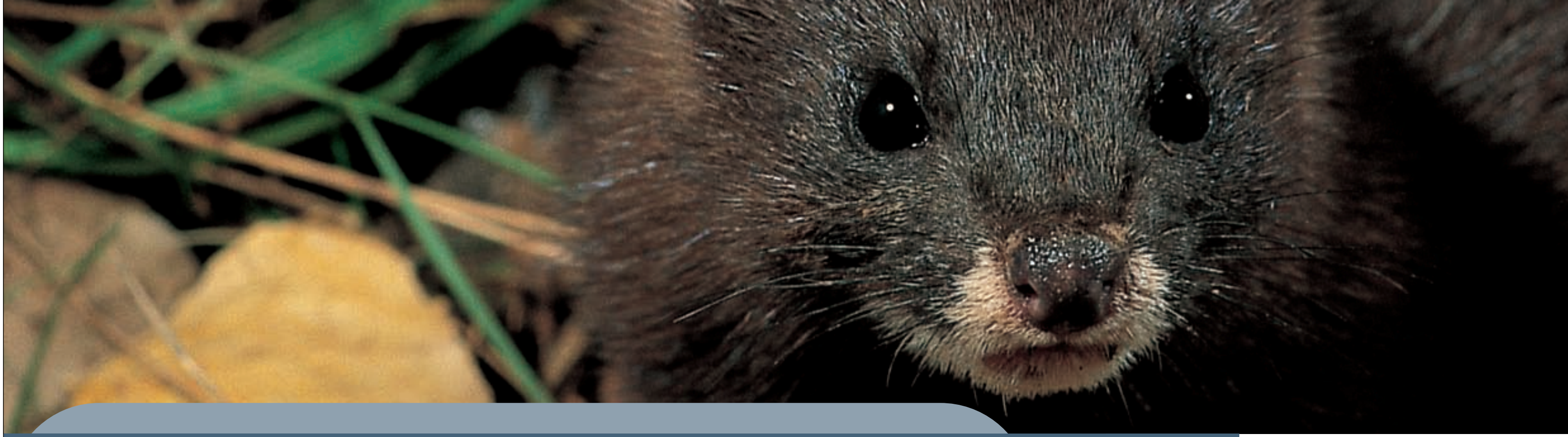

Congreso Internacional sobre la Conservación del Visón Europeo

(Mustela lutreola)

5 - 8 de noviembre de 2003. Logroño (España)

LIBRO DE ACTAS

International Conference on the Conservation of European Mink

(Mustela lutreola)

5- 8 November, 2003. Logroño (Spain)

PROCEEDINGS BOOK

Gobierno de La Rioja

Congreso Internacional sobre la
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384 p. ; 27 cm

Visones europeos-
Medio ambiente

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Primera edición: febrero, 2006

Consejería de Turismo, Medio Ambiente y Política Territorial
Pradoviejo 62, bis
26071 Logroño. La Rioja
T. 941 29 11 00
F. 941 29 13 02
www.larioja.org/ma
publicaciones@larioja.org

Impresión: Ochoa Impresores

Depósito Legal: LR-126-2006

Impreso en España - Printed in Spain

[ÍNDICE]
INDEX

[PRESENTACIÓN]
PRESENTATION

Unos días antes de Navidad, a finales de 1994, el Visón europeo fue visto por primera vez en La Rioja. Poco más de diez años han transcurrido desde entonces, pero en este tiempo el pequeño mamífero de hocico blanco ha pasado de ser un perfecto desconocido para el común de la población, a convertirse en un auténtico "símbolo" de la biodiversidad riojana.

El Visón europeo apareció en La Rioja precisamente cuando estaba desapareciendo a velocidad de vértigo de casi todas las regiones del mundo. Quizás por eso, quizás por lo elevado que era el riesgo de perderlo para siempre, o quizás por algo tan simple como que su aspecto nos resultó "simpático", lo cierto es que la sociedad riojana comprendió que nuestros visones europeos son un tesoro demasiado preciado y que su protección es una gran responsabilidad que excede el ámbito puramente autonómico o nacional.

La administración ambiental riojana, por su parte, ha emprendido en estos años numerosas actuaciones para tratar de conservar la población de Visón europeo asentada nuestro territorio. Así, la especie fue incluida en el Catálogo Regional de Especies Amenazadas de la Flora y Fauna Silvestre de La Rioja en la categoría "En peligro de extinción"; un tiempo después el Gobierno de La Rioja aprobaba el Plan de Recuperación del Visón europeo. Paralelamente, se realizaron estudios e inventarios poblacionales, labores de protección del hábitat y otro tipo de actuaciones para cuya continuación se recibió en el año 2000 apoyo financiero comunitario a través del programa Life Naturaleza.

En este sentido, una de las mayores muestras del interés que La Rioja tiene puesto en la supervivencia de esta especie fue la celebración del I Congreso Internacional para la Conservación del Visón Europeo. Durante cuatro días, los mayores expertos del mundo en Visón europeo se dieron cita en Logroño para intercambiar experiencias, debatir sobre las causas de la regresión, y evaluar cuáles son las medidas más eficaces para tratar de salvar a la especie. Todo cuanto allí se expuso se recoge ahora en este Libro de Actas. Una publicación que, al igual que el Congreso que transcribe, está llena de datos, análisis e hipótesis fruto de miles de horas de trabajo de campo y de laboratorio en los más variados rincones del continente; pero sobre todo, está llena de optimismo y del sincero convencimiento de que mientras quede una posibilidad, por pequeña que sea, de evitar la extinción de este animal, todos debemos poner lo que esté en nuestras manos para conseguirlo.

Mª Aránzazu Vallejo Fernández
Consejera de Turismo, Medio Ambiente y Política Territorial

[INTRODUCCIÓN]
INTRODUCTION

El Visón europeo (*Mustela lutreola*) es un pequeño carnívoro de régimen de vida semiacuático. *[The European mink (Mustela lutreola) is a small, semiaquatic carnivore]*

Its natural distribution area is exclusively Europe. Until the 19th century it was found throughout Central and Northern Europe, from the Atlantic coast (France) to the proximities of the Mediterranean and Black seas. However, during the 20th century it has suffered a drastic process of extinction. It has disappeared from most of the European countries it once inhabited and it is estimated that its distribution area has decreased to less than 20% of the original surface. By the end of the century, populations were only to be found in the Baltic Countries, Byelorussia, Russia, Romania, France and Spain. Now, at the beginning of the 21st century, the trend in population loss continues and only a few isolated populations persist. There is a western group covering south-western France and northern Spain, in addition to several eastern groups in central and northern Europe, namely Russia, the Danube Delta, Romania and possibly the Ukraine and Moldova.

The first references to this species in Spain date back to 1951 in Guipuzcoa. It was later detected throughout the Basque Country, Navarra, La Rioja, north-western Burgos and northern Soria. Most specimens inhabit the middle-upper Ebro river and its main affluents, in addition to some small populations in the western Cantabrian river basins.

However, the situation in Spain is precarious due, among other causes, to the small size of the population, the progressive destruction of its habitat and the expansion of the American Mink, and there is a serious threat to its continued existence in the mid term. For this reason, in 2001 and 2002, several Public Administrations (Government of Castilla-León, Alava Provincial Government, Government of Catalonia and Government of La Rioja) set up four conservation projects with financial support from the Spanish Ministry of the Environment and the European Commission, through a LIFE-Nature pro-

Su área de distribución natural es exclusivamente europea. Se trata de uno de los mamíferos más amenazados de Europa. Hasta el siglo XIX se distribuía por toda Europa central y septentrional, desde las costas atlánticas (Francia) hasta las proximidades de los mares Mediterráneo y Negro. Sin embargo durante el siglo XX ha sufrido un drástico proceso de extinción. Ha desaparecido de la mayor parte de los países europeos en los que habitaba, estimándose que su área de distribución se ha reducido a menos de un 20% del área original. A finales de siglo sólo existían poblaciones en los Países Bálticos, Bielorrusia, Rusia, Rumanía, Francia y España. A comienzos del presente siglo continúa la situación de pérdida poblacional y sólo persisten algunas poblaciones aisladas entre sí. Hay un núcleo occidental que ocupa el suroeste de Francia y norte de España, y varios núcleos orientales, en el centro y norte de la Rusia europea, el delta del Danubio (Rumanía) y posiblemente en Ucrania y Moldavia.

En España las primeras referencias lo sitúan en Guipuzcoa en el año 1951. Posteriormente ha ido apareciendo por todo el País Vasco, Navarra, La Rioja, noreste de Burgos y norte de Soria. La mayor parte de sus efectivos ocupan el curso medio-alto del río Ebro y sus principales afluentes, además de pequeños núcleos en las cuencas cantábricas orientales.

Sin embargo su situación en España es precaria debido entre otras causas a lo reducido de su población, a la destrucción progresiva del hábitat y a la expansión del visón americano, corriendo un peligro cierto de extinción a medio plazo. Por tal motivo se iniciaron entre los años 2001 y 2002, por parte de varias Administraciones Públicas (Junta de Castilla-León, Diputación Foral de Álava, Generalitat de Cataluña y Gobierno de La Rioja) cuatro proyectos de conservación que contaron con el apoyo financiero del Ministerio de Medio Ambiente y de la Comisión Europea a través del instrumento Life-Naturaleza,

con el objetivo de intentar corregir la tendencia regresiva observada .

Dentro del proyecto Life-Naturaleza para la conservación del visón europeo en La Rioja (LIFE00NAT/E/7331), promovido por el Gobierno de La Rioja con la colaboración como socio de la Fundación CajaRioja, se incluyó, en las acciones de sensibilización pública, la organización de un Congreso Internacional sobre el visón europeo, con el objetivo de conocer la situación actual de la especie en los diferentes países que componen su ámbito de distribución, ampliar los conocimientos científicos sobre su biología y ecología, y establecer unas líneas directrices comunes de actuación para la conservación de las últimas poblaciones de la especie. Por primera vez se reunieron a nivel europeo todas las personas –científicos, técnicos, gestores, conservacionistas- con conocimientos sobre la especie, con la finalidad de analizar su situación real y elaborar unas pautas de gestión. El Congreso se celebró del 5 al 8 de noviembre de 2003 en Logroño (La Rioja – España) asistiendo más de 100 personas de 13 países distintos, con representación de 42 instituciones diferentes. Entre las personas participantes se incluían científicos y técnicos europeos expertos en visón europeo, representantes de las administraciones regionales y estatales responsables de la gestión de la especie y su hábitat, así como destacados miembros de organizaciones no gubernamentales.

En el transcurso del Congreso se impartieron conferencias por especialistas sobre la situación del visón europeo en los diferentes países donde vive, además se expusieron en forma de panel los resultados de estudios y actuaciones de gestión realizados. También se debatieron en mesas de trabajo monográficas aspectos específicos de conservación haciendo una puesta en común, en una sesión plenaria conjunta, que elaboró unas conclusiones finales sobre estrategias de conservación “in situ”, estrategias de conservación “ex situ”, y aspectos legales, administrativos y de manejo de la especie. Por último se realizó una excursión por el valle del río Najerilla (La Rioja), uno de los cursos fluviales que mantiene una buena población de visón europeo, distribuida en un variado rango de ambientes ecológicos y donde se estaban realizando durante los últimos años programas de monitoreo (radio-seguimiento).

ject, whose objective is that of remedying the regressive tendency observed to date.

Within the LIFE-Nature project for the preservation of the European Mink in La Rioja (LIFE00NAT/E/7331) promoted by the Government of La Rioja with the cooperation of the CajaRioja Foundation as a partner, one of the public awareness actions carried out was the organisation of an International Conference on the European Mink. The Conference aimed to determine the current situation of this species in the various countries where it is distributed, to extend scientific knowledge about its biology and ecology and to establish some common action guidelines for the preservation of the last populations of this species. For the first time, all European experts on the species —scientists, technicians, managers and conservationists— met together with the purpose of analysing its real situation and draft some management guidelines. The Conference was held from 5 to 8 November 2003 in Logroño (La Rioja, Spain) and was attended by over 100 people from 13 different countries, representing 42 different institutions. Among the participants were scientists and technicians with expertise on the European Mink, representatives of regional and national administrations responsible for the management of this species and its habitat, and notable members of non-governmental organisations.

During the Conference, talks were given by specialists on the situation of the European Mink in the various countries it inhabits, and poster presentations were displayed on the results of surveys and management actions carried out. At monographic workshops, specific conservation aspects were discussed and subsequently summarised at aplenary session, which produced some final conclusions of “in situ” and “ex situ” conservation strategies and legal and administrative aspects of the management of this species. Finally, a trip was taken to the Najerilla Valley (La Rioja), one of the river basins that maintains a sizable population of European Mink distributed along a varied range of ecological environments where monitoring programmes have been carried out over the past few years using radio-tracking techniques.

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FUNDACIÓN CAJA RIOJA.

[PROGRAMA DEL CONGRESO]

CONGRESS SCHEDULE

EVE OF CONGRESS
Wednesday, 5 November 2003
18:00 pm.
- Reception of participants
- Accreditation and distribution of documentation

DAY ONE
Thursday, 6 November 2003

MORNING SESSION
8:00 am.
Accreditation and distribution of documentation
9:00 am.
Official Inauguration of the Congress

FIRST ROUND OF TALKS
Chairman: ***Luis Lopo Carramiñana***
Co-ordinator of the LIFE Project for the Conservation of the European Mink in La Rioja. Regional Government of La Rioja, Spain.
9:30 am. *The European Mink in Spain*
Juan Carlos Ceña
Researcher for the LIFE Projects for the Conservation of the European Mink in Alava, La Rioja and Castilla and León, Spain.
10:30 am. *Conservation of the European Mink in France*
Pascal Fournier
Veterinary Practitioner from GREGE, France and
Christian Maizeret
General Council of Les Landes, France.
11:30 am. *Coffee break.*
12:00 pm. *Situation, distribution and problems of conservation of the European mink in the Danube Delta, Rumania*
Andreas Kranz
Researcher at the Institute of Wildlife Biology and Wildlife. Management. University of Agricultural Science-BOKU. Austria.

JORNADA PREVIA
miércoles, 5 de noviembre de 2003
18:00 h Recepción de participantes, acreditación y entrega de documentación.

PRIMERA JORNADA
jueves, 6 de noviembre de 2003

SESIÓN DE MAÑANA
8:00 h Acreditación y entrega de documentación.
9:00 h Inauguración Oficial.

PRIMERA SESIÓN DE CONFERENCIAS
Moderador: **Luis Lopo Carramiñana**
Coordinador del Proyecto LIFE de Conservación del Visón Europeo en La Rioja. Gobierno de La Rioja, España.

9:30 h El Visón Europeo en España
Juan Carlos Ceña
Investigador de los Proyectos LIFE para la Conservación del Visón Europeo en Álava, La Rioja y Castilla y León. España.

10:30 h Conservación del Visón Europeo en Francia
Pascal Fournier
Doctor Veterinario del GREGE. Francia.
Christian Maizeret
Consejo General de Las Landas. Francia.

11:30 h Pausa café.

12:00 h Estatus, distribución y problemas de conservación del Visón Europeo en el Delta del Danubio. Rumania
Andreas Kranz
Investigador del Instituto de Biología Silvestre y Gestión Cinegética. Universidad de Ciencias Agrícolas-BOKU. Austria.

13:00 h INAUGURACIÓN EXPOSICIÓN DE PANELES

14:00 h Almuerzo de trabajo.

SESIÓN DE TARDE

16:00 h

SEGUNDA SESIÓN DE CONFERENCIAS

Moderador: **Santiago Palazón Miñano**
Departamento de Medio Ambiente. Generalitat de Cataluña. España.

16:00 h Estatus, distribución y características de la ecología del Visón Europeo en Rusia
Igor Tumanov
Investigador del Instituto Ártico y Antártico del Centro de Investigaciones Científicas de la Federación Rusa. Rusia.

17:00 h El visón europeo en Bielorrusia: pasado y presente, declive de la población, preguntas urgentes, problemas de conservación e iniciativas
Vadim Sidorovich
Responsable del Laboratorio de Investigación de Vertebrados Depredadores. Instituto de Zoología, Academia Nacional de las Ciencias en Bielorrusia.

18:00 h Pausa café.

18:30 h Conservación del Visón Europeo en Estonia: datos actualizados
Tiit Maran
Director de la Fundación "Lutreola". Estonia.

19:30 h **PRESENTACIÓN DE PANELES EN LA SALA DE EXPOSICIÓN**
Presentación de las comunicaciones por parte de los autores.

SEGUNDA JORNADA

viernes, 7 de noviembre de 2003

SESIÓN DE MAÑANA

9:00 horas

PRIMERA MESA DE TRABAJO

Estrategias de conservación del Visón Europeo en su medio natural
Moderador: **Jordi Ruiz-Olmo**
Coordinador del Proyecto LIFE de Conservación del Visón

__13:00 pm.__ INAUGURATION OF THE SIMULTANEOUS PROGRAMME OF PAPER PRESENTATIONS IN PANEL FORM.

__14:00 pm.__ Working lunch.

AFTERNOON SESSION

16:00 pm.

SECOND ROUND OF TALKS

Chairman: __Santiago Palazón Miñano__
Department of the Environment, Regional Government of Catalonia. Spain.

16:00 pm.
Situation, distribution and features of the ecology of the European Mink in Russia
Igor Tumanov
Researcher from the Arctic and Antarctic Institute of the Centre for Scientific Research of the Russian Federation. Russia.

17:00 pm.
The European Mink in Byelorussia: past and present, the decline of the population, urgent questions, conservation problems and initiatives.
Vadim Sidorovich
Head of the Laboratory for the Investigation of Predatory Vertebrates, Institute of Zoology, National Science Academy in Byelorussia.

__18:00 pm.__ Coffee break.

__18:30 pm.__ Conservation of the European Mink in Estonia: latest details
Tiit Maran
Director of the "Lutreola" Foundation. Estonia.

19:30 pm.
PANEL PRESENTATION IN THE EXHIBITION HALL
Presentation of communications material by the creators.

DAY TWO

Friday, 7 November 2003.

MORNING SESSION

9:00 am.

WORKSHOP

Conservation strategies for the European Mink in their natural habitat

Chairman: __Jordi Ruiz-Olmo__
Co-coordinator of the LIFE European Mink

Conservation Project in Catalonia. Environment Department. Regional Government of Catalonia, Spain.

PROGRAMME OUTLINE

Evolution of the species. Problems and conservation actions. Lines of work and research necessary. Questions from the audience.

10:30 am. *Coffee break.*

11:00 am.

WORKSHOP

Ex-situ conservation strategies for the European Mink

Tiit Maran

Director of the "Lutreola" Foundation. Estonia.

PROGRAMME OUTLINE

Breeding in captivity and restocking programmes. Reintroduction and reinforcement of populations. Genetic aspects. Other experiences. Questions from the audience.

12:30 pm.

PANEL PRESENTATION
IN THE CONFERENCE HALL

Presentation and justification for communications material on a panel at the conference facility. Each of the panels will be projected, and there will be a rota of questions for the creators.

14:00 pm.
Working lunch.

AFTERNOON SESSION

16:00 pm.

WORKSHOP

Legal, administrative and management aspects of the European Mink

Chairman: ***Luis Mariano González***

General Directorate of Nature Conservation. Ministry of the Environment, Spain.

PROGRAMME OUTLINE

Conservation/management plans. Protected natural spaces. Category of threat. Conflicts of interests (water, angling, energy, etc.) Fur farms. Questions from the audience.

Europeo en Cataluña. Departamento de Medio Ambiente. Generalitat de Cataluña. España.

PROGRAMA PRELIMINAR

Evolución de la especie. Problemática y actuaciones de conservación. Líneas de trabajo e investigación necesarias. Turno de intervención del público.

10:30 h Pausa café.

11:00 horas

SEGUNDA MESA DE TRABAJO

Estrategias de conservación ex situ del Visón Europeo

Moderador: **Tiit Maran**

Director de la Fundación "Lutreola". Estonia.

PROGRAMA PRELIMINAR

Cría en cautividad y programas de estockaje. Reintroducción y reforzamiento de poblaciones. Aspectos genéticos. Otras experiencias. Turno de intervención del público.

12:30 h PRESENTACIÓN DE PANELES EN LA SALA DE CONFERENCIAS

Presentación y defensa de las comunicaciones en forma de panel en la Sala de Reuniones. Se proyectará una imagen de cada uno de los paneles expuestos y se establecerá un turno de preguntas a responder por los autores.

14:00 h Almuerzo de trabajo.

SESIÓN DE TARDE

16:00 horas

TERCERA MESA DE TRABAJO

Aspectos legales, administrativos y de gestión del Visón Europeo

Moderador: **Luis Mariano González**

Dirección General de Conservación de la Naturaleza. Ministerio de Medio Ambiente, España.

PROGRAMA PRELIMINAR

Planes de conservación/gestión. Espacios Naturales Protegidos. Categoría de amenaza. Conflictos de intereses (aguas, pesca, energía, etc.). Las granjas peleteras. Turno de intervención del público.

17:30 h Pausa café.
18:00 horas

SESIÓN PLENARIA

Moderador: **Miguel Delibes de Castro**
Presidente de la Sociedad Española para la Conservación y Estudio de los Mamíferos. Profesor de Investigación del CSIC. Estación Biológica de Doñana. España.

