluate whether the density of animals in a shed would affect the reproduction of female mink and the behaviour of the females during the nursing period. The study was conducted during two reproduction periods in primiparous standard mink. One group was placed with an empty cage between females, while in other group females were in adjacent cages. The number of kits born and weaned was recorded and the kits were weighed at weaning. The female reactivity was evaluated according to how often they varied between being in the nest box and in the cage during 10 minute observation periods over five weeks. To assess female nesting ability a 'kit-retrieval-test' was done. Females placed in every second cage weaned

more and larger kits, and had lower kit mortality from birth to weaning. They were less reactive and were less willing to leave their nest boxes. It was concluded that fewer mink in a shed had a positive effect on female welfare.

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The Analysis of the Seasonal Character of the Chinchilla (*Chinchilla velligera* M.) Reproduction

Stanislaw Socha, Agnieszka Wrona

The aim of our study was analysis of chinchilla female fecundity, taking into consideration the analysis of seasonal character in reproduction and litter size. We studied the chinchilla reproduction over five years (1994–1998). In this period 462 litters were obtained on the farm. Two basic traits related to reproduction were recorded, the number of born and the number of weaned chinchilla. The greatest frequency of whelping was in March (13% of the year), slightly less in April and July (12%). The number of kits was much lower in winter months (3.6% in December and 2.8% in January). The mean number of chinchillas born varied from 1.81 to 2.36 per litter, according to the month. The mean number of chinchillas weaned varied from 1.57 to 1.98 (apart from January), but differences were not statistically significant.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. III-A, 49-52 (Poster)

Development of Assisted Reproductive Techniques in Farmed Fur Animals

M. Valtonen, H. Lindeberg and M. Järvinen

Artificial insemination, embryo transfer and *in vitro* production of embryos as well as cryopreservation of oocytes, embryos and spermatozoa are assisted reproductive techniques used today in a variety of animals. In fur animal production, only artificial insemination of foxes is used routinely. Embryo transfer and *in vitro* production are rare in fur industry. These techniques serve better research

purposes which aim at conservation of endangered carnivores, using farmed foxes and mustelids as model species. So far, surgical embryo transfer has been successful in the silver fox, the blue fox and the polecat. In the blue fox, transcervical embryo transfer has been successful. Transfer of frozen-thawed embryos has been successful only in the polecat, but implantation sites in uteri of the blue fox indicate possible success in the near future. These techniques can also be utilized commercially in fur industry.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. III-A, 53-55 (Poster)

Folliculo-stellate Cells of the Mink Anterior Pituitary and the Control of Anterior Pituitary Hormone Secretion

María L. Vitale and Julie Cardin

Folliculo-stellate (FS) cells of the anterior pituitary are agranular, non-endocrine cells with a characteristic stellate shape. Several roles have been ascribed to these cells. Initially, they were thought to be mainly supportive cells and to be involved in phagocytosis. More recently, an important role in the control of the immune response and hormone secretion has been suggested. FS cells express proteins, such as the S-100 protein, that are not expressed by endocrine cells of the anterior pituitary. Mink anterior pituitary possesses two morphologically different S-100 immunopositive cells. Type I were stellate-shaped cells that were more abundant during periods of high prolactin secretion. Type II were rounded cells that were more abundant during periods of high gonadotropin secretion. The total number of S-100 positive cells of the mink anterior pituitary did not vary during these two periods of the annual reproductive cycle suggesting that type I and type II are two different

states of the same cell. Mink S-100 positive cells possessed Cx43-labelled gap junctions, and the number of these junctions increased concomitantly with the increase in type I S-100 positive cells and with the increase in prolactin secretion. The present results suggest that type I S-100 positive cells may contribute to the release of prolactin by modulating communication among cellular elements involved in the control of prolactin secretion.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. III-A, 56-61 (Poster)

Ultrastructural and Cytochemical Study of the Cleavage of the Mink Embryo

Helen A. Kizilova, Alevtina N. Golubitsa, Antonina I. Zhelezova, Sergey I. Baiborodin, Oleg L. Serov

Fifty-four normal embryos flushed from 10 females (Standard) were studied using transmission-electron microscopy and Ag-NOR staining. First signs of blastomere polarization were observed at the 8-12-cell stage. Redistribution of organelles, vesicles and granules, appearance of apical microvilli and lateral cell contacts took place at this stage. Compaction began at 20-28-cell stage, but at least 2 cell cycles need to complete the cavitation process. Abundant lipid granules were structurally modified during the blastomere differentiation to ICM and trophoblast. The development of a functional nucleolus with fibrillar and granular components were observed from 6-8 to 12-16-cell stages. The results indicate activation of embryonic RNA synthesis in mink embryo at the 10-12-cell stage.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. III-A, 62 (Poster)

GENETICS ABSTRACTS

Allometric Analysis of Body Measurements in Mink from Two Selection Lines

Kristin Sørensen and Wiebe J. Koops

The objective of this study was to analyze the body composition of male (M) and female (F) kits at pelting. Animals originated from the seventh generation of lines selected for high (H) and low (L) feed efficiency. Body measurements included body weight, carcass weight, skin length, weight of pelt including fat, and weight of pelt after fleshing. This analysis concentrates on body weight and pelt weight after fleshing and fat. Allometric analysis of growth in traits relative to body weight was done in the four groups (H-M, H-F, L-M, and L-F). In this analysis, no effect due to selection lines was observed. Pelt weight has the same growth coefficient in males and females but with different intercepts. Weight of fat relative to body weight differed in both growth coefficient and intercept between males and females.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. III-B, 65-67

Effects of Genetic Selection for Domestic Behaviour on Hormonal Control of Reproduction in the Silver Fox

Ludmila V. Osadchuk.

To establish genetic and physiological mechanisms of the early evolution of domestic animals, a model of silver fox domestication was developed at our institute by long-term selection for a lack of aggression and fear towards man (domestic behaviour). The aim of this presentation is to show changes in the gonadal function of domesticated foxes. The levels and the in vitro production of reproductive hormones (testosterone, oestradiol and progesterone) were measured. Additionally sperm production, potential fertility, embryonic mortality and reproductive behaviour were assessed. Our study has shown a time shift of the annual rhythm of ovarian activity and a depressed relationship between photoperiod and endogenous hormonal cycles in domesticated foxes. Domesticated vixens were also more resistant to the detrimental effects of

the artificial photoperiods on hormonal secretion and fertility. The shorter period of testicular activity, lower sperm production and sexual activity was found in domesticated males. Selection also reduced sexual and increased agonistic behaviour in domesticated males during bisexual encounters. The study of fetal development indicated heterochrony in the pituitary-testicular axis in domesticated animals. In conclusion, selection for domestic behaviour can bring about a considerable destabilization of the gonadal function for a short period of time.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. III-B, 69-72

Genetic Trends in Population of Pastel Fox

Andrzej Jakubczak, Danuta D•browska, Grażyna Jeńowska, Stanisław Socha, Grzegorz Zi"ba

Studies were carried out on fur animal breeding farm in Jeziory Wielkie near Poznań. Females of common fox with a total of 4155 pastel offspring were investigated for the period from 1978 to 1997. Efficiency of the breeding was evaluated by the following traits: litter size at birth, and weaning as well as an individual index of external conformation traits (including body size and fur colour and quality). Genetic trends were estimated using a BLUP method with a multitrait animal model. For all investigated traits, with exception of litter size at birth, a tendency toward increase was found during the years under investigation. This shows the breeding strategy was well conceived in this herd.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. III-B, 73

Genetics of Kit Growth and Maternal Weight Changes during Lactation in Mink

B.K. Hansen & P. Berg.

The objective of this study was to establish whether genetic variation for early growth of kits and weight changes of the dam during lactation exists, and to describe the genetic correlation between these traits. Three selection lines of the Scanblack colour type

were established in 1996. The selection criteria were litter size (line 1), growth of kits caused, by the kit growth capacity (line 2), or by maternal ability to induce growth (line 3) in kits. Altogether, records of 5977 kits from 758 litters were included. The genetic variance of single traits and the genetic correlations between traits were estimated using REML under an Animal Model. A low amount of genetic variance was detected for kit growth capacity ($h^2_d \approx 0.09$). An intermediate genetic variance was detected for maternal ability ($h^2_m \approx 0.22$) to induce growth in kits and for dam weight changes from first to fourth week post partum ($h^2_d \approx 0.36$) and a favourable genetic correlation between maternal effect on kit body weight and dam weight changes from 1 to 4 weeks post partum ($r_{md} = 0.54$). However, the corresponding genetic correlation between maternal effect on kit body weight and dam weight changes from fourth week until weaning was negative ($r_{md} = -0.25$).

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. III-B, 74-77

Penetration of Red Hairs in the Coat of Silver Foxes

Dag Inge Våge, Elin B. Stavdal & Helge Klungland

Recently, two major genes regulating pigmentation have been identified in the fox (*Vulpes vulpes*). While the standard silver fox is caused by a genomic deletion in the agouti gene, a substitution mutation in a gene called extension is found in the Alaska silver fox. Given two alleles in two separate loci, nine different genotypes could be realised. Five out of these have a silver fox phenotype, and look almost identical. It has been speculated that some of these five genotypes are more prone to develop red hairs in the otherwise black coat. Due to problems with the identification of the different genotypes, this has not been investigated systematically. In the present study, DNA-based genotyping has been used to test a possible association between specific genotypes and the presence of red hairs.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. III-B, 78-80

Selection Scheme and Genetic Improvement of Orylag® for Fur Production

R.G. Thébault, D. Allain, H. de Rochambeau and J.L. Vrillon

Orylag® is a new fur derived from the Rex rabbit by genetic improvement of coat characteristics. It was obtained at INRA in 1990 from a closed original population of 200 animals bearing the Rex gene, managed in separate families and mainly selected on the absence of guard hair in order to obtain a fur only composed of undercoat. Other fur quality parameters were then introduced and animals are now selected on several criteria: body weight at 8 weeks of age, hair length, fur compactness, and 5 fur scores: bristliness, fur priming, extension of the agouti band, intensity and homogeneity of fur colour. The whole *Orylag®* fur production, which is genetically derived from the INRA population, is increasing (80,000 pelts in 2000) and marketed within a vertically integrated organisation controlled by producers. A description of the selection scheme is given and genetic parameters of the different fur traits are discussed.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. III-B, 81-86

The Influence of Heterozygosity for “Black crystal” Mutation on Cranial Size and Shape in Mink

Kharlamova A.V., Faleev V.I., Trapezev O.V.

Twenty-two cranial measurements of two genotypes of American mink were carried out. One genotype is standard, or “wild type” – a nonmutant animal with dark-brown colour of fur. The other genotype is heterozygous for semidominant autosomal mutation “*Black crystal*” (*Cr*), which changes the fur colour and has a negative effect on reproduction. Heterozygosity for “*Black crystal*” leads to a significant increase of width and height of the brain, as reflected in the cranium. Length parameters not only of the cranium, but also those of body length have a tendency to decrease. Body weight is higher in heterozygotes. Heterozygosity for “*Black crystal*” mutation changed the skull ratio toward more brachycephalic. Statistical significance of data

was estimated by the Student *t*-test and multivariate statistical analysis.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. III-B, 87

Some Anomalies in the Axial Skeleton of the Sable (*Martes zibellina* L)

Tatyana N. Petrina

Variability and anomalies of the axial skeleton elements in the sable (*Martes zibellina* L.) were studied. 33 sables of different ages (23 - 1-3 days, 3 - 1 month, 6 - 6 months, 1 - adult) were investigated. Anomalies become apparent as deviation from the norm in the number of the thoracic, (15 instead 14) and lumber vertebrae (5 instead 6) and the number of the rib pairs (15 instead 14). The decrease of the lumber vertebrae number can be associated with the development of the 15th thoracic vertebra by the 1st lumber vertebra in some cases, or as a new formation in some others. The reasons of occurrence of anomalies are discussed.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. III-B, 88

Practical Utilisation of Picture Digital Analysis for Estimation of Polar Fox Body Size

Andrzej Jakubczak, Grażyna Jeńewska, Tomasz Sakowski, Grzegorz Zi"ba

The investigations were carried out in the years 1998-1999 on the fox farm near Lublin. A program for picture analysis was used to estimate the live body length, animal body area. Additionally body weight, body width behind shoulders and body width at the abdomen were measured. Basic statistical parameters and correlations were calculated. The most prognostic multiple regression equations were selected between measurements, on the basis of R^2 determination coefficient. Values of correlation coefficients between skin length and measurements confirm the effectiveness of picture digital analysis for body size of polar fox.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. III-B, 89

Live Grading as a Tool in Pelsdyrkontrollen

Kai-Rune Johannessen, E.Børsting & H. Kristiansen

Pelsdyrkontrollen (PK), founded in 1985, is a field recording system for calculation of breeding indices for reproduction trait. PK was enhanced by a live grading system in 1994 and thereby incorporating fur quality and body size in systematic breeding. The breeder grades the young animals in November and gives scores from 1 to 5 either for overall quality or separately for hair quality and fur density. Body size is recorded as weight (g) for mink and as body length (cm) for foxes. Data are recorded at the farm and are sent to the central databank for processing. The data are analysed statistically and breeding values are estimated for the different traits. A combined selection index is calculated. The system gives the breeders an excellent tool for precise selection of the juvenile animals for the first breeding season. The central database is used for estimating genetic parameters and gives detailed information of the most important traits in the Norwegian fur animal population.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. III-B, 90-97

Selection for Increased Confidence in Foxes, and Possible Consequences for Production Economy

Nina V. Nordrum, Ulrik T. Brenøe, Kai-Rune Johannessen and Morten Bakken

A Nordic cooperation project was established in 1995 in order to select for more confident foxes. The Norwegian selection experiment included a comparison of two different breeding goals. These were the traditional goals weighting litter size, body size and pelt quality, and a confidence goal where trustfulness is weighted (50%) in addition to the production traits (50%). Data were gathered from one silver fox and one blue fox breeding cycle from farmer records submitted to the Norwegian field recording system. Confidence towards humans was tested on 5 to 6 month old pups with a tit-bit test. It seems possible to select for foxes, which are less fearful to humans. Heritability for trustfulness is estimated to 0.20 in silver foxes and to 0.10 in blue foxes (DFREML-procedure). Phenotypic and

genetic correlations between confidence and the production traits are small and partly negative (VCE-procedure). However, subjected to long term selection, using modern selection methods, genetic progress seems obtainable both for confidence and the production traits.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. III-B, 98

Confident Behaviour and Production Traits - Results from a Field Study of Foxes

Sanna Nikula, Kerstin Smeds, Hilppa Hietanen, Hilikka Kenttämies and Matti Ojala

Material for the study was collected from 30 private fox farms during years 1995 – 1997. The aim of the study was to estimate the genetic variation of temperament and its association with production traits as part of the Nordic project "Selection for more confident farm foxes". Behaviour of 11,757 adult blue foxes and 2,144 silver foxes was evaluated using the feeding test. Heritability of temperament and production traits were estimated using REML in univariate and multivariate animal models. Fixed effects of sex, age, farm and year were significant on temperament of foxes. The estimate of heritability for temperament was 0.21 for blue foxes and 0.18 for silver foxes. Correlations between temperament and reproductive traits approached zero. In addition, temperament and its association with pelt grading results was evaluated from cubs aged 6 – 7 months in six farms.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. III-B, 99-102

What May Be the Consequences of Mink Selection for Aggressive and Domestic Behaviour ?

O.V. Trapezov

It has been demonstrated that a regular consequence of mink selection for behaviour was change in penetration and expression of white piebaldness. The number of deviants with altered piebald spotting increased in the course of mink selection for behaviour. Their number was highest among mink showing domestic behaviour. A trend towards decrease in the number and colouring of piebald animals and an increase in the number of completely pigmented individuals was observed in offspring aggressively responding to human.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. III-B, 103-106

Genetic Change in Confidence and Some Production Traits in Blue Foxes (*Alopex lagopus*) Selected for Confident Behaviour

Hilikka Kenttämies and Kerstin Smeds

In 1995-1998, a selection experiment for more confident blue foxes was carried out on a private farm. The aim was to study possibilities to obtain selection response in confident behaviour, and effects of selection on production traits. Animals in the selection line were selected on the basis of breeding value (BV) for confident behaviour, and those in the control line mainly on a combination of BV's for fertility and some exterior traits. Confidence was defined using a feeding test on a scale 1 to 2. Altogether, 3,317 cubs were tested and graded. A selection response of 0.27 points was obtained for confidence within three selection generations. Nonexistent or slight positive genetic changes were found in fertility traits while moderate negative changes were found in body size, fur quality and clarity of colour when selecting only for confidence.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. III-B, 107-109

Characteristics of Selected Morphological and Chemical Blood Indices of Polish Ring Neck Foxes

Czerkas R., Frindt A., Grogowski R¹, Majewska B., Winnicka A., Kluczyński W.

The Polish ring neck fox is a dominant genetic mutation colour type of silver fox. It occurred in 1970 in Poland. It possesses a very specific colour pattern. There are no reports about its biology. Nes et al. (1988) and Jeżewska (1994) introduced the analysis of colour variations in the progeny of the ring neck fox. The experiment presented herein aims at evaluation of haematological indices; haemoglobin, haematocrit, differential leucocyte counts and selected chemical indices of haematological functions; total protein, aspartate transaminase, alanine transaminase and phosphatase in the ring neck fox.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIIth International Scientific Congress in Fur Animal Production, Vol. III-B, 110-112 (Poster)

Heritability of Motion Activity in Ferrets (*Mustela putorius*) under Open Field Conditions

Ján Rafay

Motility in 40 animals from parent and offspring generations were assessed in the experiment in an area of open field (3 x 3 m). The frequency of crossing the lines between squares during 10 minute intervals was employed as a measure of the degree of motility in tested animals. The heritability coefficients for the parameter of motility in animals in the testing field were estimated on the basis of regression analysis between parents and their offspring. From h^2 values it is concluded that this parameter expresses a low amount of genetic variety and is influenced by factors of environment.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIIth International Scientific Congress in Fur Animal Production, Vol. III-B, 113 (Poster)

Genetic Diversity of Farmed Finnish Silver Fox (*Vulpes vulpes*)

Minna Rintamäki & Jaana Tähtinen

In this study, four dog microsatellite loci (CPH6, CPH9, CPH16 and CPH18) were used to assess the genetic diversity of Finnish silver fox (*Vulpes vulpes*). A total of 253 hair samples were collected from unrelated animals of 10 Finnish silver fox farms. All examined dog microsatellites were highly polymorphic in foxes with a number of alleles ranging between 5 and 11. Variations of allelic frequencies were examined to characterize the farms and significant allele frequency differences were observed at all loci ($P < 0.001$). Deviations from Hardy-Weinberg equilibrium were not noted. The expected heterozygosity for different farms varied from 0.450 ± 0.135 to 0.716 ± 0.05 . Genetic relationships between the farms were demonstrated by the Nei's D_A distances and the dendrogram was constructed by the neighbour joining method. Because the microsatellite loci were highly polymorphic, they can be efficiently used in individual identification, paternity tests, breeding programmes, diversity changes and inbreeding studies also in farmed foxes.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIIth International Scientific Congress in Fur Animal Production, Vol. III-B, 114-119 (Poster)

Phylogenetic Aspects of Study on Variability of Alpha-Macroglobulins of the American Mink among Closely Related Species of the *Mustelidae* Family and some Other Taxons

Margarita A. Savina, Ivan G. Gorelov, Victor I. Yermolaev

We have studied the various aspects of alpha-macroglobulins in blood serum of American mink. Fourteen antigenically different variants of this protein were described. Of these, nine are specific to American mink as a species. Alloantigens AM6, AM9, AM10, AM11 and AM13 were detected in all the 13 studied species of the *Mustelidae* family. These allotypes were unexpectedly found in two species of *Phocidae* family, subfamily *Pinnipedia*. These data provide evidence for the phylogenetic proximity of the *Mustelidae* and *Phocidae* families.

A number of other immunogenetic features in the studied families are also presented.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. III-B, 120-122 (Poster)

The Heritability and Correlation Coefficients of Selected Traits in Common Silver Foxes (*Vulpes vulpes* L.)

Stanislaw Socha, Grażyna Jeżewska, A. Gontarz

The aim of the studies was to evaluate the coefficients of heritability and correlation of silver fox traits in Poland, after changing of the evaluation standard in 1997. The coefficients were estimated from dam and sire variance components. We used data from one of the largest common silver fox (*Vulpes vulpes* L.) breeding farms in Poland. The estimated rates of heritability (evaluated during the licence display) were: animal size 0.598, colour type 0.272, colour clarity 0.235, fur quality (hair length and fur density) 0.213, and the total score 0.277. The level of genetic correlation ranged from 0.468 (colour type and colour clarity) to 0.821 (animal size and total score). The phenotypic correlation coefficients had a lower span and varied from – 0.165 (colour clarity and its quality) to 0.580 (fur quality and total score).

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. III-B, 123-126 (Poster)

Effect of Behaviour on the Expression of Coat Colour Mutations in American Mink

O.V. Trapezov

The effect of the genotype environment produced by the genes for aggressive and domestic behaviour on the phenotypic expression of mutations located in two loci affecting coat colour: the “Hedlund” – hedlund white mutation (*h*) and the “black cross” locus: shadow (*S^H*), Karelskaya spotted (*S^K*), black cross (*S*), royal silver (*S^R*) was studied. It was demonstrated that the behaviour genes have strongest influence on penetration, expression and specificity of the (*h/+*) gene and also on the alleles at the “black cross” (*S^H > S^K > S > S^R > +*) locus.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. III-B, 127-133 (Poster)

Mink Domestication and Homologous Coat Colour

O.V. Trapezov

Homologous variation has been demonstrated for virtually all plants, animals and microorganisms. This parallelism of phenotypic variability allows prediction of similar forms and properties in virtually all closely related biological species. Thus, homology of coat colour pervades not only families and orders, but also even classes (Haldane 1927). In the course of selection of American mink for domestic behaviour, coat colour of Himalayan type appeared (Trapezov 1997a, 1997b) homologous to other domesticated species (Siamese cat, rabbit, guinea pig). Vavilov’s law (Vavilov 1922) of homologous series of variation offers possibilities for searching new coat colour variations in fur bearers.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. III-B, 134-137 (Poster)

Behaviour and Expression of White Piebaldness in Mink

O.V. Trapezov

Spots of different colour are usually irregularly distributed over the coat of domestic animals. This irregularity is never observed in wild animals whose coat is of the same colour or white spotting conforms to a regular pattern. The uniform standard colour in mink is conditioned in a very complex genetic fashion and an extremely delicate mechanism underlies its different distribution along hair length. This correlative mechanism is impaired under selection for domestication and, as a result, unspecific piebaldness arises on the body.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. III-B, 138 (Poster)

Selection of Mink for Behaviour Affects the Reproductive Function and Time of Eye Opening

O.V. Trapezov

Transformation of mink behaviour under selection causes changes in the dates of their sexual maturation. Thus, in January 84% of domesticated

female minks were in the state of sexual maturity, the percentage being 55% for their aggressive counterparts. A relation was established between behaviour, piebaldness expressivity and time of eye opening in American mink.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. III-B, 139 (Poster)

Asymmetry in the Expression of White Piebaldness in Mink and its Relation to Reproductive Function

O.V. Trapezov

The appearance of unspecific piebaldness was recorded in the course of long term selection for behaviour. These coat colour novelties were not randomly scattered, much rather conformed to a directional symmetric pattern. They were restricted to the left side of the body. The white piebald areas were largest in all mink with left side, asymmetrical coat colour. The leftward shift was connected with reproductive advantage.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. III-B, 140 (Poster)