PROGRAMA PRELIMINAR
Exposición de conclusiones de las mesas de trabajo, por parte de los moderadores. Discusión y redacción de Actas.
Redacción de las bases para la elaboración del “Plan de Acción Global para la Conservación del Visón Europeo”.
20:00 h CLAUSURA

TERCERA JORNADA

sábado, 8 de noviembre de 2003
9:00 horas
EXCURSIÓN EN AUTOBÚS A LA CUENCA DEL RÍO NAJERILLA (LA RIOJA)
Se visitarán áreas de presencia del Visón Europeo, en las que se desarrollan actuaciones de investigación y conservación en el marco del Proyecto LIFE-Naturaleza. La cuenca del río Najerilla mantiene una buena población de Visón Europeo, distribuida en un variado rango de ambientes ecológicos. Durante los últimos años, está siendo objeto de programas de monitoreo (radio-seguimiento) y control de los factores de riesgo (invasión de Visón Americano).
La excursión incluye almuerzo de trabajo para todos los asistentes, tras el cual se regresará a Logroño.

LUGAR DE CELEBRACIÓN
Centro Cultural Caja de Ahorros de La Rioja
C/ Gran Vía 2
26002 Logroño
La Rioja (España)

17:30 pm. *Coffee break.*
18:00 pm.

PLENARY SESSION

Chairman: ***Miguel Delibes de Castro***
President of the Spanish Society for the Conservation and Study of Mammals. Research Professor of the CSIC. DoñanaBiological Station, Spain.

PROGRAMME OUTLINE
Presentation of conclusions of the workshops by the group leaders. Discussion and drafting of minutes. Drafting of the guidelines for the production of “A Global Action Plan for the Conservation of the European Mink”.
20:00 pm. *CLOSURE OF THE EVENT*

DAY THREE

Saturday, 8 November 2003.
9:00 am
A BUS TRIP HAS BEEN ARRANGED TO THE BASIN OF THE RIVER NAJERILLA IN LA RIOJA. This will include visits to the habitats of the European Mink, where research and conservation work is currently being carried out as part of the LIFE-Nature Project. The basin of the Najerilla contains a large number of European Mink distributed over a wide range of ecological environments. In recent years it has been subjected to radio-monitoring and control of risk factors (invasion of American Mink).
The visit includes a working lunch for all participants, after which the group returns to Logroño.

VENUE
Centro Cultural Caja de Ahorros de La Rioja
C/ Gran Vía 2
26002 Logroño
La Rioja (España)

[ARTÍCULOS CIENTÍFICOS]

SCIENTIFIC ARTICLES

[Embryo transfer in the European mink and related species]

CONSERVATION OF THE EUROPEAN MINK (*Mustela Lutreola*) IN THE LIFE-ENVIRONMENT PROGRAMME 00NAT-E/7299 IN CASTILLA Y LEÓN (SPAIN).

RESUMEN

El objetivo de este estudio fue explorar la posibilidad de transferir embriones entre el amenazado visón europeo (Mustela lutreola) y otras especies cercanas de Mustélidos. En primer lugar se realizó la transferencia de embriones entre turón (Mustela putorius), turón de estepa (Mustela eversmanni), hurón (M. putorius furo) y visón europeo. Los embriones fueron transferidos a hembras receptoras, tanto preñadas como pseudopreñadas. Los métodos de lavado y transferencia empleados en esta investigación han sido descrito anteriormente (Amstislavsky et al. 1991, Lindeberg et al. 2002, 2003). Para inducir la pseudopreñez en las hembras receptoras, éstas fueron emparejadas con machos esterilizados por medios quirúrgicos o genéticos. Los machos esterilizados por medios genéticos fueron obtenidos mediante el apareamiento de machos de turón con hembras de visón europeo. En otros ensayos los embriones fueron transferidos a hembras receptoras preñadas, tras aparearse con machos de la misma especie. La transferencia interespecífica entre hurones y turones resultó satisfactoria cuando se transfirieron de seis a diez embriones, pero insatisfactoria cuando la hembra receptora obtenía sólo dos embriones. La posibilidad de usar machos esterilizados genéticamente para inducir pseudopre-

Running title: [Embryo transfer in mustelids]

Sergei Amstislavsky[1], Jussi Aalto[2], Mikko Järvinen[2], Heli Lindeberg[2], Maija Valtonen2, Galina Zudova[3] and Yulia Ternovskaya[3]

[1]Institute of Cytology and Genetics, Russian Academy of Sciences, Siberian Division, 630090, prosp. Lavrentjeva 10, Novosibirsk, Russia.

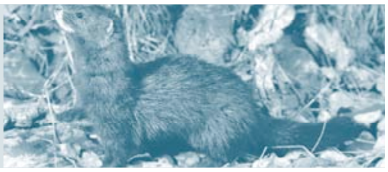
[2]Institute of Applied Biotechnology, University of Kuopio, P.O. Box 1627, FIN-70211 Kuopio, Finland.

[3]Institute of Systematics and Ecology of Animals, Russian Academy of Sciences, Siberian Division, Frunze str.11, 630091, Novosibirsk, Russia.

e-mail: amstis@bionet.nsc.ru
Fax: (383) 233-1278
Tel.: (383) 233-3859

ABSTRACT

The objective of this study was to explore the possibility of embryo transfer between endangered European mink (*Mustela lutreola*) and related Mustelidae species. On the first stage intra and interspecies embryo transfers between European polecats (*Mustela putorius*), Steppe polecats (*Mustela eversmanni*), Domestic ferrets (M. putorius furo) and European minks were performed. Embryos were transferred either to pregnant or to pseudopregnant recipient females. Embryo flushing and transfer methods used in this research have been described elsewhere (Amstislavsky et al. 1991, Lindeberg et al. 2002, 2003). To induce pseudopregnancy in recipient females they were mated to either surgically or genetically sterile males. Genetically sterile males were obtained by mating European polecat male to European mink female. In the other trials embryos were transferred to pregnant recipient females mated to conspecific males. Intraspecies transfer between domestic ferret and European polecat were successful when six or ten embryos were transferred, butunsuccessful when the recipient female obtained only two embryos. Possibility to use genetically sterile males to induce pseudopreg-



nancy was confirmed. Straightforward interspecies embryo transfer between polecat/ferret species (Steppe polecat, European polecat, Domestic ferret) and European mink did not result in live kits, though the number of experiments has not been sufficient for definite conclusions. To overcome interspecies pregnancy failure, totally 32 blastocysts of European mink were transferred into the uteri of six pseudopregnant hybrid females resulted from crossing European polecat male to European mink female and vice versa (called honoriks and nohoriks correspondingly). One recipient female received a single embryo and did not whelp. The other five recipients received 5 to 8 embryos per uterus and half of these embryos developed to term. The overall success rate was 50 % (16 kits/32 transferred embryos, Amstislavsky et al. 2004). For both male and female offspring the average weight at birth was lower in embryo transfer group, if compared with naturally bred controls. Postnatal mortality rate was higher in embryo transfer group in comparison with postnatal mortality rate in naturally bred population of European mink and in comparison with postnatal mortality rate in European polecat/Domestic ferret offspring developed from preimplantation embryos after intraspecies transfer. This study is the first one, demonstrating the possibility to overcome interspecies barrier between European mink and closely related Mustelidae species by using interspecies hybrids as a recipient for transferring European mink embryos.

Key words: Embryo transfer, European mink, ex situ preservation, mustelids, interspecies barrier.

1. INTRODUCTION

European mink is a highly endangered European mustelid. Earlier this species was common in Europe, but during the last century European mink has been totally disappeared from the majority of the European countries and the process of decline still continues (Ternovsky and Ternovskaya 1994, Sidorovich 2000). The hypotheses for the decline of this species are listed and discussed elsewhere (Ternovsky and Ternovskaya 1994, Maran and Henttonen 1995, Davison et al. 2000).

The reproductive data on the captive breeding of European mink in Novosibirsk are presented in the book of Ternovsky and

ñez fue confirmada. Claramente, la transferencia interespecífica de embriones entre especies de turón / hurón (Steppe polecat, European polecat, Domestic ferret) y visón europeo no dio resultado en crías vivas, aunque el número de experimentos no fue suficiente para obtener conclusiones definitivas. Para subsanar la ausencia de preñez interespecífica, 32 blastocitos en total de visón europeo fueron transferidos a los úteros de seis hembras híbridas y pseudopreñadas, obtenidas por el cruce de machos de turón con hembras de visón europeo y viceversa (llamados honoriks y nohoriks respectivamente). Una de las hembras receptoras recibió un único embrión y no parió. Las otras cinco receptoras recibieron entre 5 y 8 embriones por útero y la mitad de estos embriones llegaron a buen término. La tasa total de éxito fue de un 50 % (16 crías/32 embriones transferidos, Amstislavsky et al. 2004). En la descendencia, tanto de machos como de hembras, el peso medio al nacer fue menor en los casos de embriones transferidos, comparados con la de los controles, engendrados de manera natural. La tasa de mortalidad postnatal fue más elevada en los embriones transferidos, comparados con la tasa de mortalidad postnatal de los embriones de visón europeo engendrados de manera natural, así como con la tasa de mortalidad postnatal de crías de turón/hurón desarrolladas a partir de la preimplantación de embriones tras la transferencia intraespecífica. Este estudio es el primero que demuestra la posibilidad de superar la barrera interespecífica entre visón europeo y especies cercanas de Mustélidos, mediante el uso de híbridos interespecíficos como receptores para transferencia de embriones de visón europeo.

Palabras clave: Transferencia de embriones, visón europeo, conservación ex situ, mustélidos, barrera interespecífica.

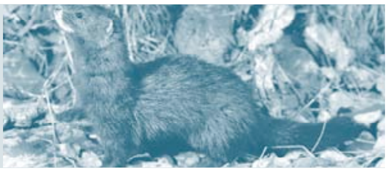
Ternovskaya (1994). There are also published data available on the results of European mink captive breeding in Tallinn Zoo (Maran and Robinson 1996). Recently a captive population of European mink has been established in Osnabrueck (Germany) (Wolfgang Festl, pers. com.). Successful breeding of European mink in captivity has been repeatedly confirmed on the long-term basis in these three places.

The breeding season in European mink in captivity extends from March to June, with a peak in the late April (Moshonkin 1983, Ternovsky and Ternovskaya 1994). The duration of oestrus varies from 1 to 10 days (Moshonkin 1983). Unmated females experience two to three oestrous cycles during the season. After ovulation, which is induced by copulation, the pregnant females deliver kits after a 39 to 44 days (mean 41.6) gestation and the average litter size is 4.3 (range 1 to 9) (Ternovsky and Ternovskaya 1994).

Till recently two main strategies of European mink ex situ preservation and propagation have been exploited: the captive breeding and the release to the wild habitats (acclimatization/re-acclimatization). These approaches have been described earlier (Ternovsky and Ternovskaya 1994, Maran and Robinsion 1996, Maran 2000). The interspecies embryo transfer approach combined with cryobanking might be considered as an alternative option of ex situ approach to European mink preservation.

Along with the traditional approach of endangered species preservation like protectingterritories/natural recovery, reintroducing, and translocation, recently cryopreservation of embryos and gametes, assisted fertilization, embryo transfer and other reproductive technologies were applied for preservation of wildlife animals (see Wildt et al. 1992, Bainbridge and Jabbour 1998, White et al. 2001 for reviews). In particular, interspecies embryo transfer has been investigated as an approach for endangered species ex situ preservation. Though a number of successful interspecies embryo transfers have been done, felids are the only Carnivora on this list (Pope et al. 1993). Even so, there have been several unsuccessful attempts at interspecies embryo transfer in carnivores (Adams 1982). Moreover, even in the successful attempts of interspecies transfer, pregnancy rates have been low (see Adams 1982, Anderson 1988, Pope et al. 1993, Bainbridge and Jabbour 1998 for reviews).

The integrated package of reproductive technologies, i.e. cryobanking, IVF, interspecies embryo transfer and reproductive cloning has been declared recently for some endangered mammalian species (Ptak et al. 2002). However, this promising approach has not been applied to European mink so far. In our previous paper, we described the world first successful attempt of embryo cryopreservation in Mustelidae (Lindeberg et al. 2003). Live term kits were obtained in European polecat after cryopreservation, storage in LN2, thawing and intraspecies transfer into recipient European polecat female. This result makes it feasible to create embryo cryobank in endangered mustelidae species, e.g. in the European mink, if combined with embryo transfer. Apparently, to overcome interspecies barrier between European mink and related polecat/ferret species is one of the most important goals. This paper describes results obtained so far on inter- and intraspecies transfer in the European mink and related species.



2. MATERIALS AND METHODS

2.1. Animals

2.1.1. INTRASPECIES EMBRYO TRANSFER

During the intraspecies embryo transfer experiments, a total of 4 Domestic ferrets and 1 European polecat female were used as resource animals, correspondingly 5 fertile conspecific males were used to induce ovulation and impregnate the resource animals. Five European polecat females were used as recipients for transferring embryos; two genetically sterile males were used to induce pseudopregnancy in recipients.

2.1.2. INTERSPECIES EMBRYO TRANSFER

During straightforward interspecies embryo transfer experiment, 5 European mink, one European polecat and one Steppe polecat resource females were mated with conspecific males. In this experimental series, 4 recipient females (one European mink and three European polecats) were mated with two surgically sterilized males, thus embryos been transferred to pseudopregnant dams. In three other cases recipient females (two European polecats and one Domestic ferret) were mated with the conspecific fertile males.

2.1.3. EMBRYO TRANSFER OF EUROPEAN MINK EMBRYOS TO HONORIK/NOHORIK FEMALES

During the breeding season 2002 the attempts to transfer European mink embryos to hybrids (honorik, nohorik) have been undertaken. During this breeding season, a total of 9 European minks were used as resource animals, 6 hybrid females as recipients for transferring European mink embryos, 4 fertile European mink males were mated with the resource animals and 2 vasectomized males were mated with the recipients (see Amstislavsky et al. 2004 for more details).

2.2. Husbandry and environmental conditions

The experiments were carried out at the Research Station of the Institute of Systematics and Ecology of Animals, Russian Academy of Sciences, Siberian Division, Novosibirsk, Russia. All animals were kept in individual wire mesh cages measuring 150 x 150 x 200 cm (length x width x height), and each included a nest box measuring 120 x 35 x 35 cm, respectively. Throughout the year, the animals were exposed to the outdoor temperature and given wet food prepared in the local kitchen and water ad libitum. Additionally, the animals were fed with live mice and fresh rat carcasses on a regular basis. All embryo transfer experiments have been done in April. In Novosibirsk, in April mean monthly temperature is –1.5 ºC and light conditions are: 14 h light and 10 h dark.

2.3. Preparing and testing of sterile males

Two European polecat males were vasectomized surgically using a technique described in our previous paper (Lindeberg et al. 2002). These vasectomized males were mated with 8 test females to confirm aspermia; none of the test females delivered kits. Additionally two genetically sterile males were used in this study. One genetically sterile hybrid male originated from crossing of a European polecat male to a European mink female. Another one originated from crossing of a Domestic ferret male to a Steppe polecat female. All sterile males were mated to test-females (totally 16 females). None of the test females delivered kits.

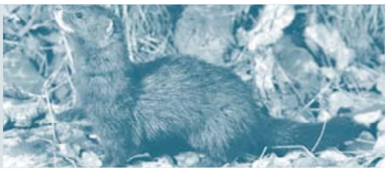
2.4. Mating of resource and recipient females

Resource animals were mated with a fertile male and recipients were mated to either vasectomized or to genetically sterile males. We used single mating system in all intraspecies and all interspecies embryo transfer experiments (first and second part of the study). In the third part of the study, when European mink embryos were transferred to hybrid recipients we used both single mating and double mating systems, so that 3 resource animals and 2 recipients were mated once daily over 2 consecutive days, while 6 resource animals and 4 recipients had only 1 mating session. The majority of the resource animal-recipient pairs were formed in a schedule, so that the first mating of hybrid recipients was 1 day after the first mating of the European mink resource animal. On the day of embryo transfer, all the resource animals were on Day 7 - 9 after the first mating and the recipients were on Day 6 or Day 7 after the first mating (Day 0 = first day of mating). The details of the mating schedule are shown in the corresponding tables. All matings were confirmed by taking a vaginal sample as described earlier (Ternovsky and Ternovskaya 1994). The resource animal was considered to have been successfully mated when spermatozoa were detected in the sample. In case spermatozoa were sparse in the vaginal sample a second mating was performed to ensure ovulation and impregnation. If possible, the second mating occurred with the same male. Spermatozoa were not detected in the vaginal samples of the recipients mated with vasectomized males.

2.5. Embryo recovery

At the first and the second stages of research (all intraspecies embryo transfers and straightforward interspecies embryo transfers) the resource animals were killed, reproductive tracts were removed and embryos flushed as described earlier (Amstislavsky et al. 1991). The final experimental series, when European mink embryos were transferred to honoriks/nohoriks, we used surgical flank method, which allows survival of the resource animal (embryo donor), and is harmless for the reproductive system (Lindeberg 2003) and does not affect subsequent reproduction in the great majority of the cases.

For surgical embryo recovery, the resource animals were weighed and anaesthetized with 0.13 mg/kg medetomidine hydrochloride (Domtor“ 1 mg/ml im, Orion-Farmos, Turku, Finland) and



9.5 mg/kg ketamine hydrochloride (Ketolar“ 50 mg/ml im, Parke Davis, S.A., Barcelona, Spain). After a 10-15 min induction interval, the animals were checked and a subsequent ketamine dose was administered, if necessary.

Embryos were flushed surgically from uterine horns with flushing medium (Complete Embryo Flushing Solution, Emcare™, Immuno-Chemicals Ltd., Auckland, New Zealand). The recovered embryos, which all were blastocysts, were transferred to a drop of holding solution (Emcare™, Immuno-Chemicals Ltd.) with a fine glass capillary and evaluated for stage of development using stereomicroscopy (x84) and then transferred as described below. This method of embryo recovery was introduced by Jussi Aalto, DVM, and is described in more details elsewhere (Lindeberg 2003, Lindeberg et al. 2003).

All resource animals were treated with antibiotics (Duplocillin LA, Intervet, Gist-Brocades NV Delft, Holland) as described earlier (Lindeberg et al. 2002) and observed in cages inside the house for the next 24 to 96 h.

2.6. Embryo transfer

For surgical transfer, the recipients were weighed and anaesthetized as described earlier for the resource animals. The surgical transfer technique was similar to that described earlier (Amstislavsky et al. 1991, Lindeberg et al. 2002). Briefly, all recovered blastocysts were aspirated into a pipette with a 10-20 µl of flushing medium and transferred into the uterine horn via a skin incision made in the left lumbar flank. The transfer pipettes, prepared from thin glass capillaries, were sharpened and sterilized by heating. The diameters of the distal sharp ends of the transfer pipettes were variable and were adjusted to the sizes of embryos to be transferred. After the flank incision was sutured, recipients received postoperative antibiotics and were observed in the recovery room for the next 24 h as described earlier (Lindeberg et al. 2002).

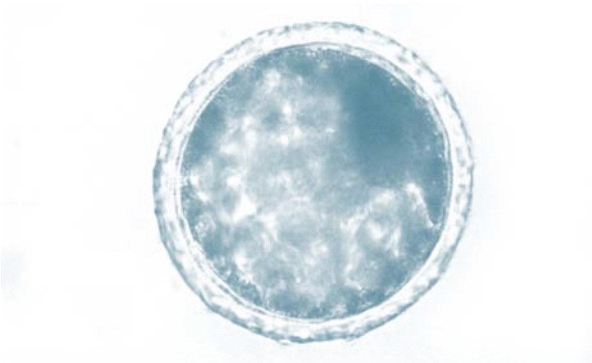


Figure 1. Day 7 blastocyst of European mink. Day 0 = day of mating.
Figura 1. Blastocito de septimo día de visón europeo. Día 0 = día de cópula.

The recipients experienced no complications after surgery, and they were returned to their home cages and handled as other pregnant females on the farm. Recipients were checked at least three times a day around the date of expected parturition. When kits were found, their condition, sex, and weight were recorded within 12 h after birth, as was their weight on Day 10 and Day 90. The same characteristics were recorded for offspring of naturally bred European mink females. There were ten stud European mink females on the farm during the breeding season 2002 that were considered as a control group.

2.7. Statistical analysis

The results are presented as percentages of the total or as means ± S.E.M. Differences between groups were compared using Student's t-test with $P<0.05$ considered statistically significant.

3. RESULTS AND DISCUSSION

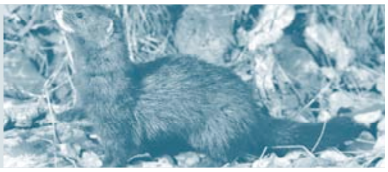
3.1. Intraspecies embryo transfer in ferrets/polecats

The origin of domestic ferret is not well known and sometimes European polecats and Domestic ferret are considered as subspecies or even different species (see Ternovsky and Ternovskaya 1994, Davison et al. 2000 for the review of current hypotheses). However, based on the results of karyotyping analysis (Graphodatsky et al. 1976) and comparative immunochemical study of serum proteins (Belyaev et al. 1980) of different *Mustelidae* species, we considered European polecat (*Mustela putorius*) and Domestic ferret (*Mustela putorius furo*) as the same species, the latter being albino form of the former.

Results of intraspecies embryo transfer between Domestic ferrets and European polecats are represented in Table 1. Two recipient females received only two embryos each, in the other three cases 6 to 10 embryos per female were transferred. These three females whelped, whereas when only two embryos were transferred to recipient dam, no kits developed to term. It is known, that success rate of embryo transfer in polytocous mammalian species depends on the number of transferred embryos (Youngs 2001). For polecat/ferret species, the number of embryos to be transferred to maintain pregnancy should most probably be more than two. The overall live birth rate was 50% (13 kits /26 transferred embryos), almost the same success rate (42%) was registered in the polecat, when the same approach was applied by the same research group for intraspecies embryo transfer in the European polecat in Finland (Lindeberg et al. 2002).