FUR PROPERTIES ABSTRACTS

Expression and Activity of Mink Skin Tyrosinase during Autumn Molt

Shigeharu Fukunaga, Kaoru Kohno, Kazuaki Takenouchi, Fumio Nakamura, Keiji Kondo

Fur color that consists of melanins is one of the important factors for fur value. Tyrosinase is the key enzyme for melanin synthesis. However, not only the characterization of mink tyrosinase, but the molecular mechanism of melanogenesis in mink has not been well identified. Using RT-PCR and cloning methods, we partially sequenced mink tyrosinase and tyrosinase-related protein mRNA that take part in melanin synthesis. We then examined mRNA expression in anagen and telogen mink skin by Northern blotting. We also measured tyrosinase activity and compared to mRNA expression. The sequence of mink tyrosinase does not differ greatly from other mammalian species. Its expression is coupled to tyrosinase activity, correlates with molting phase and is thus high in anagen, similar to the mouse hair cycle.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. III-C, 143-146

Capillary Electrophoresis Analysis of Glycosaminoglycans in Mink and Fox Skin and its Potential for Predicting Quality of Pelt and Tanning

Bent Riis

Understanding the influence of glycosaminoglycans on the quality of fur and tanning processes is of general importance. Glycosaminoglycans are a family of polysaccharides of importance for growth, development and tanning of skin. Currently, not much is known about glycosaminoglycans and their function in fur bearing animals. Previous studies have shown that chondrin sulfates, a special type of glycosaminoglycans, are correlated to hair development. However, analytical methods for performing such studies are still in their infancy. This investigation will use capillary electrophoresis methods for measuring the amount of glycosaminoglycans in skin from both foxes and

mink. An attempt to correlate the results to skin quality will be made.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. III-C, 147-150

The Beauty of Mink Pelage Observed with SEM

Keiji Kondo and Milan Vanek

This study was done to display the morphological beauty of mink pelage in telogen through the observation with a scanning electron microscope (SEM). Dark male mink were sacrificed in December, and an approximately 5 by 5 mm sample of skin was taken. The samples were cut perpendicularly to the backbone and then freeze-dried for the observation of a hair bundle. Observation of the medulla was made on specimens attached to brass standard stubs with scotch tape and then cut with a new razor blade along the axis of fiber. All the samples were sputter-coated with gold. Observations were made with a JSM-T20 SEM operated at 19 kV. Hair bundles were observed clearly and beautifully at the position between the skin surface and the upper end of hair follicle. The structure of hair medulla was better seen in detail by using SEM than under a light microscope.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. III-C, 151-154

Relationship between Feed Intake, Body Mass and Skin Length in Blue Foxes

Teppo Rekilä, Hannu Korhonen, Ilpo Pölönen and Mikko Harri

Body mass of farmed blue foxes has substantially increased due to intensive selection during the last decades. Heavier body mass produces longer skins and thus brings more money to the farmer relative to smaller body mass. In the present study, the relationship between feed intake, body mass and skin length was studied in juvenile blue foxes. At pelting, body mass and skin length averaged 11.7 kg (range 5.2 - 20.8 kg) and 115 cm (range 87 - 145 cm), respectively. The average daily feed intake from September to November was 920 g per animal. The correlation coefficient between body mass and skin length was 0.93 ($p < 0.001$), between body mass

and daily feed intake 0.77 ($p < 0.01$) and between skin length and daily feed intake 0.71 ($p < 0.01$). The relationship between feed intake and body size indicates that part of economic advantage of increased body mass is lost due to the increased feed intake.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. III-C, 155-158

Effect of Steroids on Ferret Winter Pelage Growth

A.J. Pearson

The purpose of this study was to determine the effects of five steroids, either alone or in combination with melatonin, on the initiation of hair growth during autumn in four-month old ferrets. Melatonin stimulated follicle growth within 10 days. When applied in combination with melatonin, both oestradiol and dexamethasone inhibited follicle growth initiation. Deoxycorticosterone showed only slightly inhibitory effects. In contrast, testosterone implanted with melatonin had little effect, but implanted 7 days earlier, appeared to stimulate hair growth. These four steroids all inhibited hair growth when implanted alone. Progesterone with melatonin had some promotive effect in females but inhibited follicle growth initiation in males. This model of hair growth initiation and its perturbation by steroids is being applied to identify differentially expressed genes involved in hair growth cyclicity.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. III-C, 159

Phenotypic Colour Relationship in Brown Mink (*Mustela vison*) Characterised by Sensory and Colorimetric Methods

Palle V. Rasmussen and Peer Berg

In mink production, the shade of certain coat colour can be controlled or modified by selection. In practice, it is based on sensory methods thus, differences between grades must be relative. The question is whether simple, absolute colour measurements, applied to live animals and their

pelts can complement the sensory grading and the genetic knowledge derived from it. We used sensory and colorimetric methods separately to describe the coat and pelt colour of brown mink from a selection experiment. This paper presents repeatabilities of and correlations between sensory colour intensity, clarity, and colorimetric lightness and chroma (saturation). The results show that it is possible to characterise the colour of both sexes of live brown mink and the pelts by objective and nondestructive methods.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. III-C, 160-164

The Concentrations of Selected Elements (Ca, Cu, Zn, Mg, P) in Mated Polar Fox Female Hair.

Danuta Dzierżanowska-Góry^{1/2} Robert Gwozdzowski

The level of the elements in animal hair depends not only on their concentration in feed, but also on physiological state of the animal, the breed, sex, age, environmental conditions and the season of the year. We studied an experimental group of 30 polar fox females aged from 1 to 6 years. All females were mated. Fur samples were collected from the posterior region of the body. The concentrations of Ca, Cu, Zn, Mg, P were evaluated by the ICP method. The changes in the concentration of elements were detected, and these depended on the physiological state of the female. The correlation of microelements with breeding results was calculated by statistical methods.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. III-C, 165-167 (Poster)

The Effect of Melatonin Treatment on Feed Intake, Body Weight, Fur Maturation Period and Fur Length in Growing Chinchillas

József Lanszki, Daniel Allain, René-Gérard Thébault, Zsolt Szendrő

Four-month-old chinchillas of both sexes, kept under natural light conditions, were treated with melatonin (A: 18 mg; $n = 56$, B: 9 mg; $n = 14$) during the period of long days (between March and September) or short days (between September and

March) and compared to untreated controls (C, n=69). No substantial differences between groups were observed with respect to feed intake and body weight at pelting time. Fur priming occurred 31 and 18 days sooner ($P<0.001$) in groups A and B respectively than in the control group where the animals were ready for pelting at the age of 278 days. However the fur length at pelting was similar, irrespective of the treatment, period of treatment, sex and age at pelting, even when the melatonin treated animals were pelted at an earlier age. When the moulting period occurred during short days, the fur priming process was shorter than when moulting occurred during long days: 259 and 270 days respectively ($P<0.05$).

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. III-C, 168-173 (Poster)

The Effect of Melatonin Treatment on Hair Follicle Activity in Growing Chinchillas

József Lanszki, Daniel Allain, René-Gérard Thébault, Zsolt Szendrő

Half of an experimental stock of four-month-old chinchillas, kept under conditions of natural lighting, were treated with 18 mg melatonin (group M), while the other animals remained untreated and served as controls (C). The effect of the melatonin treatment was monitored by means of histological examination of skin samples, collected once a month. A proportion of the chinchillas (n= 8 animals) were fleeced from the hindquarters region at the beginning of the experiment, while the effect of the treatment was examined under conditions of normal hair growth in the remainder of the animals (n= 23).

Melatonin treatment led to hair follicle activity decreasing at a faster rate and the hair follicles reached the telogen phase sooner than in the control group. Melatonin-treated chinchillas had prime fur one month earlier and made more fibres per follicular bundle than in the control group (at the level of the sebaceous gland M: 27, C: 23, $P<0.001$). No notable influence of plucking or normal hair development on fur maturation age was observed (plucked: 264 days, normal: 261 days, NS). Within groups M and C hair density proved to be

independent of the age at fur priming (8 to 12 months).

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. III-C, 174-178 (Poster)

Effect of Biostimulator Mival on the Quality of Mink Hair-coat Covering

Pavel P. Orlov, Nelya A. Shulyatyeva

The object of this study is the dark-brown American mink (*Mustela vison* Schr.). A morphological study of winter hair covering in mink stimulated by biostimulator Mival that has pilotropic activity, was carried out. The preparation, given in a dose of 5-20 mg/kg of an animal body weight, did not have a marked influence on the length of hair covering. It somewhat increased the thickness of guard hair on the haunches and sides.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. III-C, 179-182 (Poster)

Assessment of Selected Quality Parameters of Chinchilla Pelts Offered by Polish Breeders on the CFC (Copenhagen Fur Center) Auction

Mągorzata Sulik, L.Felska, Grzegorz Mile¹/₂zuk

In recent years chinchilla breeding has been intensively developed in Poland. It has been greatly influenced by very good market conditions for chinchilla skins, and almost 100% sale in fur auctions, compared to a general sale crisis of skins of other species of fur animals. The principal factor regulating price of chinchilla pelts appears to be their quality. The aim of the present study was to assess the selected qualitative parameters of the chinchilla skins delivered by Polish chinchilla breeders. A detailed analysis focused on the traits of the skins that can be influenced by the breeder in the course of the rearing process: size, colour intensity and clarity of the coat colour. The present study revealed that the skins of Polish chinchilla were sold mostly in size classes 1 and 2 (42.13% and 48.54% respectively) and only 3.24% of the skins were sold in class 0. This confirms that the animals bred in Poland are of small size and

emphasis should be given to improving this trait. The distribution of the colour varieties was relatively favourable because as much as 50.36% of the skins sold as the type X dark. Among the traits analysed, the poorest was the clarity of the hair cover. In clarity 59.04% of skins classified as third class and only 19.96% as first class.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIIth International Scientific Congress in Fur Animal Production, Vol. III-C, 183-188 (Poster)

NUTRITION ABSTRACTS

Effect of Feed Extrusion Temperatures on Digestibility of Protein, Amino Acids and Starch in Mink

Kari Ljøkjel and Anders Skrede

Experiments were carried out for evaluating the effect of different extrusion temperatures on a diet based on fish meal (Norse LT-94) and whole wheat meal on digestibility in mink. A double screw extruder (Bühler EX-50/134 90 kW) was used, and the temperatures were 100, 125 or 150 °C. In addition, there was an untreated sample. True digestibility of total nitrogen and amino acid nitrogen was significantly reduced by extrusion compared to the unextruded sample. Nitrogen digestibility showed minor effects of increasing the temperature from 100 to 150 °C. Amino acid nitrogen digestibility decreased further up to 125°C. Cysteine was the most affected amino acid. Starch digestibility increased after extrusion, but there was no further effect by increasing the temperature above 100°C.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. IV-A, 3-5

Effect of Dietary Protein Level and Quality on Growth Rate and Fur Parameters in Mink

Mira Kerminen-Hakkio, Tuula Dahlman, Paavo Niemelä, Taina Jalava, Teppo Rekilä and Liisa Syrjälä-Qvist

The effects of two protein levels, including subgroups with good or poor protein quality, on weight gain and fur quality in growing mink, were studied. The protein levels were a) 27 and b) 42% of metabolisable energy. Good quality protein was composed of fish-, feather-, soybean- and corn gluten meal. Poor quality protein ingredients were fishbone-, meat- and meat and bone-meal. Protein level was the most significant nutritional factor during the early intensive growth phase, while protein quality was most decisive during the later growth. Weight gain by the end of October was significantly higher in the groups with good quality protein [(a) +160 9g, b) +1774 g] than with poor quality protein [(a) +1414 g, b) +1480 g]. Good

quality protein resulted in significant increase in skin length (+4 cm) and also in better fur quality (fur density + 0.6 and guard hair + 0.3 points).