3.2. Interspecies embryo transfer

At the second stage of our research, embryos were flushed from European polecat (one animal), Steppe polecat (one animal) or European mink (five animals) and transferred into a recipient female of another (related) species. On Days 7-9, yielded embryos were blastocysts. Typical



blastocyst of European mink is presented in the Fig. 1. Straightforward interspecies embryo transfers have been performed by two different approaches. One approach was the same as in the intraspecies embryo transfer series, when pseudopregnant females were used as recipients. An alternative option was to transfer embryos into pregnant females (Table 2).

Neither pregnant nor pseudopregnant recipients gave birth to offspring after straightforward interspecies embryo transfer. In two cases pregnancy failure and lack of the term kits may be explained by the low number of embryos transferred (two and three embryos correspondingly). But in the remaining five cases, the number of transferred embryos was high enough, and the lack of offspring may be attributed to species-specific differences, and incompatibilities, i.e.: interspecies barrier (Table 2).

In efforts to overcome interspecies pregnancy failures special technological approaches have been used. For example, embryos of the endangered species have been transferred into the uteri of the related species previously inseminated with semen of homologous species to create a bispecific (mixed species) pregnancy. This approach has resulted in live offspring after transfer of wildlife Spanish ibex (*Capra pyrenaica*) embryos into the uteri of domestic goat (*Capra hircus*) (Fernandez-Arias et al. 1999). In our previous papers (Amstislavsky et al. 1996), we described similar approach, when rat embryos were transferred into a pregnant recipient female, mated in advance to a rat male of different color type. The technological trick was to put a ligature onto the oviduct simultaneously with transferring the embryos into the ipsilateral uterine horn. Because embryos of different strain were transferred before own embryos migrated into the uterus, bispecific pregnancy was achieved in rats, and due to ligature only transferred embryos were settled in one of the uterine horns. This condition, on the one hand, prevented competition for implantion sites between the recipients's own and transferred embryos; on the other hand the presence of recipient's own embryos in the other uterine horn protected the pregnancy from being disrupted by any reason.

The attempt to use similar approach for interspecies embryo transfer in mustelids, when embryos from one Steppe polecat resource animal and two European mink resource animals were transferred into pregnant recipients of different species have not resulted in term kits. None of the transferred embryos developed to term. However, in all the three cases, when embryos were transferred to pregnant female recipients, the dams delivered their own kits, and this might be considered as an indicator of their good reproductive health, e.i.: their reproductive capacities were not disturbed by the embryo transfer procedure. Thus the failure of transferred embryos to develop to term was most probably caused by other reasons.

There is no migration between uterine horns in the rat (McLaren 1982). In contrast, Mustelidae embryos migrate freely between the uterine horns (Baevsky 1960). Probably because of this reason, this particular model of embryo transfer was not successful in mustelids. The recipient's own embryos might compete with the ones of different species for implantation sites.

3.3. Transfer of European mink embryos to pseudopregnant hybrid recipients as an approach to overcome interspecies barrier

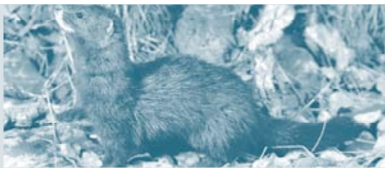
A total of 32 blastocysts of European mink were transferred to 6 hybrid recipients (Table 3). Five of six recipients each received 5 to 8 embryos. These 5 females gave birth to live kits (see Table 3). One recipient received a single embryo and this embryo did not developed to term. This observation is in content with the results of intraspecies transfer (see section 3.1) and confirms our conclusion that transferring of 1-2 embryos is not enough to support normal pregnancy in mustelids. The overall success rate was 50 % (16 kits/32 transferred embryos). The average weight of all 6 recipients was 801±41g, and the average litter size at birth was 2.7±0.8.

If to exclude the recipient, who received only single embryo and did not conceive, the average litter size at birth for the remaining 5 recipients was 3.2±0.7 (range 1 to 5 kits per litter). The average weight of the 10 naturally bred European minks (control group) was 748±27g (range of 555 to 890 g) and the average litter size at birth was 3.8±0.5 kits (range 1 to 6 kits per litter). Both the average weight of females and the litter size at birth did not differ between the embryo transfer and control group (the latter reproduced naturally). The single nohorik recipient female used in this study gave birth to 5 kits, the largest litter size in the whole ET group (Table 3).

The early studies on interspecies embryo transfer of Mustelidae embryos within the Mustelidae family (Chang 1968) did not result in birth of live kits. Among carnivorous mammals, the only successful interspecies embryo transfers have been demonstrated in felids (Pope et al. 1993), but the success rate was very low. Our studies demonstrate successful transfer of European mink embryos and confirm the possibility to overcome interspecies barrier by using hybrid females as recipients. Similar approach was successfully performed in Equidae, when horse embryos were transferred into cycling mules (Allen et al. 1993) and live foals developed to term.

In the study of Amstislavsky et al. (2004), where European mink were transferred to honoriks/nohoriks, the overall success rate, measured as a ratio of embryos transferred/kits born (50 %) was comparable with the success rate for intraspecies embryo transfer in polecats and ferrets (see Kidder et al. 1999, Li et al. 2001, Lindeberg et al. 2002).

However, for the 5 whelping recipients, due to postnatal mortality, the actual litter size after the first 10 days of life was reduced to 1.8±0.8 kits (range 0 to 4 kits per litter). Thus, in this embryo transfer group, only 9 of 16 European mink kits, born to hybrid recipients, survived (Table 3). Thus the postnatal mortality rate of the European mink kits produced by hybrid recipients was more than fivefold higher (43,8%) than that of the postnatal mortality for offspring born as a result of intraspecies embryo transfer, where only a single kit of 13 term kits died within first ten days of postnatal development (7,7%) and about fourfold higher than postnatal death in control (naturally born European mink kits during the same breeding season) group, where postnatal mortality rate was (10,1 %). This striking difference indicates some problems in postnatal development of kits born as result of embryo transfer.



Based on the long-term observation during several years, the weights of newborn European mink on this research farm have ranged from 6.2 to 12.5 g for males and from 6.2 to 11.4 g for females (Ternovsky and Ternovskaya 1994). Therefore, the average birth weight of male offspring in embryo transfer group was within the normal range, but lower than the average birth weight of the naturally born male kits. In contrast, the average weight of newborn female offspring in this group was even below the normal range (Fig.2). The observed retardation of the rate of postnatal development in the European mink term kits born as a result of embryo transfer may induce infanticide behaviour in their foster mothers and, therefore, may be the ultimate cause of low survival rate in this group. In some cases remnants of kits were observed indicating that infanticide behavior of dam against underweighed /underdeveloped kits might really take place in embryo transfer group.

The low weight and decreased viability of some term offspring, after the transfer of European mink embryos into the uteri of hybrid recipients, indicate that their prenatal development was altered. Interspecies pregnancy is often associated with problems of immunological incompatibility, failure of proper placental formation or specific endocrine problems caused by differences in immunology, physiology and endocrinology of the resource animal and the recipient species (see Anderson 1998, Bainbridge and Jabbour 1998 for reviews). However, the positive message of this study is that despite the species-specific differences, some embryos developed to term and live young were born.

The next intriguing question is whether these young of European mink born to recipient honoriks and nohoriks behave like European mink or acquired behavioral patterns of their foster mother. There are some recent data that sexual preferences and some other behavioral patterns will be changed in favor of foster mother during inter-species cross-fostering of some mammalian species, e.g.: if the kids are reared by ewe or lambs are reared by nanny goat foster mother (Kendrick et al. 2001). Whether or not this happens with European minks born to honorik/nohorik mother is still unknown and warrants further investigation.

4. CONCLUSIONS

- Embryo transfer into pseudopregnant recipients is an option for ex situ preservation of mustelids. However the number of transferred embryos should be more than two.
- Embryo transfer between resource and recipient females of the same species results in a success rate of 50%. However, straightforward interspecies embryo transfer between different Mustelidae species has been unsuccessful so far.
- Use of hybrids between European mink and European polecat (honoriks, nohoriks) can be considered as a promising approach to overcome interspecies barrier. When female honoriks and nohoriks served as recipient females for European mink embryos, an overall success rate of 50% was achieved.

– Postnatal mortality after transfer of European mink embryos into honoriks/nohoriks was relatively high (43.8%) and was most probably attributed to low body weight of the term offspring.

Acknowledgements:

This study was supported by Finnish Academy, grants No. 52680 and 201702 and Russian Academy, grant No. 11. The authors thank Victor Kolpakov for help with translation to Spanish.

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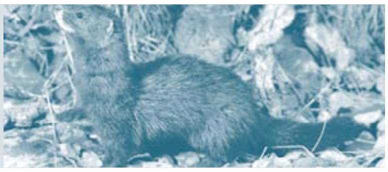

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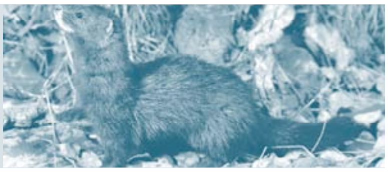


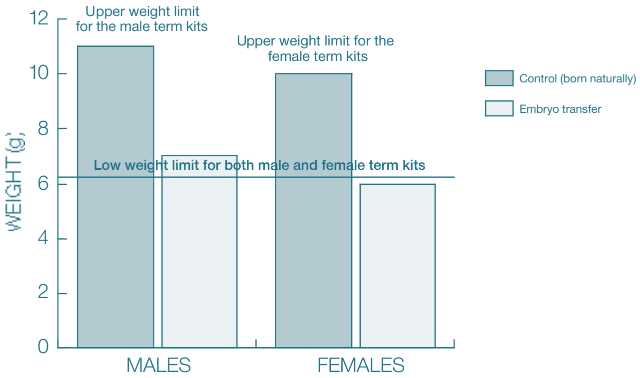


Figure 2. Body weight of term European mink kits born at the Ternovskaya farm in 2002 either as a result of embryo transfer into honorik/nohorik recipients or after natural mating (controls).
Comment: Upper and low weight limits for term kits of European mink are taken from Ternovsky and Ternovskaya (1994).

Figura 2. Peso corporal de las crías temporales de visón europeo nacidas en la granja de Ternovskaya en 2002 como resultado de la transferencia embrionaria dentro de receptoras honorik/nohorik o después de la fecundación natural (controles).
Comentario: Los límites superior e inferior del peso para crías de visón europeo son tomados de Ternovsky y Ternovskaya (1994).

Resource female	Days after first mating[a]	Number of transferred blastocysts	Weight of recipient,g (species)	Days after first mating[a]	Kits born, (success rate, %)	Live kits after 10 days
E. polecat	7	6	580 (E. polecat)	6	6 (100)	6
D. ferret	7	6	520 (E. polecat)	6	2 (33.3)	1
D. ferret	7	10	435 (E. polecat)	6	5 (50)	5
D. ferret	7	2	827 (E. polecat)	6	0	0
D. ferret	7	2	630 (E. polecat)	6	0	0
Total		26			13 (50)	12

[a] Resource and recipient animals were mated only once.

Table 1. Intraspecies embryo transfer between domestic ferret (*Mustela putorius furo*) and European polecat (*Mustela putorius*).
Tabla 1. Transplante intraespecífico de embriones entre hurón (Mustela putorius furo) y turón europeo (Mustela putorius).

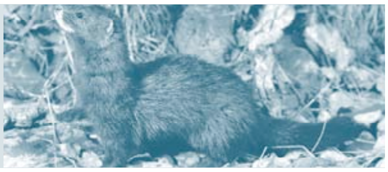
Resource animal[a]			Recipient animal[a]		Result of embryo transfer	
Species	Stage of Pregnancy (days)	Number of transferred blastocysts	Species	Weight of recipient,g	Stage of pseudopreg-nancy (days)	Kits born number
Transfer to pseudopregnant recipients						
E.polecat	7	9	E.mink	595	6	0
E.mink	9	8	E.polecat	629	7	0
E.mink	7	3	E.polecat	670	6	0
E.mink	8	2	E.polecat	617	7	0
Transfer to pregnant recipients						
E.mink	7	1	E.polecat	582	6	Only 2 kits of European polecat
E.mink	7	6	D.ferret	700	6	Only 4 kits of Domestic ferret
S. polecat	8	6	E.polecat	657	6	Only 6 kits of European polecat

[a] Resource and recipient animals were mated only once.

Table 2. Embryo transfer between European mink (*Mustela lutreola*) and polecat species (*Mustela putorius, Mustela putorius furo, Mustela eversmanni*).

Tabla 2. Transplante interespecífico de embriones entre visón europeo (Mustela lutreola) y varias especies de hurones/turones (Mustela putorius, Mustela putorius furo, Mustela eversmanni).

Abbreviations/ Abreviaturas:
E.mink- European mink *(Mustela lutreola)* - visón europeo
E.polecat- European polecat *(Mustela putorius)* - turón europeo
S.polecat- Steppe polecat *(Mustela eversmanni)* - turón de estepa
D.ferret- Domestic ferret *(Mustela putorius furo)* - hurón



Resource animal			Recipient animal		Result of embryo transfer	
Resource animals number	Days after first mating	Number of transferred blastocysts	Weight of recipient,g	Days after first mating	Kits born, (success rate, %)	Live kits after 10 days
1	7[a]	5	835	6[a]	1 (20)	0
2,3	7[b],8[b]	3 + 5	930	7[b]	2 (25)	0
4,5	8[a]	6 + 1	735	7[a]	4 (57.2)	2
6,7	7[b],8[b]	4 + 1	830	7[a]	4 (80)	4
8	8[a]	6	642	6[a,c]	5 (83.3)	3
9	7[b]	1	835	6[b]	0 (0)	0
Total		32			16 (50)	9

[a]Resource and recipient animals were mated only once.
[b]Resource and recipient animals were mated once daily on 2 consecutive days.
[c]Nohorik recipient

Table 3. Use of hybrid recipients (honorik, nohorik) to overcome interspecies barrier.
Tabla 3. Uso de receptoras híbridas (honorik, nohorik) para la superación de la barrera interespecífica.

Female number	Weight of female (g)	Duration of pregnancy (d)	Kits born, (male/female)	Live kits after 10 days, (survival rate, %)
1	790	42	6 (2/4)	6 (100)
2	555	43	2 (0/2)	2 (100)
3	735	42	4 (2/2)	4 (100)
4	749	42	4 (3/1)	4 (100)
5	765	44	3 (0/3)	3 (100)
6	890	43	4 (2/2)	4 (100)
7	740	43	6 (2/4)	5 (83.3)
8	736	42	1 (1/0)	1 (100)
9	717	41	4 (2/2)	4 (100)
10	800	41	4 (2/2)	4 (100)
Average	748±27	42.3 ±0.3	3.4±0.5	3.0±0.5
Total			38 (16/22)	34/38 (89.47)

Table 4. Reproductive data of naturally reproduced European mink (*Mustela lutreola* females during breeding season 2002 (control group) .
Tabla 4. Datos sobre la reproducción de hembras de visón europeo (Mustela lutreola) que se reproducen naturalmente durante la estación reproductora del año 2002 (grupo de control).

[Conservación del Visón europeo (*Mustela lutreola*) en el marco del Programa LIFE-Naturaleza 00NAT-E/7299 en Castilla y León]

PRESERVATION OF THE EUROPEAN MINK (*Mustela lutreola*) WITHIN THE FRAMEWORK OF THE LIFE-Nature PROGRAMME IN CASTILLA-LEÓN.

SUMMARY

Indications of the presence of the European Mink in the province of Burgos have been observed since the early 1990s. The surveys carried out in 1999 and 2000 commissioned by the Government of Castilla-León to the "European Mink Study and Preservation Group" confirmed the existence of this species and showed its distribution and status in our region. The European Mink inhabits mainly the Ebro basin in the provinces of Burgos and Soria, as well as some small areas in the northern basin in Burgos and the Duero basin in Soria.

The strategic importance of these populations for the global preservation of the European Mink arises from the fact that it is the westernmost known nucleus of this experience, which may well be expanding; also, that they are located in close proximity to the distribution area of the powerful populations of American Mink in the centre of the Iberian Peninsula.

This led to the setting up of a LIFE-Nature program by the regional government under the title "Preservation of the European Mink (Mustela lutreola) in Castilla-León" which aims for mid-term preservation of this population, thereby contributing to preventing the extinction of the species in the European Union.

Título abreviado:
[Conservación del visón europeo en Castilla y León]

Sara Brizuela González, Olga E. Alarcia Alejos y Consuelo Temiño Fernández.

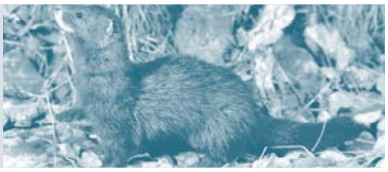
Junta de Castilla y León. Servicio Territorial de Medio Ambiente de Burgos. Sección de Espacios Naturales y Especies Protegidas.
C/ Juan de Padilla, s/n. Burgos.
e-mail: temferco@jcyl.es

ESTATUS DEL VISÓN EUROPEO EN CASTILLA Y LEÓN: BURGOS Y SORIA

Desde principios de los años 90 se conocen indicios de presencia de visón europeo en Castilla y León (Burgos). No obstante ha sido muy recientemente, en 1999-2000, a raíz de los estudios realizados por encargo de la Junta de Castilla y León al "Grupo de Estudio y Conservación del Visón Europeo" cuando se ha confirmado la presencia de la especie así como conocido su distribución y estatus en nuestra Comunidad.

La metodología utilizada en dichos estudios ha sido la captura de ejemplares en vivo siguiendo el método estandarizado de las estaciones de trampeo (Maizeret 1991, Palazón and Ruiz-Olmo 1997, Palazón et al. 2003) y la búsqueda sistematizada de indicios de presencia. Estos trabajos iniciales se han completado con los realizados a nivel nacional para la especie promovidos por el Ministerio de Medio Ambiente (MMA-Tragsa 2001, Palazón et al 2003) y posteriores campañas de chequeo y monitoreo realizadas en Castilla y León en desarrollo del proyecto Life.

En las provincias de Burgos y Soria el visón europeo ocupa fundamentalmente la cuenca del Ebro además de pequeños sectores de la cuenca norte en Burgos y de la cuenca del Duero en Soria.



Se ha prospectado prácticamente todo el Ebro así como sus afluentes más importantes, indicando los muestreos realizados la presencia de visón europeo en Burgos en los ríos Ebro , Oca, Tirón, Omecillo, Zadorra, Ayuda, Oroncillo, Gerea y Nela en la cuenca del Ebro. En la cuenca norte se ha detectado su presencia en los ríos Arceniega y Ordunte. En la provincia de Soria en los ríos Mayor (Iregua) y Cidacos (cuenca del Ebro) y en el río Tera (cuenca del Duero).

La importancia estratégica de estas poblaciones para la conservación global del visón europeo, estriba en constituir el núcleo más occidental conocido de la especie ¿en posible expansión? y en estar situadas muy próximas al actual área de distribución de las potentes poblaciones de visón americano del centro de la península.

EL PROYECTO LIFE PARA LA CONSERVACIÓN DEL VISÓN EUROPEO EN CASTILLA Y LEÓN

Desde 2001, con una duración de cuatro años, se está ejecutando por parte de la administración autonómica un Proyecto LIFE-Naturaleza bajo el título "Conservación del Visón europeo (*Mustela lutreola*) en Castilla y León" cuyo objetivo es la conservación a medio plazo de la población de visón europeo asentada en Castilla y León, contribuyendo con ello a evitar su extinción en la Unión Europea.

Dicho proyecto está coordinado con los respectivos LIFE para la conservación de visón europeo desarrollados en territorios limítrofes (Álava y La Rioja), así como con el LIFE de cría en cautividad de la especie de Cataluña. Todos ellos están cofinanciados por el Ministerio de Medio Ambiente y la Unión Europea.

Los trabajos realizados se encuentran actualmente en su recta final, actúan en territorios en su mayoría incluidos en Red Natura 2000 y se han propuesto tras la identificación de las principales amenazas que afectan al visón:

- Creciente atomización de sus poblaciones
- Competencia con visón americano
- Alteración de hábitat
- Afección de patologías (principalmente ADV, enfermedad aleutiana)

The programme has a duration of four years (2001-2004) and is coordinated with the European Mink LIFE projects carried out in neighbouring regions (Alava and Rioja), as well as the LIFE project on captive breeding presented by Catalonia. All the projects are co-financed by the Spanish Ministry of the Environment.

The main action lines focus on the following: carrying out periodic checks on known populations; doing research on the biology and ecology of the species through monitoring and radio-tracking activities; controlling the American Mink populations using traps; supervising the health of certain populations; carrying out regeneration work of river ecosystems, and implementing environmental awareness and dissemination measures.

Finally, the Plan for the preservation of the European Mink in Castilla-León approved by the government of Castilla-León, provides the project with a legal instrument that will guarantee the long-term establishment of a series of measures that will contribute to preserving the species.

Key words: Preservation, Castilla-León, Life–Nature, Mustela lutreola, European Mink.

– Falta de concienciación social hacia la conservación de la especie
– Déficits en el conocimiento científico

Habiéndose centrado en las siguientes líneas de actuación:

– Monitorización periódica de las poblaciones conocidas y de posibles nuevas áreas.
– Investigación sobre la biología y ecología a través de monitoreo o radiotracking.
– Control de las poblaciones de visón americano mediante trampeo.
– Control del estado sanitario de las poblaciones de visón europeo y visón americano (Mañas et al. 2001, 2003).
– Trabajos de regeneración de ecosistemas fluviales.
– Medidas de sensibilización y divulgación ambiental.

Por último, destacar que con el compromiso de aprobación del Plan de Conservación del visón europeo en Castilla y León, se pretende dotar al proyecto de un instrumento jurídico que garantice a largo plazo el establecimiento de una serie de medidas que contribuyan a la conservación de la especie

AVANCE DE LOS PRINCIPALES RESULTADOS DEL PROYECTO LIFE DE CASTILLA Y LEÓN

Formación de personal de campo y técnicos con competencias en materia de conservación de la naturaleza

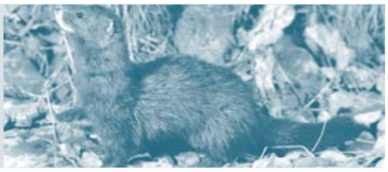
Se han realizado ocho Jornadas Formativas en aspectos relacionados con el conocimiento y la conservación del Visón europeo. Los destinatarios han sido personal propio de los Servicios Territoriales de Medio Ambiente de Burgos y Soria: Agentes Forestales, Celadores de Medio Ambiente y Vigilantes de la Reserva y cotos fluviales, así como personal técnico de dichos Servicios de Medio Ambiente.

En total han asistido a las citadas Jornadas aprox. 200 personas, destacando como principal resultado la constitución de diez grupos de trabajo en temas relacionados con el descaste de visón americano.

Creación Cartografía temática del Visón europeo y su hábitat

Se ha creado a través de ARC-VIEW, una aplicación informática que asocia toda la información existente sobre visón europeo y visón americano en las provincias de Burgos y Soria, a información geográfica, para su uso en gestión de la especie y en particular para la elaboración del Plan de Conservación del Visón Europeo.

Así mismo esta previsto para 2004, la elaboración de cartografía de detalle (1:10.000) de las riberas con presencia segura o probable de visón europeo, que incluirá aspectos relevantes para la gestión como: morfometría, calidad de aguas, régimen hídrico, vegetación de ribera y problemática medioambiental (carreteras, minicentrales, presas, etc.).



Mejora del hábitat del Visón europeo

Una de las amenazas a la que se ve sometida la población de visón europeo es la destrucción de los bosques densos de ribera que constituyen su hábitat. El Servicio Territorial de Medio Ambiente de Burgos ha redactado y adjudicado en el año 2003 un proyecto piloto de Restauración del Hábitat del visón europeo en el río Tirón, a su paso por los términos municipales de Belorado y Cerezo del Río Tirón (Burgos). Es objetivo del proyecto recuperar ocho tramos degradados del río, realizando una limpieza general de riberas y márgenes, estabilizando 1.500 m^2 de taludes mediante el perfilado e instalación de fajinas de salicáceas y estableciendo corredores continuos de vegetación ripícola mediante el estaquillado y repoblación de 8,5 ha (en su mayoría antiguas choperas de producción) con especies vegetales adaptadas a las condiciones de clima, suelo y dinámica fluvial, combinando árboles y arbustos en distintas densidades y mezcla, buscado una mayor variedad de especies y representatividad de la vegetación original que favorezca la formación de refugios, el sombreado del agua, el aporte de materia orgánica, además de mejorar el comportamiento hidrológico de la cuenca. Está previsto iniciar los trabajos de limpieza y preparación del terreno en el mes de noviembre de 2003, y de realizar la plantación en el mes de febrero de 2004.

Control de la invasión de Visón americano (*Mustela vison*)

Otro de los principales problemas para las poblaciones de visón europeo del Ebro, la constituye la presencia en buena parte de los ríos de la cuenca del Duero y en la propia cuenca del Ebro de poblaciones asilvestradas de visón americano.

Para evitar el posible avance, se ha procedido a la realización anual de campañas de trampeo sistemático de visón americano con eutanasia de los ejemplares capturados y toma de muestras en el Centro de Recuperación de Animales Silvestres de Burgos. Para ello, se han organizado diez Grupos de Trabajo formados por Agentes Forestales, Celadores de Medio Ambiente y Vigilantes de Pesca del Servicio Territorial de Medio Ambiente de Burgos, habiéndose repartido todo el territorio con presencia probable y o segura de visón americano. Similares trabajos está previsto se realicen en Soria a lo largo de 2003 y 2004. Así mismo recientemente han sido reforzados los trabajos con personal del Ministerio de Medio Ambiente.

Hasta la fecha, se vienen realizando en la provincia de Burgos dos campañas anuales de descaste (pre y post-reproductiva) con una duración total de 6 meses, que mantienen aproximadamente 200 trampas activas. Se han capturado un total de 101 ejemplares (2001-2003) de visón americano todos ellos procedentes de la Cuenca del Duero. Recientemente ha sido capturado en el Ebro (Ircio) un ejemplar de visón americano.

Dichos resultados se consideran muy satisfactorios de acuerdo con los objetivos perseguidos, que indudablemente han contribuido a reducir la densidad poblacional y por ende, la expansión de la especie, no obstante es importante valorar el alto éxito de capturas como un indicador de la gravedad del problema.

Programa de estudios poblacionales y eco-etológicos de la población de Visón europeo

Se ha realizado el programa de estudio poblacional y estudio eco-etológico correspondiente a 2001-2002, habiendo consistido los trabajos en el trampeo de ejemplares en vivo, la realización de un completo chequeo biopatológico de los animales colectados, su marcaje con chapas y emisores intraperitoneales y el seguimiento posterior mediante radio-rastreo en el medio natural.

Las áreas cuya población de visón europeo se ha monitorizado en la provincia de Burgos han sido: la cuenca del río Ayuda (Condado de Treviño), el sector oriental del río Ebro y la cuenca del río Oca.

En total se han marcado 16 ejemplares de visón europeo con emisores intraperitoneales, para ello se han realizado 1.773 jornadas/trampa y el seguimiento durante aproximadamente 16 meses, habiéndose obtenido tras su seguimiento, datos de incalculable valor científico (biología, ecología de la especie,...etc.) y datos poblacionales de aplicación al Plan de Conservación que confirman un importante descenso poblacional.

En la actualidad se está trabajando en los mismos tipos de estudio para 2003-2004.

Programa de monitorización de la población de Visón europeo

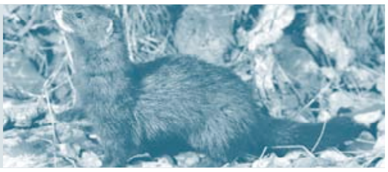
Durante el año 2002 se ha realizado la monitorización de la población de visón europeo en la provincia de Burgos y recientemente (octubre 2003) en la provincia de Soria. Se han realizado por método estandarizado (Maizeret 1991, Palazón and Ruiz-Olmo 1997) 31 "estaciones de trampeo" en 18 ríos correspondientes a las tres cuencas hidrográficas en la provincia de Burgos.

Los resultados sobre status poblacional confirman la tendencia regresiva de la población, con un descenso en el número de efectivos del 29% y una reducción importante del área de presencia regular comparando los datos con el primer estudio sobre distribución y status realizado en 1999-2000. Esta dinámica se debe a la regresión sufrida en las cuencas del Ayuda-Zadorra, Ebro oriental, Oca y cantábrico: la población en estas áreas está ahora fragmentada, es poco densa y cuenta con muy pocos efectivos.

Esta tendencia puede estar relacionada con la alta prevalencia del Virus de la Enfermedad Aleutiana del Visón (ADV) existente en estos cauces, además de la competencia directa ejercida por el visón americano.

Control del estado sanitario de las dos especies de visones

Se ha realizado el control del estado sanitario de todos los ejemplares capturados (visón europeo, visón americano, nutria y turón) por los programas de monitorización, de estudios poblacionales y eco-etológicos y, de descaste de visón americano, habiéndose realizado serología de ADV, proteinogramas, cultivos microbiológicos, estudios coprológicos y de ectoparásitos.



Para el conjunto de los visones de Álava, La Rioja y Castilla y León, se han realizado 81 serologías a 69 animales diferentes de visón europeo. El 21% de estas muestras mostraron un resultado positivo al ADV.

Para el visón americano, se han realizado 114 serologías en el presente estudio y 19 (16.7%) han resultado positivas frente al antígeno del ADV.

Campaña de educación y sensibilización sobre la importancia del Visón europeo

Las tres comunidades Autónomas implicadas en el Proyecto LIFE, conscientes de la importancia de desarrollar una Campaña de Educación Ambiental sobre el visón europeo de forma conjunta y coordinada han editado distinto material divulgativo con un mensaje común e identidad de diseño, haciéndose cargo cada Comunidad Autónoma de un recurso (Póster: La Rioja, Folleto: Castilla y León, Cómic: Álava y Exposición Itinerante: Cataluña).

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[Variabilidad genética de la población occidental de Visón europeo (*Mustela lutreola* L., 1761) basada en la secuenciación de la región control del ADN mitocondrial]

THE OCCIDENTAL EUROPEAN MINK (*Mustela Lutreola*) POPULATION'S GENETIC VARIABILITY BASED IN THE SEQUENCE OF THE CONTROL REGION FOR THE MITOCONDRIAL DNA.

ABSTRACT

Previous studies have revealed a little geographic structure with low genetic variation in the west population of the European mink, although very few specimens from the Iberian Peninsula were included in these analyses. We have obtained European mink samples from all the main basins of the Iberian Peninsula, together with some others from different areas of the whole distribution range of the species in order to get a better knowledge of the genetic variability of the Iberian mink populations, and their relationships with other European populations. The control region has been selected as the molecular marker for this work.

45 samples of European minks from Spain (19), France (6), Romania (10) and Russia (10) have been sequenced. Control region amplifications have been performed by means of a forward primer placed in the cytochrome b gene, designed specifically in this study. The H16498 has been used as reverse primer. After alignments, sequences have been analysed by Neighbor Joining (NJ), Maximum Parsimony (MP) and Maximum Likelihood (ML) methods to elucidate molecular phyloge-

Título abreviado: [Caracterización genética del visón europeo].

Cabria[1], M.T., A. Kranz[2] y B.J. Gómez-Moliner[1]

[1]Universidad del País Vasco. Facultad de Farmacia. Departamento de Zoología y Biología Celular Animal. C/Paseo de la Universidad, 7. 01006 Vitoria-Gasteiz. España.

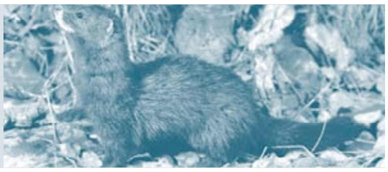
[2]Department of Wildlife Biology and Game Management, BOKU, University of Natural Resources and Applied Life Sciences, Vienna, Peter Jordanstr. 76, 1190 Vienna. Austria.

Maite Cabría
Universidad del País Vasco. Facultad de Farmacia. Departamento de Zoología y Biología Celular Animal.
C/ Paseo de la Universidad, 7. 01006 Vitoria-Gasteiz. España.
e-mail: maitec79@yahoo.es

RESUMEN

Estudios realizados durante los últimos años han revelado que existe una baja diversidad genética en la población occidental del visón europeo, aunque estos estudios fueron realizados con pocos ejemplares de la Península Ibérica. En este estudio hemos incluido muestras de diferentes cuencas en la Península Ibérica, así como del resto de áreas donde se encuentra el visón europeo, incluyendo el Oeste de Francia, el Delta del Danubio y Rusia. Así hemos abordado el estudio del polimorfismo genético de la población ibérica, comparándolo con los niveles de polimorfismo del resto de poblaciones, seleccionando la región control del ADN mitocondrial.

Se han analizado 45 muestras de visón europeo procedentes de todas las poblaciones. Para la amplificación de la región control se han empleado un "primer" forward localizado en el citocromo b, diseñado específicamente en este estudio, y un "primer" rever-



se localizado en la región control. Las secuencias obtenidas se han analizado mediante los algoritmos de Neighbor Joining (NJ), Maximum Likelihood (ML), y Máxima Parsimonia (MP) con el fin de esclarecer las relaciones filogenéticas inter e intrapoblacionales.

Se pone de manifiesto la presencia de una heteroplasmia en la región TnCn, descrita como la región con mayores diferencias inter e intrapoblacionales. Esta heteroplasmia queda definida como la adición o deleción de una de las Timinas en las secuencias de algunos individuos de las tres poblaciones de visón europeo.

Los resultados obtenidos muestran que los ejemplares procedentes del W-Francia y norte de España son monomórficos para la región analizada y constituyen un grupo monofilético. La población del Delta del Danubio presenta unos valores bajos de polimorfismo, mientras que la población rusa constituye el grupo más variable. De forma concordante con otros estudios realizados, las poblaciones de visón europeo presentan bajos valores de polimorfismo genético en todo su ámbito de distribución, al menos en esta secuencia del ADN mitocondrial analizada, siendo la población occidental la más homogénea de todas ellas.

Estos datos moleculares indican que la población occidental de visón europeo debe su origen a una expansión reciente por el oeste de Francia y Península Ibérica, a partir de un único núcleo fundador.

Palabras clave: Caracterización genética, Mustela lutreola, polimorfismo, región control, visón europeo.

INTRODUCCIÓN

Los estudios de ADN se han implantado como una herramienta fundamental para caracterizar las diferentes poblaciones de numerosas especies, atendiendo a su estructuración macrogeográfica y microgeográfica (Avise 2000). En muchas especies de mamíferos se ha podido constatar una gran diversificación genética entre poblaciones distantes geográficamente, tal y como ocurre con el oso pardo *Ursus arctos* Linnaeus, 1758 (Taberlet et

netic relationships. The data matrix included 468 sites, 10 of them variables and 9 phylogenetically informative.

The presence of a heteroplasmy in the TnCn region has been pointed out showing great inter and intra-poblational differences. This heteroplasmy is present in the three populations and consisted of the addition or deletion of one Timine into the sequences of some specimens.

Iberian populations, together with west-French populations constituted a monophyletic clade, showing a complete polytomy as a result of the total absence of D-loop polymorphism, apart from punctual mutations with not geographical significance. Romanian populations showed low levels of polymorphism, most of them being grouped in a single clade. Russian populations represented the most variable group within European mink populations which was in concordance with the previous studies.

These results indicate that the west population of European mink had a recent origin from a single founder nucleus which expanded through W-France and N-Spain.

Keywords: Control region, European mink, genetic characterization, Mustela lutreola, polymorphism.

al. 1998, Randi 2003), el erizo común *Erinaceus europaeus* L., 1758 (Seddon et al. 2001), o varias especies de micromamíferos (Taberlet et al. 1994, 1998, Bilton et al. 1998). No obstante, en otras especies de mamíferos, se ha visto que la variabilidad genética entre poblaciones es muy pequeña, como ocurre en el lobo europeo *Canis lupus lupus*, L. 1758 (Vilá et al. 1999, Randi 2003) o en la nutria *Lutra lutra*, L., 1758 (Cassens et al. 2000, Pérez-Haro et al. 2003).

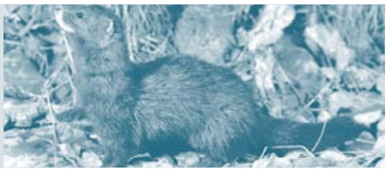
En los últimos años se han efectuado varios estudios de caracterización molecular en diferentes especies de mustélidos. Estos trabajos incluyen estudios mediante isoenzimas (Lodé 1999), microsatélites (Belliveau et al. 1999, Fleming et al. 1999), o ADN ribosómico nuclear (Hosoda et al. 1999). Otros trabajos basados en técnicas de PCR-RFLP se han empleado para caracterizar genéticamente las poblaciones de visón europeo (*Mustela lutreola* L., 1761) y turón (*M. putorius* L., 1758), a la vez que permitían la diferenciación de visón europeo, visón americano (*M. vison* Schreber, 1777) y turón a partir de los análisis de excrementos (Gómez-Moliner et al. 2004). En este último trabajo se han podido diferenciar dos haplotipos para las poblaciones de visón europeo, dos para turón y uno para visón americano, mediante PCR-RFLP de la región control del ADN mitocondrial.

Por otro lado, diversos estudios se han dirigido a conocer la secuencia de bases de las regiones más variables del ADN mitocondrial, como son la región codificante para el citocromo-b (Davison et al. 1999, 2000a, 2000b, Kurose et al. 2000), y la región control (Effenberger y Suchentrunk 1999, Kurose et al. 1999, Davison et al. 2000b, 2001), permitiendo profundizar en el establecimiento de las relaciones filogenéticas inter- e intraespecíficas, la filogeografía de las especies y su evolución.

Davison et al. (2000b) analizaron dos fragmentos separados del ADN mitocondrial (el gen del citocromo b y la región control) de 37 visones europeos poniendo de manifiesto la baja variación y los pocos linajes existentes dentro del género *Mustela*. Además de resultar en un posible origen común para visón europeo y turón, se encontró muy poca divergencia en las secuencias de visón analizadas. Ello es debido a la semejanza encontrada intrapoblacionalmente, lo que determina cierto valor de monofilia en las poblaciones.

Un estudio reciente (Michaux et al. 2004) enfocado al análisis de secuencias del citocromo b y de la región control, revela la baja diversidad genética en las poblaciones occidentales del visón europeo con apenas variabilidad geográfica. El carácter monomórfico de la población occidental de visón europeo, contrasta con las diferencias halladas entre las poblaciones orientales, donde se encuentra la mayor diversidad. Entre las varias muestras que se analizaron en este trabajo, únicamente se incluyeron cuatro ejemplares procedentes de España y dos de Rumania.

El objetivo principal de nuestro estudio es determinar la variabilidad genética de las poblaciones ibéricas de visón europeo y compararlas con las halladas en las poblaciones francesas, así



como con el resto de poblaciones orientales. Para ello se ha trabajado con la Región control, la región más variable del ADN mitocondrial y con un amplio conjunto de muestras que engloban toda el área de distribución del visón europeo en España y parte de la población francesa. Además, se han incluido muestras de Rumania y de Rusia, Esto ha permitido conocer la diversidad genética tanto de la población occidental como de la oriental.

MATERIAL Y MÉTODOS

Se han analizado un total de 45 muestras de visón europeo, de las que 26 pertenecen a la población occidental, 19 de España y 6 de Francia, 10 a la población rusa (Tver y Nelidovo) y 10 a la población rumana (Delta del Danubio). Tanto el código asignado a cada uno de los ejemplares como el tipo de muestra y origen se detallan en la Tabla 1.

Para la extracción del ADN se emplearon distintas técnicas en función de la naturaleza de las muestras. Se utilizó la técnica de fenol/cloroformo/isoamilalcohol, previa digestión con proteinasa K (Sambrook et al. 1989), para muestras de pelo y cuero, mientras que para muestras con alto contenido en polisacáridos tales como el hígado se empleó el método de extracción con CTAB (Sokolov 2000). Las muestras fueron tomadas tanto de animales vivos radiomarcados (pelo) como de animales muertos encontrados en la carretera (pelo, hígado o músculo).

Para la amplificación de la región control se emplearon primers localizados en el citocromo b LutbF (5´-AGA ACA CCC ATT CAT CAT TAT CG-3´), "primer" forward diseñado específicamente en este estudio, y en una región conservada de la región control H16498 (5´-CCT GAA CTA GGA ACC AGA TG-3´), "primer" reverse descrito previamente por Shields y Kocher (1991). Para la reacción de amplificación se necesitaron 1µl de ADN extraído, 1µl de cada primer (20pmol/µl), 2,5µl de dNTP (2,5mM), 0,75µl de MgCl2 (50mM), 2,5µl de buffer STR 10X, 1µl de BSA (10mg/ml) y 0,2µl de Taq Polimerasa (5U/µl) en un volumen total de 25µl.

Tras una incubación de 94°C durante 5 min las muestras fueron amplificadas mediante PCR de 35 ciclos, consistente en una desnaturalización de 94°C durante 1 min, un anillamiento a 57°C durante 30 seg y una extensión de 72°C durante 2 min. Finalmente se empleó un periodo de extensión final de 72°C durante 10 min. El proceso de amplificación fue llevado a cabo en el termociclador GeneAmp PCR Syst 2700 (Applied Biosystems). Los productos de amplificación fueron secuenciados mediante dRhodamine Terminator Cycle Sequencing Ready Reaction Kit (Apllied Biosystems), en un secuenciador automático ABI PRISM Modelo 310 (Applied Biosystems).

Las secuencias obtenidas fueron alineadas mediante el programa ClustalX (Thompson et al. 1997) y analizadas mediante el programa PAUP 4.0 (Swofford 2002), empleando los algoritmos de Neighbor Joining, NJ (Saitou y Nei 1987), máxima parsimonia (Maximum Parsimony, MP) y máxima verosimilitud (Maximum Likelihood, ML). Los modelos General Time Reversible (GTR) y

Tamura-Nei (TrN) fueron utilizados para calcular las distancias genéticas. Para determinar el grupo externo se realizó un Midpoint rooting. La robustez de los árboles fue testada mediante bootstraping (1000 réplicas para máxima parsimonia, y 100 réplicas para máxima verosimilitud). Las distancias genéticas intra e interpoblacionales se calcularon utilizando el programa Mega versión 2.1.