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. IV-A, 7-12

Effect of Feed Protein Level on Fur and Skin of the Blue Fox

Dahlman, Tuula & Blomstedt, Leena

Five groups of growing blue foxes (25 animals/group) were fed with diets differing in protein level. The experiment began in mid-August and lasted until pelting in the beginning of December. The animals were weighed regularly during the experiment. A skin biopsy was taken at pelting from 10 animals per each group for determination of degree (%) of fur maturity. Pelting was according to the normal procedure (fleshing, drying etc.) at the farm. Professional graders evaluated the pelt characters. Leather thickness in raw skins was measured in 10 skins per group. In general, protein level did not seem to affect the visually graded parameters. However, the fur maturity degree and the leather thickness tended to increase with higher protein level in the feed.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. IV-A, 13-16

Effects of Dietary Protein and Carbohydrate Supply on Feed Consumption, Growth performance and Blood Parameters in Mink Dams during the Nursing Period

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

Effects of dietary protein levels ranging from 61% to 39% of metabolisable energy (ME) and dietary carbohydrate levels ranging in a reciprocal fashion from 1% to 25% of ME and a constant dietary fat level of 36% of ME were investigated in female mink from January until the end of the nursing period in June. Feed consumption, mobilisation of body reserves and plasma concentrations of hormones, nutrients and metabolites in female mink

and growth performance in kits were studied. The dietary protein supply could be decreased from 61% to 39% of ME and replaced with carbohydrates and the diet could be almost carbohydrate-free diet (1% of ME) with a high content of protein without affecting either the kit body growth or the health of the females negatively. Plasma concentrations of glycerol and free fatty acids seemed to be correlated to the mobilisation of body reserves in females.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIIth International Scientific Congress in Fur Animal Production, Vol. IV-A, 17-21

¹⁴CO₂ Breath Test in Fed and Fasted Mink (*Mustela vison*) Using Methionine, Leucine and Valine as Substrates

Børsting, C.F. & Riis, B.

The aim was to study the oxidation and metabolism of amino acids (AA) in the mink by breath test and slaughter experiments during growth and fur development. In the first study undertaken during fur development in November the labelled AA [methyl-¹⁴C]-L-methionine and [U-¹⁴C]-L-leucine were injected. In the second study during the rapid growth period in August the same two tracers were used as well as [U-¹⁴C]-L-valine. In the third study during fur development [U-¹⁴C]-L-leucine and [1-¹⁴C]-L-methionine were injected. In each study each AA was injected i.p. in 4 fed and 4 fasted male mink of the black genotype. The oxidation of all AA was higher in fed than in fasted mink. The oxidation of leucine was lower during rapid growth compared to the period of fur development, whereas the opposite was the case for [methyl-¹⁴C]-L-methionine. The oxidation of the methyl-labelled methionine was very low compared to [1-¹⁴C]-L-methionine.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIIth International Scientific Congress in Fur Animal Production, Vol. IV-A, 22-25

Effects of Dietary Mineral Content on Mineral Metabolism and Performance of Growing Blue Foxes

Jarmo Valaja, Ilpo Pölönen, Taina Jalava, Sini Perttilä and Paavo Niemelä

Two experiments were conducted in order to study the effects of dietary mineral level on mineral metabolism and performance in growing blue foxes. In 150 growing blue foxes, the effects of dietary mineral level and Ca:P-ratio on Ca and P utilisation were studied. The effects of mineral level on performance and fur quality were studied with 150 growing blue foxes. Six dietary treatments were arranged as a 3 x 2 factorial. The corresponding factors were dietary mineral level (low, medium or high) and Ca-P-ratio (1.2 or 1.7). In the growth trial, three treatments contained either low (50 g/kg DM ash), medium (80 g/kg DM ash) or high level (110 g/kg DM ash) of minerals. Both the mineral level and Ca:P-ratio affected Ca and P utilisation and excretion. P excretion in faeces and urine was decreased by 73% as dietary mineral content was lowered from high to low (p<0.001). No differences were found in the weight gain of foxes between different mineral levels. The mineral level, however, had a clear effect on the phosphorus content in the faeces. The results indicate that dietary mineral level could be lowered during late growing period without negative effects on performance or bone mineralization in blue foxes.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIIth International Scientific Congress in Fur Animal Production, Vol. IV-A, 26-29

Effect of Dietary Folic Acid Supplementation on Formate Metabolism in Blue Foxes (*Alopex lagopus*)

Ilpo Pölönen, Jarmo Valaja, Taina Jalava, Sini Perttilä, Raija Sauna-Aho and Susanna Kariluoto

We have investigated the folate-dependent toxicity of formate to mink and blue foxes to better understand the effects dietary supplementation with formic acid in fur animal feeds. In order to estimate the efficiency of the blue fox to detoxify formate, a plasma-disappearance test was carried out with 35 juvenile blue foxes. For 4 weeks prior to the test the

experimental feeds were supplemented with incremental levels of folic acid (0, 5, 10, 20, 40 mg/kg feed DM), after which the animals were injected with sodium formate, 500 mg/kg BW, and then analyzed for plasma formate. Feeding group had a linear effect on the concentration of plasma formic acid analyzed 120 and 180 minutes after the injection. The lowest supplementation of folic acid (5 mg) almost tripled plasma folates, while the higher supplementations had only minor further effects. In the follow-up experiment, plasma concentration of formate was studied after different dietary intake of formic acid. These experiments confirm our earlier results with mink that, when formic acid preserved feeds are used in the feeds at least moderate supplementation of folic acid is required of these species.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. IV-A, 30-33

Effects of Lactic Acid Fermentation and Heat Treatment of Wheat and Barley on Digestibility in Mink

Anders Skrede, Grete Skrede and Stefan Sahlström

Wheat and barley were subjected to three different treatments: fermentation for 16 h at 30 °C by inoculation with a *Lactobacillus* sp. isolated from rye sourdough, autoclaving, and fermentation followed by autoclaving. The fermentation reduced the level of β -glucans by 45% in barley and 37% in wheat. Total nutrient tract digestibility was determined in adult male mink fed the experimental cereals as the sole source of carbohydrate. Fermentation and autoclaving of wheat enhanced digestibility of starch and crude carbohydrates compared with autoclaving alone. Fermentation of barley increased digestibility of starch and crude carbohydrates to the same extent as autoclaving. Combined fermentation and autoclaving of barley increased crude carbohydrate digestibility by 11% compared to autoclaving alone. Fermentation prior to autoclaving reduced total amount of faeces and faecal moisture compared with autoclaving as the sole treatment. It is concluded that lactic acid fermentation of wheat and barley has beneficial effects on digestion and intestinal performance in mink.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. IV-A, 34-36

Detailed Study of Digestive Enzyme Activities in Fur-Bearing Animals during Postnatal Ontogeny

Oleinik V. M., Svetchkina E. B.

Activity of digestive enzymes in the stomach, pancreas and small intestine of mink and blue foxes in different stages of postnatal ontogeny was studied. Changes with age in the activity of digestive enzymes that hydrolyze protein, fat and carbohydrates in mink and blue foxes were revealed. There are some common features in formation of enzymatic activity in the gastrointestinal tract in these two types of carnivorous predators, which distinguish them from animals with other ecological specializations for feeding.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. IV-A, 37-38

Thiamine Status in Farmed Mink

Petrova Galina, Ilyina Tatyana, Tyutyunnik Nikolay

Metabolism of thiamine in the farmed mink blood was studied three times during a year using fluorimetric and enzymatic methods. The first measurement (November) revealed high levels of total thiamine and its phosphate ethers, activity of thiamine biotransformation enzymes as well as thiamine diphosphate (ThDP) (15%). During the second stage of investigation (January), the content of total thiamine was slightly decreased, but other indicators were not changed. At the same time, parameters of thiamine metabolism decreased 2-3 times and the ThDP-effect increased up to 34% which indicates spontaneous hypovitaminosis. Thus, the results show that it is possible to estimate thiamine status in mink.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. IV-A, 39-40

Metabolic Antagonisms in Mink: a Review

J.E. Oldfield

Several interesting metabolic antagonisms occur in the nutrition of mink, where deficiencies induced by the presence of antagonists result in problems affecting the health and well-being of the animals, including fur color and quality defects. Examples include iron deficiency induced by feeding hake or whiting, which causes 'cotton pelts' and anemia; biotin deficiency induced by feeding eggs, particularly turkey eggs, and vitamin B₁ deficiency caused by the enzyme thiaminase, with the resulting 'Chastek Paralysis'. This paper will describe these examples of metabolic antagonism in some detail and will examine the biochemical activities that result in the animal symptoms

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. IV-A, 41-46

Preservation and Storage Stability of Poultry Silage Feedstuffs

Kirsti Rowvinen-Watt, Margot White, Lori Longmire and Michael Johnson

Poultry silage feedstuffs were prepared from culled hens with 1.5% formic acid 0.3% sodium benzoate. The tested feedstuffs 1) whole ground hen, 2) hen without viscera, 3) hen viscera, 4) hen heads, necks and feet, and 5) culled eggs with shell were preserved, stored at room temperature and evaluated monthly for 180 days. The nutritional quality (dry matter, ash, crude protein, crude fat, gross energy) of all treatments showed only minor differences during storage. The hygienic quality [pH, total volatile nitrogen (TVN), peroxide value (POV) and free fatty acid (FFA)] of all treatments showed significant ($P<0.05$) increases throughout the storage period. Fat quality of all treatments up to 180 days was within acceptable limits (POV<20 Meq O₂.kg feed⁻¹, FFA<10% oleic acid). Protein quality of all treatments, except for the eggs, was reduced after day 35 (TVN>2% in total N). The microbial analysis indicated a reduction of total bacteria counts and elimination of *E. coli*.

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Water Requirement of Farmed Foxes

Randi Oppermann Moe, Liv Lønne Dille, M. Bakken

Our earlier experiments showed that there is a large individual variation in water consumption in farmed foxes, with a daily water consumption up to 600 ml (Dille et al., 1998). This indicates that some foxes may have difficulties to fulfil their water requirement during subzero weather if only standard water cups are used. In the present study we investigated effects of water deprivation, and of two different methods of water supply on plasma and urine osmolality as well as concentrations of urea and Na during a cold weather period. Plasma osmolality and urea increased continuously throughout a 4 days period of water deprivation, even if the foxes were fed with standard fox feed with a high water content (65-70%). Such an increase in plasma osmolality indicates that the animals ability to concentrate urine in order to compensate the water loss was exceeded. When comparing the two methods of water supply (i.e. water cups vs. a frostproof system) during a cold period (less than -20 degrees Celsius for at least one week), no differences were revealed in the plasma contents of these thirst indicators, indicating that the ability to stabilise plasma osmolality through regulating mechanisms was not exceeded. However, there was an increase in the urine contents in foxes with access to water trough water cups, indicating that the animals had concentrated urine to compensate for water loss. The results indicate that the foxes had initiated concentration of urine to stabilise the levels in plasma, which in turn indicates that the foxes would have drunk more if they had the opportunity to do so.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. IV-A, 51-53

Effect of Succinic Acid on Hypotrophic Kits of Farm Mink

Unzhakov Alexei R., Kondrashova Marija N., Kozhevnikova Lia K., Tyutyunnik Nikolai N., Meldo Hilda I.