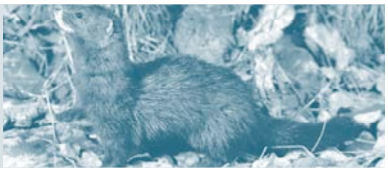
RESULTADOS Y DISCUSIÓN

Tras la secuenciación se pone de manifiesto la presencia de una heteroplasmia en la región poli TnCn de la región control por la adición o delección de una T en algunas secuencias de visón. Se encontraron individuos heteroplásmicos en las tres poblaciones de visón analizadas. Esta región se define como la más variable dentro de la secuencia del ADN mitocondrial analizada, encontrándose en ella las mayores diferencias inter e intrapoblacionales. No obstante, la variabilidad detectada en esta porción no tenía significación biogeográfica, por lo que fue eliminada para los análisis efectuados. Para realizar los posteriores análisis filogenéticos fue fijada una de las T, en aquellos individuos que presentaban heteroplasmia.

La matriz de datos obtenida incluye 468 pares de bases (pb), de las cuales 10 resultaron ser variables y 9 parsimoniosamente informativas (de la matriz de datos final fueron eliminados los GAPs para los análisis). Mediante los análisis de Midpoint rooting se obtuvieron tres agrupaciones principales, que corresponden con las poblaciones actuales de visón europeo, la población occidental, la población rumana y la rusa. Esta última mostró la mayor distancia genética con respecto a la población occidental, por lo que se tomó como grupo externo en los análisis filogenéticos posteriores. Los resultados obtenidos mediante Midpoint rooting pueden verse en la figura 1.

La filogenia obtenida con el modelo de Tamura Nei y General Time Reversible (GTR) muestra una topología similar a la que se obtuvo mediante Midpoint rooting. Los análisis de máxima parsimonia y máxima verosimilitud proporcionan filogenias con idénticas agrupaciones. Los valores de Bootstrap obtenidos para ML y MP se muestran en la Figura 2. Los individuos españoles y franceses forman un grupo monofilético soportado por un valor de bootstrap del 58% para ML y del 64% para MP. A excepción de dos individuos que se agrupan junto con la población rusa, la población rumana forma también un grupo monofilético soportado con un valor del 81% para ML y del 74% para MP. La población rusa se muestra como la más heterogénea agrupándose los individuos en diferentes clados, y soportada por valores de bootstrap que oscilan entre 51%-98% para ML y entre 51%-94% para MP.

Los niveles de divergencia genética presentaron en general unos valores muy bajos dentro y entre las poblaciones analizadas de visón europeo. Los mayores valores intrapoblacionales se presentaron en la población rusa, 0,7%, seguida de la rumana con un valor del 0,2% y de la occidental, con un valor del 0,1%. Las mayores distancias se mostraron entre las poblaciones rusa



y occidental, 0,9%, seguida por las poblaciones rusa y rumana con un valor de 0,7%. La población rumana con respecto a la occidental presentó una menor distancia genética, 0,5%.

Para corroborar los resultados obtenidos se realizó un segundo análisis, en el que se incluyeron las secuencias obtenidas en el trabajo de Michaux et al. (2004) y publicadas ya en el GenBank. Fueron analizadas las secuencias de 50 visones europeos, creando una matriz de datos final de 300pb para cada muestra. De igual forma, los GAPs fueron eliminados en los análisis, obteniendo mediante el algoritmo de Neighbor Joining un árbol filogenético idéntico al obtenido en los análisis anteriores. La falta de variación entre las secuencias de la población occidental favorece su agrupación en un grupo monofilético, siendo en las poblaciones rusas donde se encuentran las mayores diferencias nucleotídicas.

Se confirma la baja variabilidad genética del visón europeo demostrada en otros estudios de secuenciación del ADN mitocondrial (Davison et al. 2000, Michaux et al. 2004). Las tres poblaciones de visón europeo presentan diferentes niveles de polimorfismo. Así, la población rusa queda caracterizada por unos mayores valores de polimorfismo genético en comparación con los obtenidos en la población rumana, que muestra una variabilidad genética muy baja, o en la población occidental que se presenta monomórfica, carente prácticamente de variabilidad genética para esta región del ADN mitocondrial, con la salvedad de mutuaciones puntuales sin significación geográfica.

La circunstancia de que la población occidental aparezca fijada para un único haplotipo indica que los individuos del W-Francia y norte de España tienen un origen común, a partir del mismo núcleo fundador. Michaux et al. (2004) postulan que esta población occidental podría haberse originado como consecuencia de una colonización de tipo leptocúrtico desde un único refugio glaciar. Además, el origen de esta población parece haber sido un hecho reciente, sin tiempo a que hayan podido diferenciarse linajes diferentes en esta población como resultado de aislamiento geográfico, o de un flujo genético interpoblacional limitado. Estos resultados apoyan las tesis que han postulado un origen reciente del visón europeo en la Península Ibérica (Youngman 1982, Senosian y Donázar 1983, Zabala y Zuberogoitia 2003) para justificar la ausencia de citas de *Mustela lutreola* con antelación a 1951 (Rodríguez de Ondarra, 1955, Puente-Amestoy, 1956). La hipótesis de que se trata de una especie antigua para la fauna ibérica, pero cuya presencia había pasado largo tiempo desapercibida, no se mantiene con los datos moleculares obtenidos.

El carácter monomórfico para la región control del ADNmt en la población occidental de visón europeo hace necesario que se desarrollen nuevos métodos para identificar loci más polimórficos que los utilizados hasta la fecha. Entre ellos, destacan los microsatélites nucleares como marcadores moleculares, ya que debido a su alta variabilidad, son los que mayor potencialidad presentan de cara a analizar el polimorfismo y la dinámica de poblaciones de especies con baja variabilidad genética, como es el caso que nos ocupa.

En los últimos años se han diseñado varios microsatélites en diferentes especies de mustélidos (O´Connel et al. 1996, Belliveau el al. 1999, Fleming et al. 1999, Vincent et al. 2003). Estos microsatélites han sido originalmente utilizados para estudiar las poblaciones cautivas y salvajes de visón americano, y de armiño (M. erminea L., 1758). Peltier y Lodé (2003) han utilizado 16 de estos microsatélites y otros 3 recogidos de la base de datos del GenBank para caracterizar las poblaciones de visón europeo de Francia, encontrando que muchos de ellos están fijados para un único alelo, y aquellos que no lo están, muestran tan solo dos alelos. Se hace, por tanto, necesario crear nuevos microsatélites específicos para visón europeo, complementarios de los diseñados para otros mustélidos. De esta manera podrían definirse las Unidades Evolutivamente Significativas (ESUs), básicas de cara a realizar una gestión efectiva de esta especie en peligro de extinción.

AGRADECIMIENTOS

Agradecemos la colaboración de los proyectos LIFE: “Conservación del visón europeo (Mustela lutreola) en “Castilla León” LIFE 00/NAT/E7229, La Rioja” LIFE 00/NAT/E7331 y “Álava” LIFE 00/NAT/E7335 y a las diferentes personas e instituciones: Jorge González-Esteban (Sociedad de Ciencias Aranzadi), Santiago Palazón Miñano (MMA y Generalitat de Catalunya), Pascal Fournier (GREGE), Iñigo Zuberogoitia, Alfonso Senosiain, Gorka Belamendia (Museo de Ciencias Naturales de Álava) y Tiit Maran (EMCC, Tallinn Zoo), por habernos proporcionado las diferentes muestras con las que hemos podido llevar a cabo este trabajo de investigación. Gracias al proyecto de la UE financiado por una beca, las muestras de Rumania fueron recogidas por DELWET Centre of Excellence Project of the Danube Delta Nacional Institute en Tulcea.

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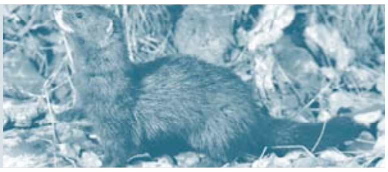

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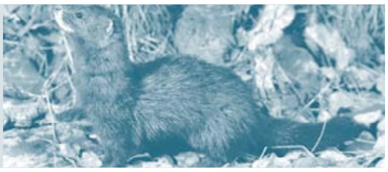

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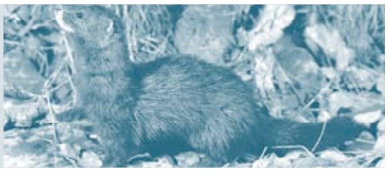
Código	Muestra	Localidad	País
RUS 01	Hígado	Parque Natural. Nelidovo	Rusia
RUS 02	Hígado	Parque Natural. Nelidovo	Rusia
RUS 03	Hígado	Parque Natural. Nelidovo	Rusia
RUS 04	Hígado	Parque Natural. Nelidovo	Rusia
RUS 05	Hígado	Parque Natural. Nelidovo	Rusia
RUS 06	Hígado	Parque Natural. Nelidovo	Rusia
RUS 07	Pelo	Region Novosibirsk, Vologda, Tver	Rusia
RUS 08	Pelo	Region Novosibirsk, Vologda, Tver	Rusia
RUS 09	Pelo	Region Novosibirsk, Vologda, Tver	Rusia
RUS 10	Pelo	Region Novosibirsk, Vologda, Tver	Rusia
ROM 01	Pelo	Delta del Danubio	Rumania
ROM 02	Pelo	Delta del Danubio	Rumania
ROM 03	Pelo	Delta del Danubio	Rumania
ROM 04	Pelo	Delta del Danubio	Rumania
ROM 05	Pelo	Delta del Danubio	Rumania
ROM 06	Pelo	Delta del Danubio	Rumania
ROM 07	Pelo	Delta del Danubio	Rumania
ROM 08	Pelo	Delta del Danubio	Rumania
ROM 09	Pelo	Delta del Danubio	Rumania
ROM 10	Pelo	Delta del Danubio	Rumania
FR 01	Pelo	Oeste de Francia	Francia
FR 02	Pelo	Oeste de Francia	Francia
FR 03	Pelo	Oeste de Francia	Francia
FR 04	Pelo	Oeste de Francia	Francia
FR 05	Pelo	Oeste de Francia	Francia
FR 06	Pelo	Oeste de Francia	Francia
SP 01SS	Músculo	Salvatore. Guipúzkoa	España
SP 02LO	Pelo	Rio Najerilla. La Rioja	España
SP 03LO	Pelo	Río Tirón. Herramélluri. La Rioja	España
SP 04BU	Pelo	Río Oca. Cornudilla. Burgos	España
SP 05NA	Pelo	Río Alhama. Cintruenigo. Navarra	España
SP 06LO	Pelo	Río Ebro. Calahorra. La Rioja	España
SP 07BI	Músculo-pelo	Muxika. Bizkaia	España
SP 08LO	Pelo	Río Iregua. Logroño. La Rioja	España
SP 09BI	Pelo	Gernika. Bizkaia	España
SP 10NA	Pelo	Río Arakil. Ziordia. Navarra	España
SP 11NA	Pelo	Río Ega. Labeaga. Navarra	España
SP 12NA	Músculo-pelo	Río Ebro. Arguedas. Navarra	España
SP 13NA	Cuero-pelo	Río Ebro. Arguedas. Navarra	España
SP 14VI	Pelo	Afluente Herrerías. Llanteno. Álava	España
SP 15VI	Pelo	Río Arceniega. Arceniega. Álava	España
SP 16VI	Pelo	Salburua. Álava	España
SP 17NA	Pelo	Río Larraun. Ihaben. Navarra	España
SP 18NA	Hígado	Río urumea. Ollín. Navarra	España
SP 19VI	Cuero-pelo	Río Amezaga. Carretera Araia. Álava	España

Tabla 1. Código asignado, tipo de muestra, origen y país al que pertenece cada uno de los ejemplares analizados en el estudio. Los códigos empleados para las muestras españolas se corresponden con la localidad; SS: Guipúzcoa, LO: La Rioja, BI: Bizkaia, BU: Burgos, NA: Navarra, VI: Álava.

Table 1. Code, type of sample, locality and country of each specimen analysed in this study. The codes used for Spanish samples correspond with the locality; SS: Guipúzcoa, LO: La Rioja, BI: Bizkaia, BU: Burgos, NA: Navarra, VI: Álava.



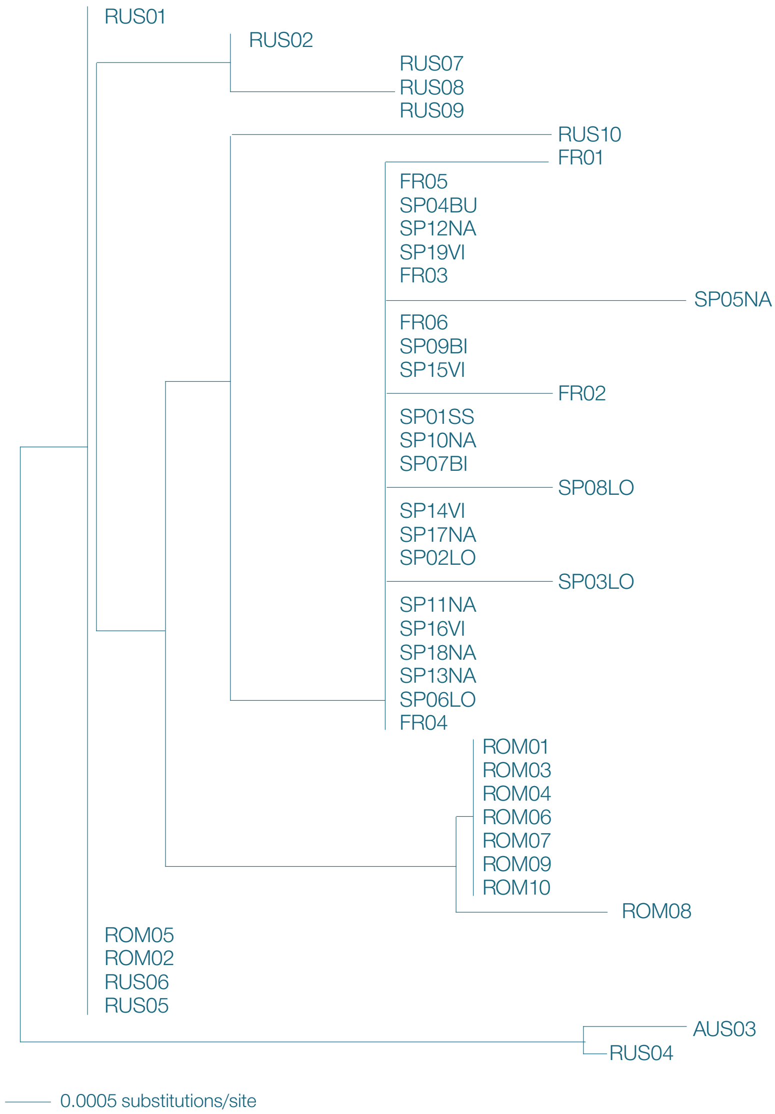


Figura 1. Árbol obtenido tras el análisis de Midpoint rooting. Los códigos de las muestras se encuentran en la tabla 1.

Figure 1. Tree obtained with a Midpoint rooting analysis. The codes of the samples are given in the table 1.

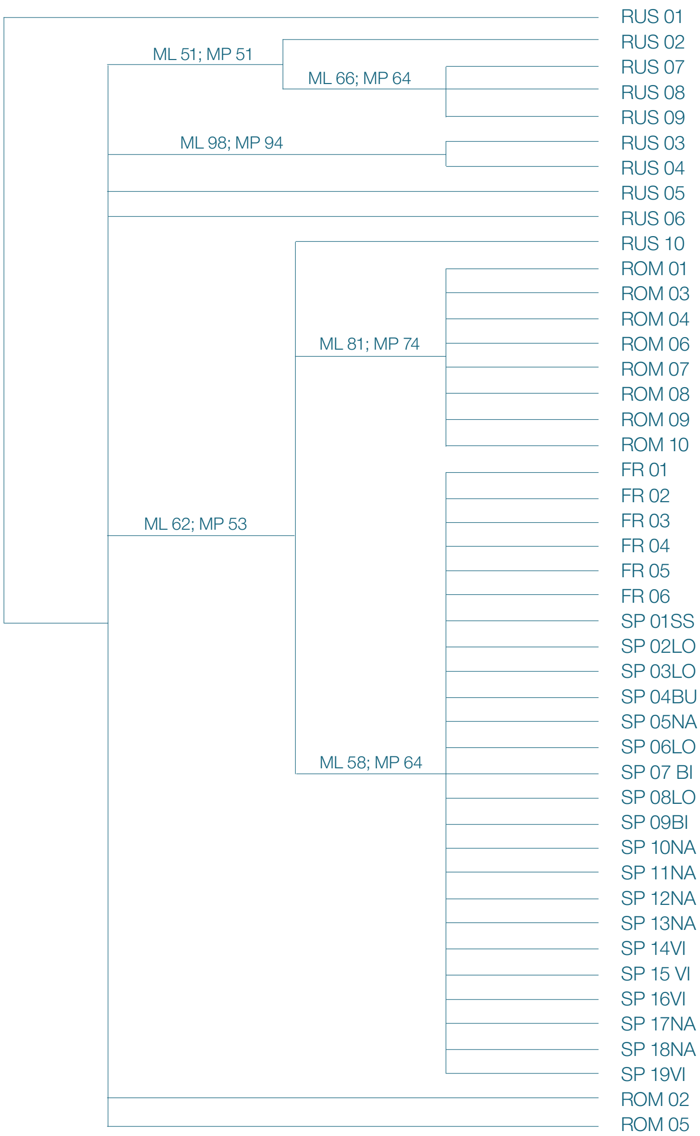


Figura 2. Filogenia basada en los análisis de las secuencias de la región control mediante los algoritmos de máxima verosimilitud (ML) y máxima parsimonia (MP). *Figure 2. Phylogenetic relationships based on maximum likelihood (ML) and maximum parsimony (MP) analysis of the control region.*

[Aspectos de ecología y composición de la población de Visón europeo *Mustela lutreola* (Linnaeus, 1761) en la cuenca alta del río Ebro (España)]

ASPECTS OF ECOLOGY AND COMPOSITION OF THE EUROPEAN MINK *Mustela lutreola* (Linnaeus, 1761) POPULATION IN THE RIVER EBRO HIGH BASIN (SPAIN).

ABSTRAT:

Through the years 2000 to 2004, the ecology and composition of the european mink population in six water courses (213 km.) of the river Ebro higher basin (N Spain) have been studied. A combined method of both intensive trapping and radio-tracking was used: the trapping allowed us to obtain relative densities of the population and to determine its composition (sex and age ratios), while the radio-tracking provided knowledge about use of space and key factors affecting population dynamics. Having this information integrated, agregation models were defined and the implications for its conservation evaluated. The effects of inter-species relations with the otter, the polecat and the american mink were also studied.

Using 16.861 days-trap, 80 europeans minks were captured and 48 of them (25 females and 23 males) radio-tracked with intraperitoneal transmitters for an average of 12,5 months/mink. The population was mainly composed of resident adults with a use of space pattern showing a clear territorial behaviour, highly stable through the years. The average home ranges were significantly larger in males (9,7 km.) than in females (4,9 km.) Two different agregation models were observed: all

Título abreviado: [Aspectos de ecología y composición de la población de visón europeo *Mustela lutreola* (Linnaeus, 1761) en la cuenca alta del río Ebro España]

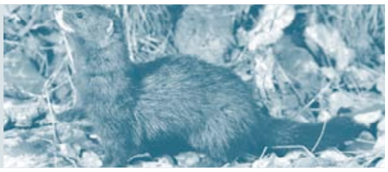
Juan Carlos Ceña, Alfonso Ceña, Mª. Asunción Gómez y Javier López de Luzuriaga.

Juan Carlos Ceña
C/ Estambrera, 13 - 3ºB. 26006 Logroño (La Rioja. España)
E-mail: mlutreola@yahoo.es

RESUMEN:

Entre los años 2000 y 2004 se ha estudiado la ecología y composición de la población de visón europeo presente en seis ríos (213 km.) de la cuenca alta del Ebro (N de España). Se empleó un método combinado de trampeo intensivo y radio-seguimiento: el trampeo permitió obtener densidades relativas de población y determinar su composición (proporción de sexos y edades), el radio-seguimiento conocer aspectos del uso del espacio y factores básicos de la dinámica de poblaciones. Integrando esta información se definieron los modelos de agrupación espacial que presenta la especie, evaluando sus implicaciones de conservación. Así mismo, se estudió el efecto de sus relaciones interespecíficas con la nutria, el turón y el visón americano.

Empleando 16.861 jornadas-trampa se capturaron 80 visones europeos diferentes y 48 de ellos (25 hembras y 23 machos) fueron radio-seguidos durante una media de 12,5 meses/visón usando emisores intraperitoneales. La población estuvo compuesta principalmente por adultos residentes, que desarrollaron un patrón de uso del espacio basado en una marcada territorialidad con gran estabilidad interanual. Las áreas de campeo medias de los machos (9,7 km.) fueron significativamente mayores que las de las hembras (4,9 km.). Se observaron dos modelos de agrupación espacial diferentes: en los ríos Najerilla, Tirón y



Alegría-Salburúa, se registraron visones a lo largo de todo el tramo estudiado, presentado densidades relativas elevadas (5-10 ej.capturados/10 km.), con alta proporción de hembras por macho y pequeñas áreas de campeo; mientras que en el resto de ríos (Ebro, Ayuda y Oca) sólo en algunos tramos se registraron visones, su densidad relativa fue mucho menor (0,5-3 ej. capturados/10km.), con más machos que hembras y mayores áreas de campeo. La tasa de mortalidad registrada en la muestra de ejemplares radio-seguidos fue del 16,1% anual y el tamaño de camada de 1,8 cachorros/hembra. Se observó una amplia simpatría entre el visón europeo y la nutria, sin predación por parte de ésta sobre el visón. El turón fue muy escaso en las zonas de presencia del visón europeo, habiéndose observado tres ejemplares híbridos entre ambas especies. El visón americano invadió los ríos del sector NW del área de estudio que paralelamente sufrieron un acusado descenso en sus densidades relativas de visón europeo; sin embargo, la especie autóctona ha conservado un relicto de población en las lagunas de Salburúa, pese a la presencia en ellas de ejemplares de visón americano, que son sometidos a control. La conservación de la especie en el area de estudio pasa por establecer áreas protegidas en las zonas con mejores poblaciones, mantener el control sobre el visón americano, reducir las principales causas de mortalidad conocidas (atropellos) e investigar las desconocidas.

PALABRAS CLAVE: Composición, ecología, España, Mustela lutreola, población, uso espacio.

INTRODUCCIÓN

El visón europeo *Mustela lutreola* (Linnaeus, 1761) viene padeciendo un declive continuado que le ha llevado a presentar poblaciones fragmentadas y aisladas; en la actualidad, las más importantes se conservan en la Europa oriental (Rusia, Rumania); a considerable distancia de ellas, se mantiene un pequeño núcleo en Europa occidental, comprendiendo el suroeste de Francia y el norte de España (Camby 1990, Maizeret et al. 1998, Sidorovich 1991, Tumanov 1999, Youngman 1982). La población española presenta un área de ocupación restringida, menor de 30.000 km^2, y el número de efectivos que la componen es pequeño, menor de 1.000 ejemplares (Palazón y Ceña 2002). Esta pobla-

along the studied sectors of the Najerilla, Tirón and Alegría-Salburúa rivers data were recorded with high relative densities (5-10 individuals trapped/10 km.), with a bigger proportion of females over males and small home ranges; while in the rest of the rivers (Ebro, Ayuda and Oca) minks were found only in a few sectors, their relative densities were much lower (0,5-3 indviduals trapped/10 km.), with more males than females and larger home ranges. Mortality rate recorded out of the radio-tracked sample rose to 16,1% per year and the litter size was 1,8 cubs/female. Overlapping between the european mink and the otter was commonly observed, the latter not preying on the former. Polecats were sparse in areas with european mink presence and three hybrids between both species were found. American minks invaded the NW sector of the area of study with rivers showing correlative severe decreases in their relative densities of european mink. The original species, however, has remained as an small isolated population in the Salburúa wetlands despite the presence of american mink individuals under trapping control. Conservation of the species requires protection of areas with good populations, continued measures to control the American Mink, reduction of known mortality causes (road traffic) and investigation of the unkown ones.

KEY WORDS: Composition, ecology, Mustela lutreola, population, Spain, use of space.

ción fue descubierta en la década de los años 50 del siglo pasado (Rodríguez de Ondarra 1955 y 1963), aunque no es hasta los 90 cuando comienzan a estudiarse algunos aspectos relativos a su distribución y ecología (Garín et al. 2001, Palazón 1998, Palazón, Ruíz-Olmo y Ceña 1997).

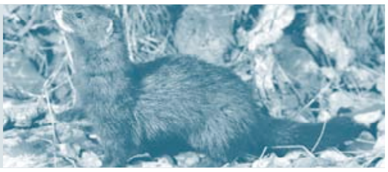
Recientemente, se han puesto en marcha programas coordinados destinados a su estudio y conservación en las comunidades de La Rioja, País Vasco y Castilla y León. Como necesidad básica de estos programas, se plantea conocer cuál es la situación de la especie en sus territorios y obtener información sobre su ecología que ayude a establecer medidas de conservación eficaces. En este contexto, el presente artículo da a conocer los resultados obtenidos sobre su distribución, densidad relativa, composición de la población, uso del espacio, modelos de agrupación espacial y relaciones interespecíficas, en un estudio llevado a cabo la cuenca alta del río Ebro, zona en la que se está produciendo el contacto entre el visón europeo y poblaciones asilvestradas de visón americano (*Mustela vison* Schreber, 1777) (Bravo 2002, Ceña et al. 2003).

ÁREA DE ESTUDIO

En el norte de España, el visón europeo ocupa ríos incluidos principalmente en la cuenca alta del Ebro y en menor medida ríos costeros situados entre esta cuenca y el mar Cantábrico (cuenca Norte); ocasionalmente, penetra en ríos contiguos de la cuenca del Duero (Palazón y Ceña 2002). El área de estudio comprende parte de seis cursos fluviales enmarcados en la cuenca del Ebro, pertenecientes a las provincias de Álava (País Vasco), Burgos (Castilla y León) y La Rioja: los ríos, Ebro (un tramo de 70 km de longitud, con un caudal medio de 86 m3/sg y una anchura media de 60 metros), Oca (respectivamente: 63 km, 4 m3/sg y 2,5 m), Ayuda (23 km, 3 m^3/sg y 2,1 m), Tirón (25 km, 7,3 m^3/sg y 7,6 m), Najerilla (17 km, 14,1 m^3/sg y 15 m) y Alegría-áreas húmedas de Salburúa (15 km y 1,8 m; 200 Has). Los ríos Ayuda, Alegría y el área húmeda de Salburúa se inscriben a su vez en la subcuenca del río Zadorra que es tributario directo del Ebro (2º orden) al igual que Oca, Tirón y Najerilla (Mapa 1). Estos tramos integran una longitud total de 213 km, lo que supone aproximadamente un 35% de la red hidrográfica con posible presencia de visón europeo de las citadas provincias.

MAPA 1. Localización del área de estudio. Se indica la situación de los tramos fluviales estudiados dentro de la cuenca alta del río Ebro (N de España).
Location of the area of study. Situation of the studied fluvial sectors in the higher basin of the river Ebro (N Spain) is shown.

La morfología natural de los cauces se encuentra alterada en muchos



tramos a consecuencia de obras de defensa hidrológica (motas, escolleras, canalizaciones) e infraestructuras energéticas (centrales hidroeléctricas) y de regadío. Las márgenes se encuentran intensamente cultivadas, principalmente por cereales y viñedo. Existen numerosos pueblos junto a los ríos, generalmente de tamaño pequeño (100-10.000 habitantes); una excepción es la ciudad de Vitoria-Gasteiz (214.000 habitantes), situada junto al área húmeda de Salburúa-río Alegría.

El régimen de estos ríos es de tipo pluvio-nival, con caudales máximos en invierno-primavera y mínimos en verano-otoño. Bioclimáticamente la zona resulta heterogénea, encuadrándose los ríos Ebro, Najerilla y Tirón en el Piso Mesomediterraneo de la Región Mediterránea (T: 13 a 17°C, m: -1 a 4°C, M: 9 a 14°C, It: 210-350), Oca y Ayuda en el Piso Supramediterraneo (T: 8 a 13°C, m: -4 a -1°C, M: 2 a 9°C, It: 60-210) y Alegría-Salburúa en el Piso Montano (T: 6 a 10°C, m: -4 a 0°C, M: 3 a 8°C, It: 50-180) de la Región Eurosiberiana; los hombroclimas varían entre el tipo Seco (P: 350-600 mm.) y el Húmedo (P: 900-1.400 mm.) (Rivas-Martínez 1986).

La vegetación azonal natural está formada por bosques ribereños integrados en el Orden Populetalia albae, constituidas por aliso común (*Alnus glutinosa*), chopo negro (*Populus nigra*), frenos (*Fraxinus angustifolia*, *F. excelsior*), sauces (*Salix spp.*) y zarzales (*Rubus spp.*). Estos bosques-galería presentan generalmente un estado de conservación deficiente, estando con frecuencia invadidos por choperas (Populus x hibrida), tanto asilvestradas como cultivadas en turnos muy cortos (12-20 años). Los medios palustres son escasos y de muy reducidas dimensiones, siendo un ejemplo sobresaliente de ellos el área húmeda de Salburúa en la que existen lagunas, praderas encharcadas y una extensa red de pequeños arroyos y drenajes ocupados principalmente por carrizales (*Phragmites*, *Typha*) y zarzales (*Rubus spp.*). (Sánchez-Mata y Fuente1985)

Las especies de peces más comunes son la trucha común (*Salmo trutta* L.), barbo de Graells y barbo colirrojo (*Barbus graellsii* Steindachner, *B. haasi* Mertens), carpa común (*Cyprinus carpio* L.), madrilla y bermejuela (*Chondrostoma toxostoma* Vallot, *C. arcasii* Steindachner), gobio

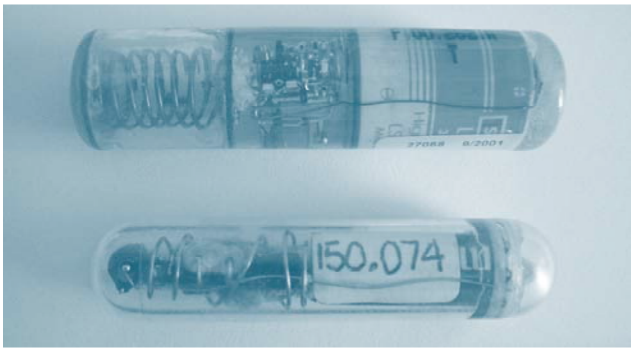


FOTO 1. Radio-emisores encapsulados, de implante intraperitoneal, empleados en el estudio: modelo 1-2 (arriba) y modelo 3 (abajo).

Intraperitoneal transmitters used in the study: model 1-2 (up) and model 3 (down).

(*Gobio gobio* L.), piscardo (*Phoxinus phoximus* L.), alburno (*Alburnus alburnus* L.), lamprehuela (*Cobitis calderoni* Bacescu) y pez lobo (*Noemacheilus barbatulus* L). Los ríos Najerilla, Tirón, Ayuda y Oca son aprovechados intensivamente para la pesca deportiva de la trucha, siguiendo una estricta orden de vedas; en los ríos Ebro y Alegría, principalmente ciprinícolas, la pesca se practica con escasa intensidad. Existen tres especies de cangrejos: la autóctona (*Austropotamovius pallipes*) se encuentra amenazada de extinción, mientras que las dos alóctonas (*Procambarus clarkii* y *Pacifastacus leniusculus*) son objeto de aprovechamiento regulado. La única especie de anfibio abundante en estos ríos es la rana común (*Rana perezi* Seoane) y el reptil más frecuente es la culebra viperina (*Natrix maura* L.). Las aves acuáticas son escasas, salvo en las lagunas de Salburúa. Las comunidades de micromamíferos presentes en las riberas son ricas y diversas. En todos los ríos incluidos en el área de estudio son frecuentes la nutria euroasiática (*Lutra lutra* L.), la gineta (*Genetta genetta* L.) y la garduña (*Martes foina* Erxleben), siendo raro el turón europeo (*Mustela putorius* L.); el visón americano se ha asilvestrado recientemente, ocupando ríos del centro de la provincia de Álava. (Ceña et al. 1996).

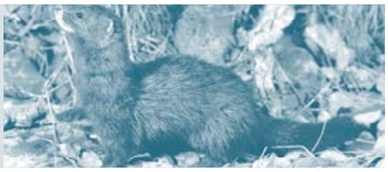
MÉTODOS

Para el estudio de la población de visón europeo en los tramos fluviales que componen el área de estudio se empleó una metodología que combina el trampeo intensivo periódico con el radioseguimiento. El trabajo de campo se desarrolló entre los años 2000 (preparatorio) y 2004.

Trampeo intensivo periódico

La realización de trampeos homogéneos y estandarizados ha permitido obtener densidades relativas de visón europeo (nº ej capturados/10 km.) en cada curso fluvial, relacionando directamente el Mínimo Número de animales capturados vivos con la amplitud de las áreas muestreadas (Soriger et al. 1997). La composición de la población estudiada se obtuvo determinando el sexo de los visones colectados y su edad relativa. El sexo se determinó mediante la palpación del hueso peneano (Petrides 1950). La edad relativa de los visones se estimó en atención a la biometría externa y al estado de la dentición (muda y desgaste) de los animales, siguiendo los patrones descritos para el visón americano (Enders 1952, Mitchell 1961, Pascal y Delattre1981, Venge 1973), agrupándolos en dos amplias clases de edad: subadultos (3-8 meses) y adultos (más de 8 meses).

Los trampeos fueron de tipo intensivo para intentar la captura del mayor número posible de ejemplares. Para ello, se dispusieron trampas a lo largo toda la longitud de la red fluvial susceptible de albergar visones, excluyéndose los tramos urbanos, sin cobertura vegetal o canalizados: de este modo, se trampearon de modo efectivo 167 km. de los seis ríos referidos (78,4% del área de estudio). En cada río se realizaron inicialmente dos tandas de trampeo (captura/recaptura), respectivamente en época pre-reproductora (marzo-abril) y post-reproduc-



tora (septiembre-noviembre). Las trampas fueron emplazadas a intervalos regulares de unos 100 metros, manteniéndolas activas durante 10 días, pudiendo alcanzar un máximo teórico de 100 jornadas-trampa/km. en el conjunto de las dos tandas de trampeo. En cada cuenca fluvial, cada tanda de trampeo se completó en un periodo inferior a un mes. En algunos ríos, los trampeos se repitieron en varias temporadas (años 2002 a 2003) para conocer la evolución de estas poblaciones, pero en estos casos únicamente se trampeo en las zonas en que previamente se había registrado la presencia de visones; en los ríos Oca y Ayuda sólo se pudo realizar un trampeo en 2003 al ser paralizado temporalmente el proyecto por cuestiones administrativas. En todos los trampeos se emplearon jaulas-trampa prismáticas (56x12x12 cm.) fabricadas en malla metálica y provistas de balancín; como cebo se utilizó pescado fresco o conservado en aceite. A la información obtenida en los trampeos propios se ha añadido la de los destinados al control del visón americano, desarrollados por la Diputación Foral de Álava (DFA) en el río Zadorra (70 km.) utilizando una metodología similar. A todos los visones europeos capturados se les dispuso un transponder subcutáneo para su control en caso de recaptura y una parte de ellos entró a formar parte del programa de radio-seguimiento.

Siguiendo esta metodología, se han trampeado las seis cuencas fluviales incluidas en el área de estudio realizándose un esfuerzo global de trampeo de 16.861 jornadas-trampa, con un esfuerzo medio de 72,8 jt/km. (SD= 19,35; n= 12). Las características de los trampeos realizados en los diferentes ríos (periodo, amplitud, esfuerzo) se muestran en la TABLA 1.

Radio-seguimiento

Los visones europeos colectados durante los dos primeros años de estudio (2001 y 2002) en cinco de los ríos estudiados (Oca, Ebro, Najerilla, Ayuda y Alegría-Saburúa) entraron a formar parte de un programa de radio-seguimiento; en el tercer año (2003), se radio-marcaron de nuevo todos los ejemplares colectados en el río Najerilla. De ellos se ha obtenido información sobre el uso del espacio, factores básicos de demografía y relaciones interespecíficas.

Se eligió el uso de radio-emisores de larga duración implantados en la cavidad pleuroperitoneal para intentar conseguir periodos de seguimiento amplios y evitar molestias a los visones (Fournier et al. 2001). Se emplearon tres tipos distintos de emisores encapsulados: dos modelos ATS (Minesota, EE.UU.) semejantes pero con una duración esperada de 3 y 14 meses, ambos de 18 g. de peso y dotados de sensor de actividad, y un modelo BIOTRAK (Dorset, Reino Unido) de 12 meses de duración teórica, 9 g. de peso y con sensor de mortalidad (Figura 1). El segundo modelo resulta adecuado para los machos y fue empleado mayoritariamente; el tercer modelo es adecuado para hembras, que son más pequeñas. En las pruebas previas, la distancia media de recepción de los emisores, en terreno llano e introducidos bajo tierra, fue de 150 metros (n= 60, rango: 70-450 m.); estas condiciones varían con el tiempo de uso de cada emisor y con la orografía propia de cada zona. La escasa distancia de recepción de los modelos empleados dificulta la localización de los visones en ríos amplios (Ebro) y en sectores de difícil acceso.

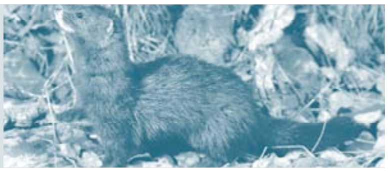
Se implantaron emisores intraperitoneales a un total de 48 ejemplares de visón europeo; en 46 de ellos se emplearon emisores de larga duración (12-14 meses) y en dos (H-104 y M-001) de corta duración (3 meses). A tres ejemplares (M-112, H-120 y H-106) se les reimplantó un nuevo emisor intraperitoneal para prolongar su periodo de control, respectivamente a los 8, 18 y 22 meses del primer implante; a un ejemplar (M-096), se le implantaron tres emisores sucesivamente, a los 12 y 23 meses del primer implante.

Durante el radio-seguimiento, se intentó localizar a los visones al menos una vez por semana; en cada localización diaria se determinó su posición y el tipo de actividad desarrollada, intentando no interferir en su comportamiento. Para la búsqueda, se emplearon diversos modelos de receptores y antenas omnidireccionales y direccionales (principalmente: RA- 5A / 14K y TR- 4 / 2 de TELONICS, Arizona, EE.UU; y Y- 4FL, TVP Positioning AB, Suecia) que fueron llevados en mano durante los recorridos a pie (Figura 2) o montados sobre vehículos todo-terreno; ocasionalmente, se empleó una lancha tipo zodiac y una avioneta para intentar la localización de ejemplares perdidos. El radio-seguimiento cesó tras el agotamiento de la batería del emisor, la pérdida de su señal (desplazamiento fuera del área de estudio) o la muerte del ejemplar. Los visones capturados en el río Tirón no fueron provistos de radio-emisores a fin de testar, comparando el porcentaje de ejemplares recapturados en él con el de las otras cuencas, si existían modificaciones en estas poblaciones que pudieran estar relacionadas con el empleo masivo del radio-seguimiento.

La determinación de la longitud de las áreas de campeo se realizó mediante la acumulación de todos los puntos de radio-localización y de captura obtenidos de cada ejemplar sobre los mapas hidrológicos (E- 1:5-10.000), para posteriormente planimetrar la amplitud máxima del tramo fluvial utilizado; la superficie del área de campeo se calculó multiplicando la longitud anterior por la anchura media de banda fluvial utilizada por cada ejemplar (distancia media de los puntos de localización al eje del río). En el caso de los ejemplares que utilizaron hábitats palustres (zonas húmedas de Salburúa) la superficie se refiere a la del mínimo polígono conve-

FOTO 2. Radio-seguimiento a pie con receptor escáner en el río Najerilla (España).

On foot radio-tracking with a scanner receptor in the Najerilla river (Spain).



xo que comprende todas las localizaciones de cada ejemplar y su longitud a la máxima en línea recta incluida en dicho polígono. La distribución se obtuvo mediante la acumulación de todos los datos de presencia de los ejemplares radio-seguidos y de las capturas habidas en los trampeos. El radio-seguimiento de las hembras proporcionó información sobre su tamaño de camada, para lo cual se intentó localizarlas con periodicidad diaria durante la época de formación de grupos familiares (junio a agosto) buscando observar de modo directo a las hembras con las crías tal y como se hace con otras especies de carnívoros (Barrientos 2000, Campo et al. 1984). Los sensores de movilidad y de mortalidad dispuestos en los emisores permitieron localizar los ejemplares muertos y con ello calcular la tasa de mortalidad (% anual de bajas) de la muestra monitorizada. El patrón de uso del espacio se estableció analizando las características (disposición, tamaño y solapamiento) del conjunto de áreas de campeo registradas de modo simultáneo. El modelo de agrupación espacial se definió integrando las densidades relativas de captura, la composición de la población y el patrón de uso del espacio obtenidos en cada río. Para valorar algunos aspectos relativos a las relaciones interespecíficas (cohabitación, exclusión, hibridación) de los visones europeos radio-seguidos frente a la nutria, el turón y el visón americano, se registró la presencia de ejemplares de estas especies en las zonas ocupadas por los visones europeos, mediante: a) captura (turón, visón americano e híbridos de visón europeo y turón) en los trampeos propios o en los desarrollados por la DFA, b) observación directa y c) detección de sus indicios de presencia (excrementos y pisadas en nutria; letrinas en visón americano y turón). El análisis de hipótesis estadísticas se realizó mediante contraste bilateral de igualdad de medias para dos subpoblaciones normales de varianzas desconocidas y distintas, con muestras pequeñas ($n_1+n_2<30$), a través del contraste t de Student para un nivel del 99% o muy significativo (α = 0,01) (Quesada et al. 1982, Spiegel 1991).

RESULTADOS

En el conjunto de las seis cuencas fluviales estudiadas han sido capturados a lo largo del periodo de estudio 80 ejemplares diferentes de visón europeo; los resultados de los trampeos (capturas/recapturas, densidad relativa y proporción de sexos) realizados en las seis cuencas fluviales se muestran en la TABLA 2. Mediante el radio-seguimiento se han obtenido 2.512 jornadas de localización efectiva de los 48 visones radio-seguidos (ε = 52,33 jornadas/ejemplar; rango= 3-287; SD= 61,58) a lo largo de 598 meses-visón de control (ε = 12,46 meses/ejemplar; rango= 0-34; SD= 8,63); las características principales del radio-seguimiento se muestran en la TABLA 3.