It has been shown that succinic acid (SA) added to the diets of hypotrophic kits of dark brown mink improves their physiological condition and ultimate size. SA has an improving effect on energy metabolism of weak kits. This natural metabolite is a biologically active preparation that normalizes blood enzyme activity, increases the aerobic fraction of LDH and stimulates the growth of the mink. The effect of SA on the hypotrophic kits is more pronounced than in healthy fur animals. Adding SA to the rations of animals increases the size of skins and their quality.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. IV-A, 54-56

Measurement of Milk Production in Blue Fox Dams with Different Litter Size Using an Isotope Dilution Technique

Øystein Ahlstrøm, Søren Wamberg, Gorm Sanson and Anne-Helene Tauson

Milk production in 12 blue fox females in three groups with different litter size (average 5.0, 7.3, 10.8 pups) were measured in the suckling period from 2-3 days to 14-15 days after parturition. The milk production was measured indirectly through milk intake by the pups, calculated using the dilution of injected tritium over a 48 h period. The assumption for this technique is that milk is the only source of water in the pups. The result showed that the milk production exceeded 500 ml per 24 h 14-15 days after parturition for the females with the highest litter size. The milk production in blue fox is therefore energy demanding and requires a substantial energy intake to maintain. The study also included calculation of body growth per g milk consumed, total body water turnover in pups and energy data.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. IV-A, 57-59

Meat-and-bone Meals from Different Animal By-products as Protein Sources for Fur Animals

Øystein Ahlstrøm, Anders Skrede, Ole Sylte Heggset, Oddvar Mikkelsen and Sissel Frogner Tangen

Fur animals require high protein diets, and it is therefore important to find low-price protein sources for economical feeding. Meat-and-bone meal is cheap protein, but the amino acid composition and digestibility are often dubious. This study focuses on the amino acid composition and amino acid digestibility of some types of meat-and-bone meal in comparison with other protein sources used in fur animal production. Mink digestibility experiments revealed that, for some limiting essential amino acids for fur animals, the digestibility was very low, indicating that protein from meat-and-bone meal only can be a part of the dietary protein. Therefore other protein sources of higher quality must be added when meat-and-bone meal is included in the diet to ensure adequate amino acid supply.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. IV-A, 60-63 (Poster)

Comparison of Feed Digestibility Determined *in vivo* in Nutria and *in vitro* by Laboratory Methods

Bogusław Barabasz

The present study is an attempt to develop simpler and quicker methods for the determination of feed digestibility by laboratory methods instead of laborious and time-consuming studies on animals. Nutria were fed traditional rations composed principally of bruised grains, wheat bran, cooked potato, beets and carrots, constituting relatively uniform carbohydrate-protein mass. Digestibility of each feed was tested on 5 nutria, housed in metabolic cages adjusted for the present experiment. The study examined a total of 20 different feeds commonly used in nutria feeding. Digestibility testing *in vivo* by the classic balance method was conducted in parallel with *in vitro* determination of the digestibility of feed dry mass and organic substance using two, modified laboratory methods: The first was a modification of the enzymatic method of Kellner and Kirchgessner (1976)

consisting of boiling sample in HCl for 30 minutes, and subsequent incubation in turn in cellulase solution (24 hours), alpha-amylase solution (24 hours at a temperature of 25 °C) and pepsin solution (48 hours); The second was the method of Jones & Hayward (1975) consisting in sample digestion with pepsin solution at a temperature of 40°C and 1 % celulase solution in acetate buffer pH 4.8 for 48 hours. Digestibility of dry mass and organic substance of the tested feeds was calculated as a decrease in the content of these constituents in the sample in relation to its initial mass, and expressed in percent. The coefficients of digestibility of dry mass and organic substance were reciprocally compared. Moreover, their interdependence was assessed by the calculation of correlation coefficients.

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The Decrease of Food Losses in Feeding Nutria

Oleg Yu. Bespyatykh, Igor A. Plotnikov

Different types of construction of cages for keeping nutria were tested. Shelf-tables were placed into a cage in addition to food trays. The following types were tested: a sheet plate, plates with 2 and 3 ribs, a plate with edges sides. About 40% of granulated feed were lost from food trays. With a shelf- table in place, the feed losses made up 10-25% of feed depending on design of the shelf-table. As a result, the amount of feed eaten by nutria increased from 6-12%. The shelf-tables function with respect to cage sanitation and animal comfort. The data on the growth and injuries in young animals and pelt quality were investigated. Those studies resulted in recommendations for the most effective type of a shelf-table for nutria husbandry.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIIth International Scientific Congress in Fur Animal Production, Vol. IV-A, 69-70 (Poster)

Different Energy Distribution in the Feed for Mink Females in the Winter and Reproduction Period.

Carsten Hejlesen and Tove N Clausen

In the winter and reproduction periods Danish mink feed traditionally consist of 50-55% of the metabolisable energy (ME) from protein. A protein surplus increases feed costs and needless N-discharge. To evaluate a possible reproductive effect of reduced protein supply in this period an experiment was conducted with 8 groups (N=125) of mink females. The protein content was lowered from 55% of the ME to 45 and 30% respectively. Carbohydrate content varied from 10 to 20% of the ME. The results showed that the protein content in the winter and reproduction periods can be lowered from 55 to 45% of the ME, and carbohydrate can be increased to 15% of the ME without negative consequences on litter size, and kit and female weights at weaning. Females fed 30% of the ME from protein until February 19 and afterwards 45% until weaning, had an increased number of greasy kits.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIIth International Scientific Congress in Fur Animal Production, Vol. IV-A, 71-74 (Poster)

Body Length and Pelt Length Relationship

William L. Loeschke and Mark Michels

All factors considered, the size of a mink at marketing depends not only on the length of the animal, but also upon its weight, which includes body fat distribution at pelting. This presentation comprises figures that indicate a specific linear relationship between body weight in November and length of pelt marketed.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIIth International Scientific Congress in Fur Animal Production, Vol. IV-A, 75-78 (Poster)

Determination of Body Composition in Mink (*Mustela vison*) Kits Using Hydrogen Isotope Dilution and Direct Carcass Analysis

Heather N. Layton, Kirsti I. Rouvinen-Watt and Sara J. Iverson

Carcass analysis and hydrogen isotope dilution (tritiated water) methods were compared to measure body composition in the mink. Dilution space (D) of mink at 21-42d of age (n=20) was determined and compared to carcass analysis of total body water (TBW), body fat, protein and energy. A validation set of 27 kits was used to test the accuracy of predicting body composition from TBW. D overestimated TBW by a consistent and predictable 4.1% ($r^2 = 0.999$, $P < 0.001$). Estimates of fat, protein and energy content derived from TBW were not significantly different from those obtained from direct carcass analysis ($P > 0.980$) in either the initial or validation set of mink. TBW was shown to decrease from 81% to 76% and total body protein to increase from 14% to 19% of lean body mass of the kits from 21–42 days of age. Although a rapidly changing hydration state was apparent in the kits accurate estimates of body composition can be obtained from hydrogen isotope dilution.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. IV-A, 79-82 (Poster)

Effects of a New Generation Feed Supplement on Some Performance Indices and Health State in Mink

Lorek M. O., Gugolek A., Szarek J., Przeździecka D.

Studies on the use of a feed supplement containing yeast that facilitates digestion, probiotic bacteria, plant extracts from *Yucca schidigera* and zinc bioplex in mink nutrition, were performed in two experiments. In the first, 80 mink in the period from weaning to pelting were divided into two equal groups. The feed supplement was added to rations for the experimental group (II), in the amount of 5 g per animal. The results obtained indicate that the preparation did not affect the growth of mink nor any pelt parameter that was measured. Histopathological examinations of internal organs showed that the supplement had a positive effect on the health state of the animals. The second

experiment was carried out by providing the supplement to females for the period from January 15 to the third week after whelping. It was found that more pups were born and weaned in the group that received the supplement.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. IV-A, 83-85 (Poster)

Nutrient Excretion and Manure Management in the Mink Industry

Cory W. Newell, Kirsti I. Rouvinen-Watt, Derek M. Anderson and Michael A. Johnson

Management of livestock manure is necessary to minimize the environmental impact of manure nutrients, in particular nitrogen (N) and phosphorus (P). A production trial was carried out with 240 mink between the months of July and November to investigate excretion of N and P in growing mink. Daily N excretion ranged between 3.27-5.12 g d⁻¹ (males) and 2.42-4.13 g d⁻¹ (females). Approximately 80% of the N was excreted via the urine. Daily P excretion remained relatively constant throughout the trial at 0.5 g d⁻¹ (males) and 0.4 g d⁻¹ (females). Approximately 90% of the P was excreted via the feces. N excretion was used to estimate that 1 manure animal unit (MAU) consists of 80 growing mink. The use of peat moss as a bedding material for collection of manure slurry under the cages of mink improved N capture in the manure by over 20% ($P < 0.05$).

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. IV-A, 86-88 (Poster)

Effects of Different Fat Supplements on Liver Lipids and Fatty Acids and Growth of Mink

Ilo Pölönen, Reijo Käkelä, Maija Miettinen and Juha Asikainen

Male mink kits of the wild type were fed diets including different fat supplements: 1) beef-pork fat, 2) fur animal fat, 3) broiler offal, 4) rainbow trout offal, 5) fish oil, 6) soybean oil and 7) linseed oil, for 12 weeks. In all dietary groups, the proportion of digestible fat was adjusted to 8 %. Using

chromatographic methods, mink livers were studied for lipids and fatty acid composition. The different contents of total lipids in liver suggest large differences in the absorption of different fats in mink. Also the fatty acid compositions differed greatly. Interestingly, linseed oil, rich in α -linolenic acid (n-3 fatty acid), failed to increase the proportion of longer-chain n-3 polyunsaturated fatty acids in liver membranes.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. IV-A, 89-91 (Poster)

Use of Culled Hens and Hen Silage in Growing-Furring Diets for Mink

Kirsti Rouvinen-Watt, Margot White, Tanya Morse, Daphne Boudreau and Michael Johnson

The use of culled hens (CH) and hen silage (HS, 1.5% HCOOH, 0.3% Na benzoate) was investigated in growing-furring diets for mink. The diets (ME 4700 kcal/DM, CP:CF:CHO 32:51:17) were formulated by replacing half or all of the herring (30%) in the CTRL diet by raw, ground hens or hen silage. Dietary pH was 6.1 in CTRL, 6.0 in CH15, 6.2 in CH30, 5.6 in HS15 and 5.1 in HS30 diet. The final body weights of the mink did not differ among the test groups and were as follows: CTRL (n=39) M 2267 \pm 54g, F 1184 \pm 52g; CH15 (n=20) M 2209 \pm 73g, F 1260 \pm 70g; CH30 (n=19) M 2235 \pm 80g, F 1159 \pm 70g; HS15 (n=20) M 2161 \pm 70g, F 1227 \pm 70g; HS30 (n=19) M 2144 \pm 70g, F 1187 \pm 72g. Fur quality, based on live animal grading and pelt evaluation showed no significant differences among the diets. Raw, ground hens or hen silage were found to support normal growth and

fur development in the mink with no detrimental effects on animal health or performance.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. IV-A, 92-95 (Poster)

Potato Industry Byproducts as Feed Ingredients for Mink during the Growing-Furring Period

Kirsti Rouvinen-Watt, M. White, and M. Johnson

The suitability of two potato industry byproducts, potato starch (PS) and tater meal (TM), were studied in growing-furring diets for mink. The test diets (4700 kcal ME/kg DM, CP:CF:CHO 32:51:17) were made by replacing half or all of the extruded wheat (12%) in the control (CTRL) diet with PS or TM. Animal growth did not show significant differences among the experimental groups. Body weight gain from July until December in the test groups were: CTRL (n=39) M 1024 \pm 46g, F 373 \pm 42g; PS6 (n=20) M 1035 \pm 53g, F 402 \pm 61g; PS12 (n=20) M 1094 \pm 58g, F 337 \pm 61g; TM6 (n=20) M 1004 \pm 58g, F 395 \pm 60g; TM12 (n=20) M 1079 \pm 57g, F 378 \pm 56g. According to live animal grading [pelt grading] of male mink, the two best color categories comprised of 72% [94%] in the CTRL group, 91% [91%] and 82% [82%] in the PS6 and PS12 groups, whereas the TM6 and TM12 groups only had 20% [30%] and 50% [70%] of animals in these categories (p<0.05).