Densidad de población y distribución

Se han registrado notables diferencias en la densidad relativa de población obtenida en las distintas cuencas estudiadas. Las densidades más altas se dieron en los ríos Alegría-Salburúa (2000-01: 10 ej. capturados/10 km.), Najerilla (2001-02: 6,5 ej./10 km.) y Tirón (2002-03: 5,6 ej./10 km.); estos ríos han estado ocupados por visones europeos en toda su longitud.

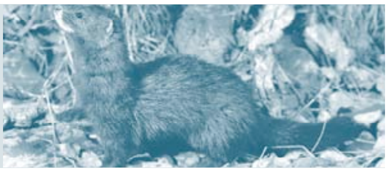
Densidades relativas mucho menores se obtuvieron en las cuencas de los ríos Ayuda (2001-02: 2,6 ej. capturados/10 km.), Ebro (2002: 2,4 ej./10 km.) y Oca (2002: 1,3 ej. /10 km.); estos ríos han contado con amplios tramos fluviales donde no se ha registrado la presencia de visones europeos.

Las densidades relativas obtenidas en los años posteriores, en los que fueron trampeadas exclusivamente las zonas con presencia previa de visones, fueron semejantes a las obtenidas en la primera temporada en los ríos Najerilla (2003: 6,5 ej. capturados/10 km.), Ebro (2003: 2,3 ej./10 km.) y Oca (2003: 1,1ej./10 km.), pero descendieron notablemente en la zona húmeda de Salburúa-río Alegría (2001-02: 4,6 ej./10 km. y 2002-03: 2,6 ej./10 km.) y en el río Ayuda (2003: 1,3 ej./10 km.).

Composición de la población y factores demográficos

De los 80 Visones Europeos colectados dentro del área de estudio, 43 fueron hembras (53,7 %) y 37 (46,3%) machos (relación de sexos= 1 macho : 1,2 hembras). El porcentaje medio de hembras por macho obtenido en las diferentes tandas de trampeo fue muy distinto de unos ríos a otros, variando entre 1,3-2,7 hembras/macho para las cuencas del Tirón, Najerilla y Alegría-Salburúa, y 0,5-1 hembras/macho para las del Oca, Ebro y Ayuda; el valor máximo registrado fue de 5 hembras/macho, en el río Najerilla. Se estimó que el 25 % del total de visones colectados pertenecían a la clase de edad subadultos en el momento de su primera captura (relación de edades= 1 subadulto / 4 adultos). De los 80 ejemplares capturados, 59 (73,8%) fueron recapturados dentro de las mismas áreas en una o más ocasiones (ε = 3,21; rango: 1-12; SD= 2,01) en un periodo de tiempo superior a 3 meses, siendo considerados ejemplares residentes. Se realizó un seguimiento con más de 6 meses de control y más de 20 días de localización con 31 ejemplares (64,6%, n= 48), correspondiendo con los visones residentes; los radio-seguimientos más cortos pudieron deberse al desplazamiento de los visones fuera del área de estudio (20,8%; n= 10), correspondiendo con ejemplares transeúntes o residentes temporales y, más raramente, a la muerte del visón (8,3%; n= 4). El nº medio de recapturas de los ejemplares radio-seguidos fue de 3,06 (rango= 1-12; SD= 2,53).

Se observó a 6 de las hembras radio-seguidas en compañía de cachorros pequeños (1,5-2 meses) con un tamaño medio de camada de 1,83 cachorros/hembra (rango= 1-4). Se detectó la muerte de 8 de los ejemplares radio-seguidos, lo que supone una tasa de mortalidad anual del 16,28%: 2 machos murieron por atropello en carreteras, 1 hembra por trampeo ilegal, 1 hembra por disparo y 4 hembras por causa desconocida no violenta (en el interior de la madriguera); además, otros 7 de los ejemplares no radio-implantados fueron localizados muertos dentro del área de estudio: una hembra murió por golpes, otra por enfermedad (neumonía) y 5 ejemplares (4 machos y 1 hembra) por atropello, lo que sugiere que esta causa de mortalidad no natural puede tener una incidencia importante sobre estas poblaciones.



Uso del espacio

Los visones europeos radio-seguidos presentaron un patrón de uso del espacio de tipo territorial y de carácter individual. Machos y hembras mantuvieron dominios vitales exclusivos, con pequeña superposición intrasexos: los machos solaparon sus áreas de campeo simultáneas con las de otros machos en un porcentaje medio del 13,04% (SD= 22,15; n= 25) y las hembras con sus congéneres en un 3,04% (SD= 5,79; n= 28). Las áreas de campeo de los machos fueron solapadas por las de las hembras en un 50,87% (SD= 30,20; n= 29) mientras que las de éstas fueron solapadas por las de aquellos en un 85,52% (SD= 31,09, n= 29), denotando una amplia superposición intersexual.

La longitud media de las áreas de campeo utilizadas por los machos (9,66 km.; SD= 4,87; n= 21) fue muy significativamente mayor (nivel 99%; α= 0,01) que la de las hembras (4,86 km., SD= 4,94; n= 25), de hecho, las áreas de los machos contienen con frecuencia a las de varias hembras; lo mismo sucede en el caso de su superficie, siendo de media 83,71 Ha para los machos (SD= 138,94) frente a 34,92 Ha (SD= 43,46) para las hembras. Los machos, usaron áreas de campeo de longitud muy significativamente menor en las cuencas en que se registró una elevada densidad relativa de capturas (río Najerilla y área húmeda de Salburúa-Río Alegría), con una media de 4,47 km. (SD= 2,04; n= 6), que en las cuencas con densidad baja (ríos Oca, Ebro y Ayuda), con una media de 11,7km. (SD= 4,05; n= 15); también las hembras de Salburúa-Alegría y del río Najerilla usaron tramos medios muy significativamente más cortos (2,22 km.; SD= 0,84; n= 12) que las de las cuencas del Ayuda, Ebro y Oca (5,15km.; SD= 2,73; n= 13). La superficie media utilizada por los visones fue muy significativamente mayor en los medios que disponen de hábitats 'superficiales' (Salburúa-Alegría, Ebro y Najerilla-La Grajera) frente a los ríos con hábitats más 'lineales' (Oca, Ayuda y Najerilla), tanto para los machos como para las hembras, siendo ésta de 151,36 Ha (SD= 165,02; n= 11) y 68,20 Ha (SD= 48,60; n= 10) en los primeros, frente a 9,30 Ha (SD= 3,82; n= 10) y 12,73 Ha (SD= 18,53; n= 15), en los segundos, respectivamente para machos y hembras.

Relaciones interespecíficas

No se ha registrado ningún caso de predación por parte de las nutrias sobre los ejemplares de visón europeo radio-seguidos. Los excrementos y huellas de pisadas de ejemplares de esta especie han sido observados de modo continuado durante todo el periodo de estudio en todas las zonas de presencia de los visones europeos.

Los datos de presencia de turón europeo en los ríos estudiados se limitan a la colecta en los trampeos de tres ejemplares macho. Precisamente en las zonas de captura de los turones (ríos Tirón, Najerilla y área húmeda de Salburúa) se colectaron simultáneamente tres animales macho con fenotipo (biometría, pelaje, coloración, etcétera) intermedio entre visón europeo y turón europeo; el estudio de sus ADN mitocondriales a través de la Facultad de Farmacia de la Universidad del País Vasco reveló que su ascendencia materna concordaba en los tres casos con visón europeo (B. Gómez com. pers.).

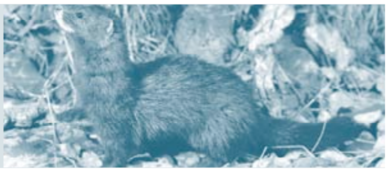
El visón americano estuvo presente en la cuenca del río Zadorra. En algunos sectores de su cuenca (ríos Alegría, Ayuda y Salburúa) y en la zona contigua a su desembocadura en el Ebro se registraron los primeros visones americanos precisamente durante los años 2001-2002. En estas zonas se realizaron capturas de ejemplares de esta especie invasora -seguidas de eutanasia- y se observaron sus características letrinas. En las campañas de control, desarrolladas en este área durante 2002-03 por parte de la DFA, se extrajeron 80 visones americanos (76,3% subadultos y 23,7% adultos), lo que supone una densidad relativa superior a las 12 capturas/10 km. Los 5 visones europeos (2 machos y 3 hembras) radio-seguidos en el área húmeda de Salburúa compartieron espacio con otros de visón americano durante todo el periodo de control (2001-2004): dentro de sus áreas de campeo se registraron observaciones reiteradas de varios ejemplares de visón americano y de sus indicios de actividad. Además, dentro de esta pequeña zona, se constató la reproducción del visón americano en los años 2002 y 2003, realizándose observaciones de grupos familiares y capturas de cachorros menores de 2 meses de edad. En el resto del área de estudio (ríos Oca, Tirón, Najerilla y la mayor parte del Ebro) no se ha registrado presencia de visón americano.

DISCUSIÓN

La monitorización de ejemplares mediante el empleo de emisores intraperitoneales se confirma como una metodología de interés para el estudio del visón europeo. El periodo de control de los visones radio-marcados y el número de recapturas obtenidos en el presente estudio resultan superiores a los conseguidos en estudios previos, en los que se usaron emisores montados en collares, a la par que la mortalidad registrada ha sido mucho menor. Palazón (1998) monitoriza 15 visones europeos consiguiendo una media de 17,7 días de seguimiento (rango: 1-77 días; SD: 22,70) con una tasa de mortalidad anual muy elevada del 686,1% (5 bajas en 266 días-

FOTO 3. Hembra de visón europeo (H- 106) monitorizada durante un periodo de 34 meses.

European mink female (H-106) radio-tracked for a 34-month period.



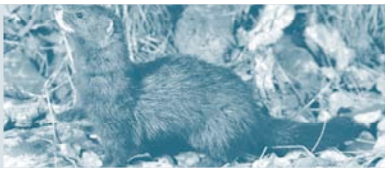
visón); Garín et al. (2001) efectúan el radio-seguimiento de 9 visones europeos con una media de aproximadamente 3,7 meses de seguimiento (rango: 0-9 meses; SD: 2,75) y una mortalidad superior al 73% (2 bajas en menos de 33 meses-visón). En ambos casos, y en especial en el primero, resulta patente que el empleo de collares metálicos distorsionó las poblaciones, tal y como observan los propios autores. En Francia se emplearon estos mismos collares emisores (Biotrack, Reino Unido) en el radio-seguimiento de visones europeos produciéndoles una elevada afección por rozaduras severas en el cuello que derivaron en mortalidad, lo que hizo a los autores abandonar su utilización y comenzar a usar emisores intraperitoneales (Fournier et al. 2001). En el presente estudio se han radio-seguido 48 visones europeos con emisores de disposición interna, consiguiéndose un seguimiento medio de 12,5 meses/visón (valor máximo: 34 meses; Figura 3) y una mortalidad anual del 16,3%. El porcentaje de ejemplares recapturados durante el primer periodo del estudio en los ríos cuya población de visones fue radio-seguida (29,3%, n= 41) resultó semejante al registrado en el río Tirón (28,6%, n= 14) donde no se implantaron emisores a los visones. En el mismo sentido, se observó que las densidades relativas obtenidas en las principales zonas de monitoreo tras la conclusión de las campañas de radio-seguimiento fueron similares a las registradas en la época previa.

En la mayoría de los estudios de radio-seguimiento realizados en visones (europeo y americano) la información obtenida procede de un pequeño número de ejemplares que ha sido controlado durante periodos de tiempo cortos (Maizeret 1990). En visón europeo, los escasos datos disponibles sobre tamaño de sus áreas de campeo sugieren unos requerimientos espaciales amplios, al menos para los machos, habiéndose obtenido en España longitudes medias de 7 km. en zonas mediterráneas del S de Navarra (Palazón 1998) y de 12,7 km. en ríos costeros de Vizcaya (Garín et al. 2001); su comportamiento social sería de tipo territorial con un solapamiento máximo registrado en las áreas de campeo de los machos del 3-10% (Garín et al. 2001). En Europa oriental, en ambientes de taiga, se han citado espacios vitales de 20-100 Ha (Novikov 1975) y áreas de campeo medias de 2,4 km. (Danilov y Tumanov 1976). Movimientos de gran alcance se han registrado en breves periodos de tiempo en ejemplares pertenecientes a poblaciones de Bielorusia distorsionadas por la presencia del visón americano (Sidorovich et al. 2000) o en proceso de extinción como las francesas de las Landas de Gascuña (Fournier et al. 2003). Los visones europeos estudiados el presente estudio en ríos submediterráneos del N de España han presentado una marcada territorialidad, manifestada a largo plazo (al menos, 1-3 años) e implicando a un porcentaje elevado de la población (65-74%); sin embargo, las amplitudes de las áreas de campeo registradas -y las densidades relativas- han sido muy variables de unas zonas a otras, sugiriendo la existencia en ellas de factores diferenciales. Mitchell (1961) encuentra una sobreabundancia de subadultos (80% de los capturados, n= 111) en una población de visón americano sometida a caza de Montana (EE.UU.), en la que se produjo una renovación total de efectivos en un periodo de 3 años. Gerel (1970) observa en Suecia áreas de campeo en visón americano de pequeño tamaño (medias de 2,6 y 1,8 km. respectivamente para machos y hembras) en zonas humanizadas, mientras Birks y Linn (1982) registran territorios más amplios en zonas no cazadas. Dunstone y Birks (1983) observan machos de visón americano netamente territoriales en medios costeros que incluyen en sus territorios a 1-2 hembras.

La realización por primera vez de una metodología sistematizada de trampeo, con la que se ha muestreado toda la red fluvial incluida en una extensa área de estudio, ha permitido obtener valores de densidad relativa (nº ej. capturados/10 km.) para el conjunto de varios ríos, mientras que el radio-seguimento de estos ejemplares aportó información sobre aspectos de su ecología. De este modo, se han observado dos patrones distintos de agregación espacial: 1) los sectores fluviales que registraron mayores densidades relativas de visón europeo (superiores a 5 ej. capturados/10km.) se localizaron en el curso bajo de los ríos de tamaño medio (Najerilla y Tirón) y en la única zona húmeda de cierta extensión existente en el área de estudio (Salburúa-Alegría). En estas zonas, todo el tramo fluvial está ocupado por ejemplares, sucediéndose encadenadamente los territorios de visones de ambos sexos. Los machos cuentan con varias hembras en su territorio (2-5), de modo que la densidad total está condicionada en parte por la presencia de un elevado porcentaje de hembras por macho. La longitud media de las áreas de campeo es significativamente menor que en el resto de sectores fluviales, denotando una mayor capacidad de carga del medio, lo que también contribuye a la existencia de mayores densidades. Por tanto, la presencia de poblaciones maduras hace que estas zonas reúnan buenas condiciones para la conservación del visón europeo. 2) En el tramo estudiado del río Ebro y en los ríos Ayuda y Oca, se han obtenido densidades relativas más bajas (menores de 3 ej. capturados/10 km). En ellas, sólo en algunos sectores se localizan visones, contando éstos con una ocupación completa del sector por parte de machos y la presencia discontinua de hembras; de modo que existen pocas (1-2) o ninguna hembra por cada macho. Las áreas de campeo observadas son significativamente más amplias que en los ríos anteriores. Estos aspectos denotan poblaciones más inestables e inmaduras y, por ello, estos medios resultan de peor calidad para el mantenimiento de la especie. Las causas de fondo que ejercen una influencia destacada en esta situación demográfica permanecen ocultas y han de ser estudiadas en detalle.

El porcentaje de ejemplares subadultos de visón europeo capturados en el área de estudio resulta en apariencia escaso para garantizar el mantenimiento de estas poblaciones; en el mismo sentido apunta el pequeño tamaño medio de camada observado en la muestra de hembras radio-seguidas. Sin embargo, la baja tasa de mortalidad obtenida en la muestra de ejemplares radio-seguidos hace viable el mantenimiento de esta población, si no es sometida a extracciones. Máxime, cuando muestra una importante proporción de ejemplares residentes que manifiestan una marcada territorialidad. Esta denso-dependencia permite ajustar el tamaño de población a los recursos disponibles en el medio, mientras que la relativamente amplia permanencia en el medio de los ejemplares territoriales hace que, con únicamente una pequeña incorporación anual de subadultos, la población pueda permanecerse estable. No se dispone de información sobre estos aspectos relativa a otras poblaciones de visón europeo, pero situaciones similares se han descrito en poblaciones no cazadas de visón americano (Gerell 1971, Maizeret 1990).

La convivencia en simpatría de nutrias y visones europeos, registrada en la zona de estudio de modo amplio y continuado, y la ausencia de predación de la primera sobre los segundos,



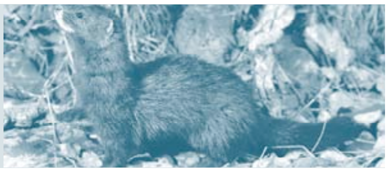
contradicen la supuesta segregación entre ambas especies sugerida por Palazón (1998). Situaciones similares se han registrado en Rusia y Bielorusia (Sidorovich 1997, Sidorovich y Macdonald 2001), donde la nutria ha sido siempre frecuente en las áreas de presencia del visón europeo, y aún lo es hoy en día.

La presencia de algunos machos de turón en zonas habidas por el visón europeo en las que se colectaron simultáneamente ejemplares de fenotipo mixto entre ambas especies, con ascendencia genética materna de visón, apoya la existencia de fenómenos de hibridación entre machos de turón y hembras de visón europeo, reforzando lo señalado por Ceña et al (2003) quienes citaron por primera este fenómeno en España. En Europa oriental la hibridación entre ambos ha sido citada en los países de la antigua U.R.S.S. y Finlandia (Maran y Henttonen 1995, Novikov 1939, Sidorovich 2001, Tumanov y Zerev 1986), siendo asociada a situaciones de declive en las poblaciones de visón europeo. Por otro lado, los motivos de la escasez del turón europeo en los ríos estudiados -se capturó 1 turón por cada 27 visones europeos- nos son desconocidos. Esta especie incluiría en su hábitat en España medios menos vinculado a los ecosistemas acuáticos que el visón europeo (Virgós 2002), si bien en el SO de Francia el turón es frecuente en los mismos ambientes que el visón europeo siendo colectado en mayor proporción que éste (Fournier-Chambrillón 2004).

Se conoce la presencia regular del visón europeo en la cuenca del río Zadorra desde mediados del siglo pasado (Puente Amestoy 1956), habiendo sido citado desde entonces frecuentemente, en especial en su tramo central. A comienzos de los años 90 se obtienen citas de visón americano en libertad en este río, procedentes de escapes producidos en pequeñas granjas locales; a mediados de los años 90, el visón americano constituye un núcleo estable en el Zadorra, centrado en el Municipio de Vitoria-Gasteiz, que entra en competencia con el visón europeo originando su casi completo desplazamiento hacia los años 2000-2001 (Ceña et al. 2003). Esta dinámica ha continuado en el transcurso del presente estudio, ya que la contigua zona húmeda de Salburúa y el río Ayuda han visto disminuir las densidades relativas de visón europeo obtenidas inicialmente (10 ej. capturados/10 km. en Salburúa en 2000-01 y 2,6 ej. /10 km. en el Ayuda en 2001-02) tras la llegada a estas zonas del visón americano en 2001-02 (Salburúa: 4,6 ej. /10 km. en 2001-02 y 2,6 ej. /10 km. en 2002-03; Ayuda: 1,3 ej./10 km. en 2003). En 2001, la DFA pone en marcha un programa de control del visón americano, mediante trampeo y posterior eutanasia de los ejemplares colectados. En estas campañas de trampeo intensivo se constató una fuerte expansión del visón americano, que ocupo gran parte de la cuenca del río Zadorra, a la par que se confirmó la casi completa desaparición del visón europeo en este curso fluvial, dada la práctica ausencia de capturas de la especie autóctona. La densidad relativa de capturas de visón americano obtenida en el Zadorra resultó el doble de la que hemos registrado en las mejores áreas de

presencia del visón europeo. Esta alta densidad, y la elevada proporción de subadultos obtenida, pueden estar en relación con el hecho de ser una población en expansión, aunque sometida a control. En una población sueca de esta especie, intensamente cazada, también se halló un elevado porcentajes de jóvenes (3:1), proporción que se redujo notablemente (1,2:1) por el efecto de la territorialidad, que hizo disminuir el nº de subadultos supernumerarios, cuando la caza cesó durante tres años (Gerell 1971). El elevado éxito reproductor y rápida capacidad de colonización del visón americano (Gerell 1967 y 1971), junto a su mayor tamaño corporal, estarían detrás de su capacidad para desplazar a la especie autóctona, utilizando la agresión directa, tal y como ha sido registrado en Bielorusia (Sidorovich 1991, Sidorovich et al. 1999, Sidorovich et al. 2000). La agresión directa del visón americano sobre el visón europeo fue observada repetidamente en experimentos realizados en cautividad (Maran et al. 1998). En este contexto, llama la atención que los ejemplares de visón europeo radio-seguidos en el área húmeda de Salburúa y río Alegría hayan compartido espacio con otros de visón americano durante todo el periodo de seguimiento: este fenómeno puede achacarse, por un lado, al éxito de las tareas de control de la especie invasora, que habría dificultado la formación de territorios estables en esta zona; por otro, a las características propias del medio palustre (hábitat superficial), pródigo en refugios. Este fenómeno de simpatría entre ambas especies no ha sido registrado en los cursos fluviales, donde las posibilidades de evitar enfrentamientos agresivos serían menores al ser medios con disposición lineal.