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. IV-A, 96-99 (Poster)

BEHAVIOUR/WELFARE ABSTRACTS

Alternative Housing and Reproduction in Silver Foxes (*Vulpes vulpes*)

Vivi Pedersen

The aim of the experiment was to examine how an alternative nest box and housing regime influenced reproductive success in the silver fox. The experiment was a 2 x 2 factorial design performed with 100 silver fox vixens. These were kept either traditionally or with a whole-year nest box and housed either permanently in the same cage year round or continuously moved according to standard routines according to expected parturition. The experiment was repeated for three years. Data on parameters linked to mating and insemination, birth, cub mortality and maternal qualities were gathered each year. Information on how the alternative housing system affected reproduction in silver foxes will be forwarded and conclusions will be drawn as to whether this alternative system can be implemented without negative consequences on the reproduction of silver foxes.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. IV-B, 103-107

A Family Housing Experiment in Raccoon Dogs

Kasanen Sari, Mononen Jaakko, Harri Mikko, Ahola Leena & Pyykönen Teija

Family housing of raccoon dog cubs in an enriched environment was compared to traditional pair housing. Each family (vixen and her seven cubs) had four cages connected to each other via openings. There was a resting platform and a plastic tube for resting and hiding in each cage. The control cubs were kept in brother-sister pairs in a cage without any interior structures. There were no differences between the family (N=49) and pair (N=42) cubs in their final body weight, body length, gastrocnemius muscle mass or serum cortisol after ACTH administration. The skins of the family group were longer, the adrenals heavier and the intestine longer than those of paired cubs. The heart was heavier in pair-housed animals. Family housing did not markedly affect growth performance, and unambiguous welfare effects were not observed.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. IV-B, 109-111

A Family Housing Experiment in Mink

Jaakko Mononen, Sari Kasanen, Sanna Harjunpää, Mikko Harri, Teija Pyykönen & Leena Ahola

Mink kits are usually kept in male-female pairs from weaning to pelting. We compared the traditional system (N=62 kits) to family housing (N=72 kits) in wild type mink, i.e. keeping the kits together with their mother in a row-cage system during the growing season. The stocking density was the same in both systems. At pelting in late November, male kits from the pair group were heavier than those from the family group, but there were no differences in the skin length between the groups. In females, no marked differences were observed in growth between the two groups. There was some indication in both sexes that the family housed kits were less stressed than the pair housed kits, as indicated by adrenal weights. The former group had more bite scars than the latter.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. IV-B, 112-114

Stress-Induced Responses in Farmed Blue Foxes

Mikko Harri, Heli Karhunen, Jaakko Mononen & Sari Kasanen

Stress-induced hyperthermia and tachycardia, when coupled with behavioural changes, have been shown to be useful indicators of stress. We telemetrically monitored the heart rate, deep body temperature and activity of five unrestrained farmed blue foxes for 24 hours to determine normal variation in these variables. We measured also foxes' reactions to some specified situations to assess the stressfulness of these situations. All three parameters fluctuated largely during the course of day. Responses to gunshot, measurement of rectal temperature with a probe and a person standing in front of the cage produced hyperthermia, tachycardia and increased activity in the animals. Typically all these variables changed simultaneously. However, fox reactions

varied greatly among individual, from little change to small but detectable changes..

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIIth International Scientific Congress in Fur Animal Production, Vol. IV-B, 116-118

Information Value and Applicability of Mink Welfare Indicators for on Farm Assessment

Steen H. Møller & Steffen W. Hansen

The objective of this paper is to describe the development of an operational welfare assessment system for use on private mink farms that enables the farmer to respond to the information. Animal welfare cannot be measured directly, but has to be assessed indirectly. Various indicators have been examined for implementation in the welfare assessment system. Behavioural data like: the temperament of kits and breeding animals measured by the stick test, stereotypy, and weight loss during the winter; clinical data in the form of: physical damages observed at pelting as well as health and mortality data. In the present paper two of these indicators are evaluated for I: independent relevance, II: marginal information value and III: applicability in practice. Results from the first season and the evaluation of the welfare indicators will be presented and discussed.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIIth International Scientific Congress in Fur Animal Production, Vol. IV-B, 119-123

Fifteen Years of Otter Breeding

O.V. Trapezov, L.I.Trapezova

Four generations of river otter have been in captivity for 15 years. In mid-1999 the composition of the population was the F₀ – 2%; the F₁ – 33%; the F₂ – 63%; the F₃–2%. For the first step of domestication, selection was very strict, and genotypes providing higher resistance to the stress of domestication were retained through successive generations. Selection coefficients (SC) under conditions of man-made environmental stress were 67% for females and 77% for males in the F₀; the SCs were 46% for females and 61% for males in the F₁. Individuals exhibiting the fear response to humans and, hence, susceptible to stress could not breed successfully and contributed little to the gene pool. The observed

fertility was 3.01±0.2 pups / female for domestic otters, while it was 0.72±0.5 pups / female for those responding by fear to humans.

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The Effect of Response Type on the Demand for Food in Mink

Steffen W. Hansen, Margit B. Jensen , Lene J. Pedersen , Jan Ladewig and Lindsay Matthews

The behavioural priorities of farm animals can 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 response type on the demand 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 went through 5 runs of successively increasing fixed ratio (FR) levels (4, 8, 16, 25, 60, 80 and 100). The rewards were available for 24 hours per day and each reward was 0.5 g of food. Half of the animals worked the lever in the first period and the chain in the second period, the other half of the animals, vice versa. The number of rewards, and thereby the amount of food earned, decreased as the FR values increased for all animals. There was a significant interaction between method and FR value (P<0.001). The demand curve for food obtained by chain pulling was steeper than the demand curve obtained by lever pressing. There was a significant interaction between method and run with respect to the weight of the animals (P<0.01). The weight in the last runs was lower when mink were working on the chain compared to the lever. The weight of the animals was higher in period one compared to period two (P<0.01), and there was a significant decrease in weight over the FR levels (P<0.001). A reason for the difference in the slopes of the demand curves may 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 each type of response.

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Do Silver Foxes Become Feral when Housed in Outdoor Enclosures?

Leena Ahola, Mikko Harri, Jaakko Mononen, Teija Pyykönen

We measured the effect of an increased possibility to avoid human contact on silver fox daily activity rhythm and on stress-induced-hyperthermia (SIH). Silver fox cubs were housed from August until the pelting time either alone in standard fox cages (C-group) or in sibling groups consisting of two male and two female cubs in outdoor enclosures (112 or 50 m², E-group). Rectal temperatures at the beginning of the SIH-test (T₀) and 35 min after human exposure and restraint (T₃₅) were measured in mid October. T₃₅ and the change in rectal temperature (T₃₅-T₀) were both higher in E foxes than in C foxes (40.2 vs. 39.8 °C and 0.7 vs. 0.1 °C, respectively, p<0.01). In November, compared to C foxes, activity of E foxes was lower during the work-day hours (p<0.000) but higher during morning and night hours (p<0.000). Both the increased SIH and changes in activity pattern show that foxes housed in large enclosures become feral.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. IV-B, 130-133

Peculiarities of Keeping, Feeding and Breeding of Steppe Marmots (*Marmota bobak* Mull.) and Black-capped Marmots (*M. camtschatica* Pall.)

Igor A. Plotnikov, Yuri S. Zabolotskikh

The marmot is a new subject for fur farming. A colony of 300 marmots of two species were kept at the biological station of the Institute. Four types of housing were tested. The best results for fur farm breeding were provided by a shed and a barn with cages like those for foxes. Three types of feed were developed and tested: 1. Dry food type: full ration granulated combined food (suitable for steppe marmots). 2. Mixed fodder: granules and succulent foods (suitable for all marmots). 3. Wet food mixtures (for black-capped marmots). In experiments on food balance, species and age differences in metabolism and digestibility of all

main nutrient substances of foods and rations were determined. Reproduction was also studied.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. IV-B, 134-136

Behavioral Traits and Adrenal Function in Mink Selected for Tameness and Aggressiveness

Gulevich R. G., Kharlamova A. V., Trapezov O. V.

The level of locomotion in the open field test and critical distance to investigator were studied in mink kits (2.3-5 months of age) born to mothers selected for reduced and increased aggressiveness toward man, as well as in a control unselected group. Serum levels of cortisol in these kits were determined before and after open field testing. Tame and aggressive mink demonstrated higher levels of locomotion than controls at the end of open field test. The critical distance in contact with man was also reduced in tame kits as compared with control and aggressive ones. A decreased serum cortisol content was observed in the domesticated group as compared with control animals (both intact and tested in the open field). These data may be indicative of an enhanced exploration and decreased fear response in mink from the tame group by comparison with control mink.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. IV-B, 137-140

What is the Attitude towards Protection of Animal Rights

O.V.Trapezov, L.I.Trapezova, A.L.Simanov, E.M. Koldaeva

Fur, along with diamonds and gold, are the world's capital stocks. Overproduction of currency stabilizers, such as fur pelts, may appear unreasonable on an international scale. It has been estimated that mink production should not exceed 27 million pelts annually. Teams organized and supported by protectors of animal rights within the Greenpeace framework have a view of containing

fur overproduction. Their ultimate goal is to impose an artificial limitation on the inflow of fur, thought to be redundant into the market. How the issue is addressed in Russia is discussed in this section.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. IV-B, 141-143

Activity and Stereotypic Behaviour in Mink Dams Fed *ad libitum* or Restricted during the Winter

Birthe Houbak & Steen H. Møller

In order to compare the effects of *Restricted* and *Ad libitum* feeding strategies, aiming at 25% and 10% reduction in body weight from November to February, respectively, an experiment with 531 brown primiparous females was conducted on a private farm. Activity and stereotypic behaviour were recorded using direct observation before and after feeding time on January 26, February 19 and March 23. The reduction in body weight was 21% and 13% in the *Restricted* and *Ad libitum* feeding group, respectively. The percentage of active females was significantly higher in the *Restricted* fed group, compared to the *Ad libitum* fed group, both before and after feeding in February. In February and March, significantly more females were active before feeding than after feeding in both groups. Significantly more females in the *Restricted* group than in the *Ad libitum* group performed stereotypies after feeding in January. In February the stereotypic behaviour was observed significantly more often before than after feeding in both groups. Females observed active or stereotyping at least once lost 66 g and 147 g more body weight, respectively. The results indicate that females on a restricted feed allowance may lose more weight than the reduction in energy intake would indicate because they become more active and perform more stereotypic behaviour.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. IV-B, 144-148 (Poster)

Relationship between Weather Conditions and Cub Losses in Farmed Blue Foxes

Ilukha, V., Harri, M., Rekilä, T.

The aim of this study was to analyse relationship between cub losses and several components of weather. The study sample included 394 primiparous and 755 multiparous vixens, which gave birth to 2,324 and 8,217 cubs (15.7% and 10.3% of them died before weaning, respectively). Their litter size and cub losses were evaluated by inspecting the nest boxes three times a day over a period of three subsequent springs. Low ambient temperature significantly influenced on cub losses. The analysis yielded five factors which explained 76.2 and 69.8% of the variance in primiparous and multiparous vixens, respectively. However, as the several parameters of weather generally were confounded by different factors, we still lack a good index of the weather, which could be used when analysing relationship between weather and cub losses.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. IV-B, 149-152 (Poster)

Stress-Induced Hyperthermia in Confident and Fearful Mink

H. Korhonen, S.W. Hansen, J. Malmkvist and B. Houbak

Response levels of stress-induced hyperthermia (SIH) were compared in confident and fearful mink in three different experiments. Treatments like capture, re-capture, immobilization in a trap and handling were found to evoke measurable rectal temperature responses. After the first capture, no significant differences in SIH responses were noted among animals of different temperament lines. However, fearful and confident animals tended to react differently to trap immobilization, i.e. fearful ones by increasing their response levels, and confident ones by decreasing them. After re-capture, SIH was significantly higher and lower in fearful and confident animals compared to the first capture, respectively. The results showed that hyperthermic response in the mink is rapid. It is concluded that systematic temperament selection has led to

measurable differences in SIH responses between mink selected for confident and timid behaviour.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. IV-B, 153-156 (Poster)

Measuring Maternal Care in Mink: Kit Retrieval Test

Jens Malmkvist and Birthe Houbak

A kit retrieval test was developed as a potential indicator of maternal ability, with the ratio of weaned to born kits as the success criterion. In the kit retrieval test the reactivity of the dam towards a kit placed outside the nest was evaluated, as chilling of kits is among the causes of early mortality. The test was performed on day 5 (n=136) and day 20 (n=140) after birth, by recording the time until the dam touched and retrieved her kit to the nest. Within 120 seconds over 90 percent retrieved their kit. Latency to reaction on day 5, but not on day 20, was significantly correlated with kit loss, as dams reacting slower towards a kit in distress tended to have the highest kit loss. We regard the kit retrieval test a simple measure for reactivity towards kits, being easy to conduct on a large sample of animals.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. IV-B, 157-159 (Poster)

Raising of Young Muskrat (*Ondatra zibethicus*) in Cages of an Industrial Type

Mukhamedvail M. Mukhamedyanov

The elements of an industrial technology for raising young muskrats in heated buildings, providing concentration of a large stock of animals in small housing areas, and using mechanisms of labour-intensive processes in a dry type of feeding were studied. Males and females raised in groups (5 or 6 individuals) in wire-meshed cages without houses, floor litter or pools for swimming grow quite well, and as to the increase of their weight and size, exterior, quality of hair covering they have even better indices than the animals raised in standard cages with wooden houses and a floor litter. Muskrats can be successfully kept in two-level wire-

meshed blocks using automatic waterers, hopper-type feeders, dung cleaning machines and full ration granulated mixed fodder. This husbandry requires 3.2 fold fewer man hours compared to the traditional cage system.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. IV-B, 160-162 (Poster)

Reaction of the European Polecat to the American Mink Introduction in Experiments

Andrey A. Petrin

Behavioural interactions between close-related species European polecat (*Mustela putorius* L.) and American mink (*M. vison* L.) were studied. The work was carried out at the Biological Station "Tchernogolovka" of the A.N. Severtsov Institute of Ecology and Evolution, Russian Academy of Sciences, in 1996-1997 in large enclosures (40 m²) during non-breeding and breeding seasons. Single American mink (males or females) were introduced to the experimental groups of European polecats (1 male and 1 female). 33 experiments were conducted. All interspecific interactions between European polecats and American mink were recorded. Practically all interspecific interactions were aggressive. American mink were more aggressive, than European polecats, males stronger, than females. In European polecats defensive aggression prevailed.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. IV-B, 163-167 (Poster)

Characteristic and Optimization of Husbandry Conditions of Herbivorous Fur-bearing Animals

Igor A. Plotnikov, Oleg Yu. Bespyatyh, Victor Z. Gazizov, Igor A. Donski

The nutria (*Myocastor coypus* M.), the muskrat (*Ondatra zibethica* L.), and the steppe marmot (*Marmota bobac* M.) were studied. The microclimate of different types of buildings for herbivorous fur-bearing animals was investigated. Its impact on morphobiochemical and immunological indices of blood, and on production

was established. New and precise hygienic and technological standards for designing and building the farms on breeding herbivorous fur-bearing animals have been developed.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. IV-B, 168-169 (Poster)

How to Farm Sables

O.V.Trapezov, L.I.Trapezova, A.V.Sajdinov

This paper gives guidelines for Russian sable farming: mating, nursing, lactation, weaning, feeding, grading, pelting.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. IV-B, 170 (Poster)

Measuring the Essentiality of Swimming Water for Farmed Mink by a Classic Conditioning Technique

C.M. Vinke and B.M. Spruijt

Deprivation of essential behavioural needs are often forwarded as potential causes that farmed mink suffer from a variety of behavioural disorders. However, in general, there is still no consensus on the concept of "essential needs". Present research introduces a classic conditioning technique for mink which was earlier used for measuring the incentive values of commodities in rats. We assume that the intensity of "anticipation behaviour" for a forthcoming rewarding stimulus reflects the state of an animal in terms of deprivation of needs. The anticipatory responses for a positive stimulus (food) were studied in 4 groups (N=14 females per group), reared in the presence or absence of swimming water, in the presence of a palatable food item and one group with neither of the extra commodities. If swimming is highly valued by mink we expect that anticipatory behaviour for a forthcoming reward will increase when mink was denied of swimming during ontogeny in order to compensate for the lack.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. IV-B, 171-174 (Poster)

WORKSHOP ON RECENT ADVANCES IN ALEUTIAN MINK DISEASE RESEARCH

Perspectives on Aleutian Disease

John R. Gorham

Of all the infectious diseases of mink, Aleutian mink disease (AD) no doubt causes the greatest direct mortality and associated losses in mink reproduction and fur quality. Moreover, the immunosuppression caused by Aleutian mink disease virus (ADV) markedly influences the course of other viral, bacterial and nutritional diseases. It would be difficult to estimate the total economic harm for the mink industry from ADV. The complex interactions between the mink's age and genotype with the particular infecting ADV remain to be explained by virologists and molecular biologists.

Conventional ADV vaccines were a disaster, but novel molecular approaches to the study of the ADV may lead to a future vaccine. Also, identification of high and low virulence isolates of ADV, determinants of neurotropism, and transmissibility of strains will be based on studies elucidating the structure-function relationships encoded within the genome of the ADV.

Counterimmunoelectrophoresis (CIEP) testing detects ADV infected mink and provides the best means of control. If the test is applied aggressively and diligently as it is on Danish farms, there is hope for eventual eradication in Denmark. The Iodine Agglutination Test (IAT, Mallen's test) only identifies infected mink with hypergamma-globulinemia. Since other ADV infected mink will not be detected, the use of the IAT offers no valid hope for eradication of AD on farms. As a new century begins, many challenges remain in the field of ADV. Addressing these challenges will require the active engagement and co-operation of basic scientists of all stripes, mink husbandry specialists, the fur industry, and the mink growers.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. V, 3-6

Aleutian Mink Disease Parvovirus Infections: Practical Insight from Basic Research

Marshall E. Bloom.

Infections with ADV remain a scourge for mink ranchers with many vexing questions still unanswered. However, basic virology research has provided several important insights. Recombinant ADV constructions have been made by combining segments of pathogenic and non-pathogenic isolates. Infection of Aleutian mink with these viruses reveals that pathogenicity is regulated by sequences in the capsid protein gene. Furthermore, additional work indicates that some viruses can persistently infect animals without causing progressive disease. Other studies on the physical structure of ADV suggest a possible mechanism for the failure of antibody to eliminate virus from adult animals. Antibodies have been made against certain short peptides exposed on the ADV capsid surface, and tested for the capacity to neutralize virus in cell culture and to allow virus to infect macrophage-like cell lines. The results show that the same antibodies can mediate both phenomena. Because infection of macrophages may play a crucial role in pathogenesis of ADV infections, antibodies to these peptides may contribute to viral persistence and the development of progressive disease.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. V, 7-11

Mink Plasmacytosis Vaccines

Bent Aasted

For the last 10 years, nine experimental vaccination trials have been performed in our laboratory. They have been based on vaccination with Aleutian Mink Disease Virus (AMDV) capsid proteins p85/75 (VP1/2) and the non-structural protein p71 (NS1). We have used adjuvants, such as the classical aluminium hydroxide, but also the ISCOM (immune stimulating complexes) technology. Recently we began a DNA vaccination trial based on plasmids containing the ADV NS1 gene. Vaccines based on the viral capsid proteins (VP1/2) enhanced disease by accelerating virus-induced pathology in vaccinated mink when compared to unvaccinated mink. These findings, when

considered along with previous work, suggest that vaccines based on the virus capsid will not be useful. Altogether, six trials of AMDV NS1-based vaccines have been performed. Three were based on the ISCOM technology and three used aluminium hydroxide adjuvant. All trials showed partial protection from disease, but the vaccines could not prevent infection, and AMDV induced typical pathology in some of the vaccinated mink. Surprisingly, the NS1 aluminium hydroxide vaccines proved to give the best vaccination results when compared to the ISCOM groups and to the unvaccinated groups of mink. The results presented in this review suggest that vaccines based on the NS1 (p71) protein should be given strong consideration. There is a great demand for evaluation of the efficacy of the NS1 vaccines under normal farm conditions using double blind vaccination trial protocols. Such experiments can not be performed in Denmark due to the national AD eradication program. I hereby invite interested parties for constructive discussions on this matter.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. V, 12-15

Impact of Outbreaks of Acute Aleutian Disease in Danish Mink Farms

Mariann Chriél

Acute Aleutian disease was described in the early eighties. The outbreaks are characterised by severe lung lesions in the young mink kits in the early weaning period. The outbreaks are associated with high mortality rates and often lowered production result. The earlier the outbreaks are diagnosed in the weaning period the higher are the mortality rates, and thus the impact.

This paper will focus on the annual incidence of acute Aleutian disease. The risks for outbreak of acute Aleutian disease will be discussed. The impact of the outbreaks both on the involved farms as well as the impact on the neighbouring farms in a 5-km diameter around will be presented.

A country-wide control programme for Aleutian Disease (AD) was initiated in Denmark in 1979. The strategy was based on testing and removal of all animals reacting to ADV. Participation was

voluntary up to 1999, at which time legislation was instituted. The principles in the legislation are two annual compulsory control tests of the mink – 10% of the breeders in May/June (barren breeders) and 20% in the winter period (corresponding to all males). If reactors are detected removal from the herd is mandatory before a new breeding season. Some farmers choose to perform a total depopulation of the farm with reactors, but this procedure is optional and subsidised by the Fur Breeders Association. In order for a mink farm to be declared free of AD the herd must be free of reactors on two occasions with a minimum of nine and a maximum of eighteen-month interval. All breeding animals in the herd must be tested and no reactors detected.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. V, 16-20

Aleutian Disease: Current Thought on Eradication

Gary R. Durrant

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. V

Cleansing and Disinfection Procedures in Connection with the Danish Aleutian Disease Eradication Programme

J. Østergaard, M. Chriél and C.M. Willadsen

Strategies began in the 1970's have substantially reduced the frequency of Aleutian disease (AD) in Danish mink herds. Recently, legislation was instituted aimed at eradication of the disease by regular testing of mink herds, and removal of infected animals. Depopulating, disinfecting and repopulating with AD-free mink is frequently employed as a means of eliminating the disease from farms. This sanitation process is achieved in a series of steps which comprise: planning of the project, provision of uninfected bedding material, removing the animals, clearing of the premises of manure, bedding and extraneous materials, cleansing of the farm by dry and wet methods, chemical disinfection, and repopulation with AD-

free animals. Since the AD-sanitation strategy began to gain momentum in 1998, approximately 250 farms have been sanitized according to these procedures

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. V, 22-26

Effect of *Mytilus* Hydrolyzate in the Mink at Reproduction and Viral Plasmacytosis

Nikolai Tyutyunnik, Ludmila Uzenbaeva, Victor Ilukha, Hilda Meldo

The effect of *Mytilus* hydrolysate (MIGI-K) on mink reproduction and Aleutian disease was studied. The addition of hydrolysate to the diet had a positive effect on the morphobiochemical status of the animals, reproductive indices, growth and development of mink kits. The effect depended upon dose, duration of treatment, and the animals' condition. In mink naturally infected with Aleutian mink disease parvovirus, the hydrolysate changed the fractional composition of serum proteins to a more normal pattern, the total leukocyte count and the differential leukocyte count. The beneficial effect observed in infected mink may be connected with the immunomodulating substances in the *Mytilus* hydrolysate (MIGI-K), which are thought to inhibit the synthesis of abnormal serum proteins.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. V, 27-30

Prevalence of Genital Microorganisms in Aleutian Mink Disease Parvovirus (ADV)-Infected Female Mink

Pablo Martino, Nestor Stanchi and Juan Jose Martino

Intrauterine swabs were collected from clinically healthy mink at pelting time on two commercial

farms with differing incidences of Aleutian mink disease parvovirus (ADV) infection. When samples from 50 non-infected females were cultured for bacteria, 10 % had aerobic bacteria with recognized pathogenicity (*Klebsiella pneumoniae*, beta-hemolytic *Streptococcus* sp, *Pasteurella* spp and *Escherichia coli*), 24 % contained transient bacterial isolates, and 74 % were sterile. In contrast, when samples from 36 ADV-infected dams were examined, 8 % had bacteria with recognized pathogenicity, 64 % contained transient bacteria, and 28 % were sterile. Thus, while there was no difference in the isolation of pathogenic organisms, transient bacteria were cultured significantly more often from the ADV-infected dams ($p < 0.05$). Based on the type and number of the organisms recovered here, the female mink appears to possess a relatively simple uterine microflora.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. V, 31-33

Modified Dot Immunoenzyme Assay of Antibodies against Mink Aleutian Disease Virus

Taranin A.V., Faizulin R.Z., Miroshnichenko S.M.

Dot-immunoenzyme assay (DIA) is a powerful tool for mass-screening of mink Aleutian disease. DIA possesses a number of important advantages over counterimmunoelectrophoresis and is particularly convenient for diagnostic labs performing thousands of tests. We developed a novel modification of DIA, in which, instead of purified virus, a crude virus preparation was used as antigen. This improvement further decreases antigen consumption per test and substantially simplified production of DIA diagnostic kits. The modified method was used for Aleutian disease testing in two large mink farms over three years (300,000 tests) and was found to be specific, sensitive and reproducible.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. V, 34

WORKSHOP ON HEALTH AND DISEASE IN MINK PRODUCTION

Current Infectious Disease Problems in United States Mink: Distemper

*Robert Westlake
John R. Gorham
Gary Durrant*

Aleutian disease (AD) continues to cause losses in all mink raising areas. In Utah, poor production, loss of fur quality and exceptionally high mortality rates were observed on several farms. The standard for control is the CIEP test and pelting of reactors. Recently, the iodine agglutination test (IAT) has been re-introduced on non-Aleutian mink farms where the CIEP has failed to control AD. The results of IAT testing will be given. A longitudinal study of Utah and Idaho mink disease outbreaks and the isolation of pathogens will be documented. Distemper vaccines have provided an effective immunity until recently. Massive vaccine failures were observed in 1998 in which thousands of mink died of distemper following field exposure. Possible explanations for the distemper losses will be discussed. Other diseases that will be discussed include epizootic catarrhal gastroenteritis, transmissible mink encephalopathy, and toxoplasmosis.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIIth International Scientific Congress in Fur Animal Production, Vol. VI, 3-5

Specific Prophylaxis of Salmonellosis, Carnivore Distemper and Adenovirus Infections in Caged Fur-Bearing Animals

Domski I.A., B.M. Zhitkov, Ulasov V.I., Malakhov Yu.A., Zakharova Ye.D.

Improvement and development of new effective preparations for infectious disease prophylaxis of animals is an important and urgent problem of veterinary science. Recently, a new vaccine for caged foxes, arctic foxes, and raccoon dogs was developed. As antigens, the preparation contains attenuated strains of *Salmonella* (3 strains) and distemper virus, and an inactivated adenovirus component. Experiments in furbearing animals and tests at farms proved the innocuity, moderate

reactivity and high immunogenicity of the vaccine. The use of a new vaccine preparation in fur farming allows prophylactic immunization of animals against the above mentioned infectious diseases efficiently, at the earliest possible date and with minimum expenditure of labour. It also favours increased animal reproductive capability, survival and better growth and development.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIIth International Scientific Congress in Fur Animal Production, Vol. VI, 6-10

Mortality in Ranch Raised Mink: A Year in Review

Gary R. Durrant

As consulting veterinarian for the Fur Breeders Agricultural Cooperative located in Midvale, Utah, I receive calls from ranchers both within and outside of the state Utah concerning mink and the various diseases that affect ranch raised mink. From October 1998 through December 1999, 286 mink were necropsied for ranchers in Utah and Idaho. The months with the most losses were June and October. Of the 286 mink necropsied, many of the mink were noted to have multiple lesions.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIIth International Scientific Congress in Fur Animal Production, Vol. VI, 11-12

Health Surveillance in Danish Mink Farms - a Prospective Study

Hans Henrik Dietz, Thomas Holmen Andersen & Mariann Chriél

Production of mink is characterized by one annual reproduction cycle in which all animals are synchronized within few weeks. Kits enter the annual cycle in their first year, resulting in a great homogeneity in disease patterns at any given time of the year. This means that all animals potentially are at risk at the same time and that all animals are subjected to the same risk factors throughout the country with respect to production factors and production diseases and to a certain extent, infectious diseases. Each age group presents its own health problems, and the study of diseases in mink is

often limited to a narrow period of time once a year. Many mink farms may acquire the same disease, be it infectious or production related, at the same time, hence the demand for advice and medication is often concentrated over short periods of time. Definitive knowledge of disease distribution among Danish mink farms is limited to the data obtained through material submitted by practicing veterinarians to the Danish Veterinary Laboratory. This laboratory is the only general diagnostic laboratory in Denmark handling fur animal diseases.

Results from a pilot study showed a considerable discrepancy between disease data obtained through necropsies of mink dying in a production period and the diseases recorded from the material routinely submitted to the Danish Veterinary Laboratory (Rattenborg et al. 1999). A prospective study, including 6 mink farms serviced by 3 veterinary practices was initiated.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. VI, 13-17

Outbreaks of Mink Distemper in Denmark during 1999: Epidemiological Observations

C. M. Willadsen

Mink distemper is a notifiable disease in Denmark. The government order dealing with the disease (Anon.1993) stipulates that a farmer who suspects the presence of the disease among his animals must seek veterinary assistance. If the veterinarian cannot exclude the diagnosis out of hand he is obliged to notify the district veterinary officer and to submit diagnostic material to the State Diagnostic Laboratory. Once the diagnosis is confirmed, the farm in question is put under the authority of the district veterinary officer who then decides how to proceed. Control measures normally instituted are quarantining of the farm (restricted admission; indoor confinement of dogs and cats), ban on removal of fur animals, feed, equipment etc. outside the premises, euthanasia of all clinically affected animals and destruction of the carcasses, vaccination of the rest of the animals, burial of manure, cleaning and disinfection of the premises, and separate delivery of feed to the farm. Restrictions are normally lifted following an eight-week interval during which no new cases of distemper have been observed. Any fur animal farm located within 1 km

from an affected farm and with unvaccinated stock will normally be ordered to have its animals vaccinated immediately.

Despite regulatory control measures and other means of control, including the availability of efficacious vaccines, distemper continues to linger on in the Danish mink population. Even though it appears that a diagnosis of distemper nowadays does not necessarily entail the dire consequences found in textbooks, the infection may still give rise to severe losses in terms of mortality, unthriftiness of surviving animals and decreased skin quality.

The paper contains a collation of information from all Danish mink farms with laboratory-confirmed diagnosis of distemper during 1999. The aim of the exercise was to look for characteristic features of the outbreaks, knowledge of which might be useful in the future control of the disease.

Scientifur, Vol. 24, 4, 2000 Proceedings of the VIIth International Scientific Congress in Fur Animal Production, Vol. VI, 18-23

Lipogranulomatous Lesions in Mink with Hyperlipoproteinemia Type I

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A familial form of hyperlipoproteinemia in mink (*Mustela vison*), associated with lipoprotein lipase deficiency has been investigated for the last decade. The purpose of the study has been to compare the biochemistry and the pathology with the corresponding conditions in man and cats. Lipogranulomatous changes were found in the jejunal mesentery and within, or in close proximity to, the pancreas. The mesenteric granulomas arose from obstructed lymph vessels and consisted frequently of individual, coalescing nodules that sometimes had central spaces containing a gray-white, semi-liquid, or darker and rather solid, greasy material. Surrounding granulomatous tissue contained many foamy and/or hemosiderin-laden macrophages. Lipogranulomatous lesions of macroscopic size were unusual at other sites, but microgranulomas or scattered foam cells were observed in a number of organs, including the spleen, lymph nodes, bone marrow and the liver. This metabolic disturbance in mink is the only known animal model for the study of

hyperlipoproteinemia type I in man, accompanied by inflammatory changes in the pancreas.

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Disease and Production Management in Mink Farming.

Bert Urlings, Haiko Koenen

This paper presents some results of the implementation of managerial concepts related to health in mink farming. The concept is based on the hazard analysis critical control points (HACCP) concept. An example of improving the health and reducing the use of antibiotics during the early stages of life of mink kits is discussed. The results are based on a small number of farms. Under Dutch circumstances it is impossible to reach sufficient numbers of mink farms to present data that are, from an epidemiological point of view, scientifically justified to draw definite conclusions. However the results presented in this paper suggest that there are good possibilities to improve health in mink by the use of health control programmes.

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Medication in Danish Mink Farms

Mariann Chriél and Hans Henrik Dietz

In 1995 DANMAP the Danish Integrated Antimicrobial Resistance Monitoring and Research Programme was initiated. The objective of the programme was to monitor the occurrence of antimicrobial resistance among bacteria isolated from production animals, food and humans as well as the consumption of antimicrobials. The results are registered in a database and will form the basis for a more prudent use of antimicrobials, both as growth promoters and as therapeutic use of antimicrobials in production animals (Anon. DANMAP 1997-99).

The reason for initiating this programme was the rising public concern about transferring resistant bacteria from the production animals through the

food chain to humans. The concern was raised due to occurrence of VRE (Vancomycin Resistant Enterococci) and resulted in banning of avoparcin in Denmark in May 1995, followed by an EU-wide ban in 1997.

However, problems in establishing associations between the consumption of antimicrobials used for production animals and the detection of resistant bacteria in humans were soon identified. Hitherto only the total consumption was recorded and lack of knowledge regarding species, herd and dose was noted in order to draw conclusions.

Therefore, in May 2000 VETSTAT was initiated. This register is based on the Central Husbandry Register (CHR) and all antimicrobial prescriptions are recorded on farm level, including the veterinary practice prescribing the antimicrobial, as well as the species, age and date of treated group of animals, and the diagnosis.

Recording of all Danish mink farms in CHR took place in 1999. Due to the fact that mink is monocyclic only the diagnosis is required because the age group is defined by the date of prescription. In practice an almost perfect correlation between date of prescription (and thereby age group) and diagnosis is observed in mink production regarding production diseases. Infectious and contagious diseases may occur at all times of the production period.

One might argue that because mink is not part of the stable-to-table chain no concern regarding use of antimicrobials needs to be taken. This approach is, however, not in accordance with the public opinion and is to be regarded as irresponsible with respect to good farm practice. Danish recommendations are more and more focused on reducing the consumption of antimicrobials, not as a goal in itself, but rather as a tool for optimisation of production facilities and management practices.

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Health Effects of Feeding Strategies in the Pre-Mating and Gestation Periods of Mink

S. H. Møller & M. Chriél

In recent years, potential health and welfare aspects have been included in the debate of the optimal feeding strategy prior to the mating period and during the gestation period. Based on two studies

under farm conditions, the health effects of restrictive feeding during the winter and the gestation periods are examined. A study in 1994 of four farms was carried out to investigate the health implications of restrictive feeding during the winter period. The number of litters diagnosed "sticky kits" was higher in the restricted feeding group, but the diagnosis was not significantly ($p < 0.1$) affected by the individual loss of body weight during the winter. A study in 1999, of six farms participating in a health status survey, was used to evaluate the health effects of the farmers feeding strategies during the gestation period. The number of dead kits and of females treated for sticky kits was significantly higher on farms that restricted the feed allowance during the gestation period. It is concluded that reduction in the energy intake of mink dams in late gestation, to a level significantly below the maintenance needs, increases the risk of sticky kits and kit mortality rate. Restricted feeding during the winter, along with a severe weight loss, is associated with an increased risk of sticky kits, but possibly only secondary to the feeding strategy during gestation.

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Some Aspects of Feeding and Welfare of Mink

Eva Aldén

Each year we expect breeding results to improve, growth and size of the mink to increase and pelt quality to get better. We try to reach these goals while, at the same time, maintaining good animal health, which is one condition of welfare. In this paper some aspects of management and feeding are discussed in relation to animal welfare.

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Indicators of Health and Welfare Observed at Pelting of Mink

Steen H. Møller

The objective of this paper is to describe the use of clinical examination of mink at pelting, as part of an operational health and welfare assessment protocol. Mink are pelted on private farms and health related data are not collected at present. In order to evaluate the information value of data easily obtained at pelting, animals from six farms were examined at pelting in 1999. Immediately after euthanasia, bodies of male and female mink were examined for damage to the fur, skin, ears, eyes, feet and mouth. After fleshing, the flesh side of female skins was examined to determine the number of bites penetrating and other damage to the skin. After skinning, bodies were necropsied and the urinary tract examined for bladder and kidney stones and fat infiltration in the liver. Based on an evaluation of the independent relevance, marginal information value and applicability as health and welfare indicators, bite marks on the flesh side of female skins is included in the protocol, while tartar on the molar teeth will be further investigated.

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Reflections on the Relationship between Genetics, Nutrition and Health in Modern Mink Production

Lena Englund

In this paper the breeding goals and present housing system for fur animals are discussed in relation to animal welfare and future production systems.

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