En lo que se refiere a implicaciones prácticas de conservación, cabe reseñar que un ligero incremento de la mortalidad -cuyas causas principales permanecen ocultas y que habría que investigar- puede hacer que estas poblaciones de visón europeo disminuyan rápidamente, mientras que su reducción (por ejemplo, eliminando los puntos en que se generan atropellos) podría incrementarlas en las zonas menos pobladas. Por otro lado, el patrón de uso del espacio observado, con disposición lineal y sucediéndose uno tras otro los amplios territorios de los diferentes ejemplares, facilita el progresivo aislamiento y la atomización de la población, haciéndola vulnerable ante la presencia de puntos de riesgo (carreteras, centrales hidroeléctricas, zonas humanizadas, puntos de trampeo ilegal); en sentido contrario, puede favorecer la creación de barreras artificiales, utilizables para su defensa ante los factores de amenaza (llegada de visón americano, afección de patologías, etcétera) que puedan afectar a las áreas de mayor interés. Así mismo, este patrón de uso del espacio condiciona el establecimiento de áreas protegidas específicas para la conservación de esta especie, ya que, la inclusión en ellas de un número significativo de animales ha de implicar a tramos fluviales muy amplios, de decenas o centenas de kilómetros de longitud, si se quiere incluir contingentes de población viables a corto plazo. Dado que la composición de la población de visón europeo y su reparto en el área de estudio no resultan homogéneos, presentando modelos de agregación espacial distintos, es evidente que los sectores más valiosos para constituir espacios protegidos son aquellos en los que se han registrado densidades relativas más altas, en los que las hembras son más abundantes y presentan pequeñas áreas de campeo (ríos Najerilla y Tirón, y la zona húmeda de Salburúa/Alegría), ya que en ellos se mantiene el grueso de la población reproduc-



tora. El deterioro que vienen padeciendo los pequeños ríos, canales y charcas, a través de su reducción (desecación) y homogeneización (canalizaciones, dragados, eliminación de la vegetación natural), está repercutiendo severamente en los medios más valiosos para la conservación de esta especie amenazada.

AGRADECIMIENTOS

Este estudio ha sido realizado en el marco de los Proyectos-LIFE Conservación del visón europeo en La Rioja (00NAT/E/7331), Álava (00NAT/E/7335) y Castilla y León (00NAT/E/7299), dirigidos por Luis Lopo (Gobierno de La Rioja), Joseba Carreras de Bergaretxe (Diputación Foral de Álava), Consuelo Temiño y Sara Brizuela (Junta de Castilla y León). En particular a ellos, y en general a todas aquellas personas (técnicos, naturalistas, veterinarios, agentes forestales, etcétera) y entidades que han participado en el proyecto o han facilitando su realización, queremos hacerles llegar nuestro agradecimiento.

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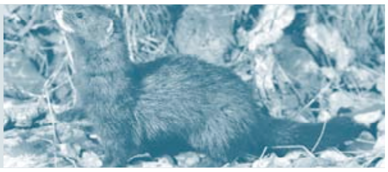

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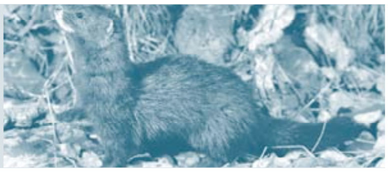


CUENCA	AÑO TRAMPEO	Nº TRAMPEOS[1]	LONGITUD muestreada[2]	ESFUERZO TRAMPEO TOTAL[3]	RELATIVO[4]
RÍO EBRO	2002	II	58 (70)	3.879	66,9
	2003	II	31 (50)	2.220	71,6
RÍO NAJERILLA	2001-2002	II	14 (17)	1.200	85,7
	2003	II	16 (17)	1.542	96,4
RÍO OCA	2002	II	40 (63)	2.773	69,3
	2003	I	15 (17)	537	35,8
RÍO ALEGRÍA-	2000-2001	II	7 (7)	560	80,0
SALBURÚA	2001-2002	II	15 (15)	1.146	76,4
	2002-2003	II	15 (15)	1.472	98,1
RÍO AYUDA	2001-2002	II	20 (23)	1.612	80,6
	2003	I	10 (15)	380	38,0
RÍO TIRÓN	2002-03	II	15 (25)	1.540	85,6

1) II: realización de dos trampeos (fases pre y posreproductora) completando un ciclo de captura/recaptura;
I: realización de un solo trampeo.
2) Número de km. de curso fluvial efectivamente trampeados (total km. cubiertos por el trampeo).
3) Número de jornadas-trampa realizadas, descontando las que permanecieron inactivas (máximo teórico 100 jt/km).
4) Jornadas-trampa/km. trampeado.

TABLA 1. Características de los trampeos sistematizados (estandarizados) para la captura de visón europeo realizados en seis ríos de la cuenca del Ebro.

Features of standardized trapping to capture the european mink in six rivers of the Ebro basin.

CUENCA FLUVIAL	AÑO TRAMPEO	EJEMPLARES CAPTURADOS[1] TOTAL	RECAPTURAS	DENSIDAD RELATIVA[2]	PROPORCIÓN DE SEXOS[3]
RÍO EBRO	2002	17 (6-11)	3 (1-2)	2,4	0,5
	2003	16 (5-11)	5 (1-4)	2,3	0,5
RÍO NAJERILLA	2001-2002	11 (8-3)	3 (1-2)	6,5	2,7
	2003	11 (7-4)	4 (3-1)	6,5	1,8
RÍO OCA	2002	8 (4-4)	3 (1-2)	1,3	1,0
	2003	1 (1-0)	1 (1-0)	1,1	0,8
RÍO ALEGRÍA-SALBURÚA	2000-2001	7 (4-3)	0	10,0	1,3
	2001-2002	7 (5-2)	2 (2-0)	4,6	2,5
	2002-2003	4 (2-2)	2 (1-1)	2,6	1,0
RÍO AYUDA	2001-2002	6 (2-4)	2 (2-0)	2,6	0,5
	2003	3 (1-2)	1 (0-1)	1,3	0,5
RÍO TIRÓN	2002-03	14 (9-5)	4 (1-3)	5,6	1,8

1) Nº total de visones europeos diferentes capturados en el periodo (nº de hembras y de machos) y número de recapturados (nº de hembras y de machos).
2) Ejemplares capturados/10 km. (hace referencia al conjunto de la cuenca).
3) Cociente hembras/machos.

TABLA 2. Resultados de los trampeos de visón europeo realizados en seis ríos del N de España.
Results of european mink trapping in six rivers in N Spain.

Ejemplar(1) Nº campaña	Características Seguimiento(2)	CUENCA FLUVIAL	CAPTURAS			RADIOLOCALIZACIONES		PERIODO CONTROL	ÁREA	
			Nº	PRIMERA	ÚLTIMA	ÚLTIMA	Nº Jornadas		Longitud(3)	Superficie(4)
Vi 116	1/2/A	Ayuda	[illegible]	[illegible]	[illegible]	[illegible]	41	11 meses	13,1	[illegible]
[illegible]	1/1/C	Ayuda	1	[illegible]		[illegible] ( )	3			
[illegible]	1/2/A	Ayuda	2	29.10.2001	11.11.2001	01.07.2002	[illegible]	10 meses	10,5	6
VH11[illegible]	1/2/C	Ayuda	1	01.03.2002		11.03.2002 ( )	3			
[illegible]	1/2/B	Ayuda	[illegible]	[illegible]	[illegible]	[illegible] (−)	15	[illegible]	[illegible]	[illegible]
[illegible]	1/2/A	Ayuda	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4
[illegible]	1/3/A	Ayuda	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Vi 115	1/2/A	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	1/2/A	[illegible]	[illegible]	[illegible]	03.12.2003	[illegible]	10	15 meses	[illegible]	[illegible]
[illegible]	1/2/A	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	52	[illegible]	[illegible]	[illegible]
[illegible]	1/2/C	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	7	[illegible]	[illegible]	[illegible]
[illegible]	1/2/A	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	41	11 meses	11,[illegible]	[illegible]
Vi 112	1/2/C	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	11	[illegible]	[illegible]	[illegible]
[illegible]	1/2/B	[illegible]	2	[illegible]	[illegible]	[illegible]	15	[illegible]	[illegible]	[illegible]
[illegible]	1/2/C	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	12	[illegible]	5,7	[illegible]
[illegible]	1/2/A	[illegible]	1	[illegible]	–	[illegible]	33	[illegible]	[illegible]	[illegible]
[illegible]	1/2/A	[illegible]	1	[illegible]		[illegible] (l)	33	[illegible]	[illegible]	[illegible]
[illegible]	1/2/B	[illegible]	2	[illegible]	[illegible]	[illegible]	17	12 meses	[illegible]	[illegible]
[illegible]	1/2/A	[illegible]	1	[illegible]		27.12.2002(l)	22	[illegible]	7,2	15
[illegible]	1/2/B	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	1/2/A	[illegible]	1	[illegible]	–	[illegible]	[illegible]	11 meses	[illegible]	[illegible]
[illegible]	1/3/A	[illegible]	1	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Vi 112	2/2/A	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
VH127	1/2/B	[illegible]	[illegible]	21.03.2002	[illegible]	10.03.2002	[illegible]	22 meses	[illegible]	[illegible]
[illegible]	1/2/A	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	1/2/C	[illegible]	1	[illegible]	–	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	1/2/A	[illegible]	1	[illegible]		[illegible] (l)	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	1/2/C	[illegible]	1	[illegible]		27.07.2003	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	1/2/A	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1,5	[illegible]
[illegible]	1/2/B	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	1/2/A	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	41	[illegible]	[illegible]	[illegible]
Vi 119	1/2/B	[illegible]	1	[illegible]		[illegible]	[illegible]	11 meses	[illegible]	[illegible]
[illegible]	1/2/A	[illegible]	1	[illegible]		[illegible]	102	12 meses	5,7	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	152	[illegible]	[illegible]	[illegible]
[illegible]	1/2/B	[illegible]	[illegible]	[illegible]	[illegible]	[illegible] (−)	[illegible]	[illegible]	1,5	[illegible]
[illegible]	1/2/A	[illegible]	1	[illegible]		[illegible] ( )	[illegible]	[illegible]	[illegible]	14
[illegible]	1/2/A	[illegible]	2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	12
[illegible]	1/2/A	[illegible]	5	[illegible]	[illegible]	27.07.2002	[illegible]	38 meses	[illegible]	[illegible]
[illegible]	1/3/C	[illegible]	1	[illegible]	–	[illegible]	[illegible]	[illegible]	[illegible]	7
[illegible]	1/3/A	[illegible]	1	[illegible]	–	[illegible]	130	11 meses	[illegible]	[illegible]
[illegible]	1/3/A	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	1/1/C	[illegible] (L.G.)	2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	287	38 meses	[illegible]	[illegible]
[illegible]	1/1/A	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	25 meses	[illegible]	[illegible]
[illegible]	1/2/A	[illegible]	5	[illegible]	[illegible]	[illegible]	51	24 meses	[illegible]	[illegible]
[illegible]	1/2/A	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1,[illegible]	144
[illegible]	1/3/A	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	197	[illegible]	1,2	[illegible]

[illegible]

TABLA 3. Características del seguimiento de 48 ejemplares de visón europeo (*Mustela lutreola*) provistos de emisores intraperitoneales.
Tracking features of 48 european mink (Mustela lutreola) individuals with intraperitoneal transmitters.

[Captive breeding of European mink *Mustela lutreola* (Linné, 1761) - effects of keeping methods and stress factors on the reproduction success]

REPRODUCCIÓN EN CAUTIVIDAD DEL VISÓN EUROPEO *Mustela Lutreola* (Linneo, 1761). EFECTOS DE LOS MÉTODOS DE MANTENIMIENTO Y FACTORES DE ESTRÉS EN EL ÉXITO REPRODUCTIVO.

RESUMEN

EuroNerz e. V. participa en el programa EEP para el visón europeo, con un stock de cría de unos 40 individuos. Para el presente estudio sobre los efectos de métodos de manejo y los factores de estrés en el éxito reproductor, se analizaron datos procedentes de la población alemana en cautividad. Aproximadamente, el 65 % de los machos y el 25 % de las hembras mantenidos hasta después de la madurez según el protocolo habitual no mostraron ningún comportamiento sexual. Con un método experimental (manteniendo la camada entera como un grupo más allá de la madurez) se consiguió aumentar el porcentaje de cópulas con éxito. Se redujo el éxito reproductor en hembras que presentaban ansiedad o resistencia durante el cortejo. Algunos factores potencialmente causantes de estrés no afectaron significativamente al tamaño medio de la camada. Sin embargo, hubo correlación positiva entre el número de factores estresantes y las cópulas no exitosas. Se concluye que el método experimental de manejo mejora la capacidad de comunicación para el apareamiento debido a una mejor socialización. El estrés parece causar un incremento en el número de fallos más que un descenso en el tamaño de la camada.

Palabras clave: Comportamiento, cría en cautividad, manejo, Mustela lutreola, estrés.

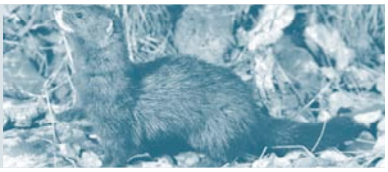
Running title:
[Effects on Mustela lutreola reproduction success]

W. Festl, C. Bodenstein and C. Seebass
EuroNerz e.V., Borgloher Str. 13, D-49176 Hilter a.T.W., Germany
E-mail: Christian.Seebass@euronerz.com

ABSTRACT

EuroNerz e. V. participates in the EEP program for the European mink with a breeding stock of about 40 individuals. For the present study on effects of keeping methods and stress factors on the reproduction success we analyzed data from the German captive population. About 65 % of the males and 25 % of the females kept after maturity according to the usual protocol did not show any sexual behaviour. With an experimental method (keeping whole litters as groups beyond maturity) we were able to increase the percentage of successful copulations. The reproduction success of females behaving resisting and/or anxiously during courtship was reduced. Some potentially stress-causing factors did not affect the mean litter size significantly. However there was a positive correlation between the numbers of stress factors and unsuccessful copulations. We conclude that our experimental keeping method improves the ability to communicate with sexual mates due to a better socialization. Stress seems to cause increased numbers of failures rather than decreased litter sizes.

Keywords: Behaviour, captive breeding, keeping, Mustela lutreola, stress



INTRODUCTION

The association EuroNerz e. V. is a member of the European Endangered Species Conservation Program (EEP) for the European mink Mustela lutreola (Linné, 1761) since 1998. It participates with a European mink breeding stock of about 40 individuals. The main aim of EuroNerz e. V. is to contribute to the ex situ-conservation of the European mink as well as to support reintroduction projects, e. g. by providing founder individuals. For breeding, we cooperate with zoos and wildlife parks. The mating is done centralized in a breeding centre. Afterwards, the pregnant females are lent to the keeping institutions, where they rear their litters. By the presentation of attractive European mink "families", the zoos and wildlife parks act as strong disseminators for information about this species. In addition, EuroNerz e. V. provides individuals of its breeding stock for ethological studies at the Dept. of Ethology (University of Osnabrück, Germany). In cooperation with Dr. E. Peters, among other topics the behaviour before and during the mating season and the effects of stress are studied. For the present article, own data sets regarding the methods and success of mating and keeping were analyzed.

The actually most important problem concerning the captive breeding of European minks is the low breeding efficiency within the EEP population (see Maran and Põlma 2003). This is due to a "hyper-aggressive" behaviour towards conspecifics, which occur in both males and females even when their physical condition indicates their readiness to mate. Such a behaviour might be fixed (mainly) on the genetic level. If so, the proportion of hyper-aggressive individuals should decrease markedly within some generations because of their low breeding efficiency. Nevertheless, to our observations there is no evidence of such a decrease. Therefore, in the present article we test an alternative hypothesis, that the method of keeping during the early ontogeny affects the development of social behaviour.

The second part of this study concerns potential effects of stress on the reproduction success. In comparison to other lutreola-facilities (E. G. Tallinn and Novosibirsk), in the EuroNerz e. V. breeding stock a proportionally high number of unsuccessful copulations and low mean litter sizes were observed (Maran and Põlma 2003). We tested the hypothesis that this is caused by several stress factors, which may have influence on our breeding stock during the mating season: (1) Experiences show, that females do not accept every male for copulation, even when both individuals seem to be ready for mating according to their physical and ethological condition. Recent studies gave evidence that this might be due to a female mate choice (Peters et al. 2003). This means, that the keeper is sometimes forced to offer more than one male to a female consecutively, which may cause stress for the latter. (2) Another problem may arise due to the additional handling for ethological studies before and during the mating season. (3) After mating, the pregnant females are partly lent to other facilities joined to the EuroNerz e. V. project. This transport during pregnancy may also act as a stress factor and may influence the breeding success.

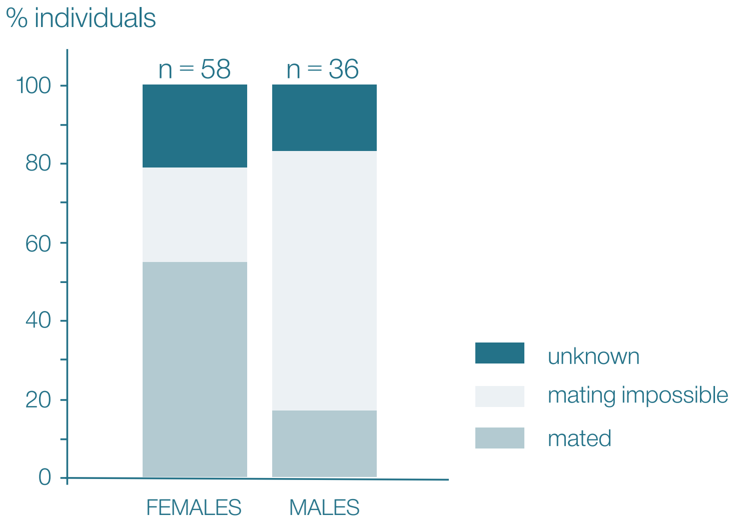


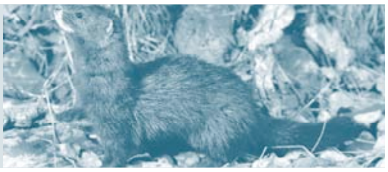
Figure 1: Results of mating attempts of European mink individuals, kept during early ontogeny according to the "usual protocol" (see text for explanations). Due to breeding constraints some individuals (considered as unknown) were not tested sufficiently for a characterization.

Figura 1: Resultado de los intentos de cópula de los individuos de visón europeo, mantenidos durante la ontogenia temprana según el "protocolo normal" (ver texto para explicaciones). Debido al comportamiento reproductor cohibido, algunos individuos (considerados como desconocidos) no se testaron suficientemente para la caracterización.

MATERIALS AND METHODS

The analyses for the present article were done with data from the EuroNerz e. V. breeding stock (EEP-member) and the breeding stock at the University of Osnabrück (Dept. of Ethology; not included in the EEP). In the mating seasons from 1997 to 2003, the following data were recorded: (1) the physical status and the behaviour of the individuals at every mating attempt checked by visual inspection, (2) the number and duration of copulations, (3) if possible the number of born cubs as well as (4) the number of weaned cubs at an age of 12 weeks. In addition, the total number and the different types of potential stress factors were recorded for the females (see chapter 1 for explanations). Only those factors were considered, which were acting on a given female at the day of its first copulation in a mating season or during its following pregnancy. Statistical analyses were done with the software STATISTICA® 5.5 (StatSoft Inc., Tulsa/USA, 1999).

Moreover, the method of keeping and separation of females and their litters after maturation of the latter was noted. Two different basic approaches were tested: (I) from 1997 to 1999, according to Maran and Robinson (1996) all cubs were separated after maturation when the family break-up was noticed by increased signs of stress and fighting behaviour. Afterwards, all individuals were kept in single enclosures. This procedure is subsequently named as "usual



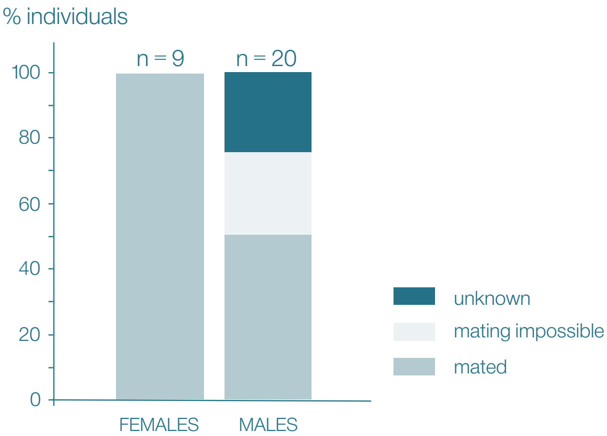


Figure 2: Results of mating attempts of European mink individuals, kept during early ontogeny according to the "experimental method" (see Fig. 1 and text for explanations).

Figura 2: Resultados de los intentos de cópula en los individuos de visón europeo mantenidos durante la ontogenia temprana según el "método experimental" (ver Fig. 1 y texto para explicaciones).

protocol". (II) In contrast, from 2000 to 2003 only the females were separated from their litters, when the cubs were about 11 weeks old. In this stage, normally no signs of stress and no fighting behaviour were observed. The cubs were furthermore kept together with their littermates as a group. Usually no problems occurred until late autumn or winter, when the subadults finally were separated to single enclosures. This new approach is subsequently named as "experimental method".

In order to assess the consequences of the keeping methods, the behaviour of the females throughout the mating attempts was observed and compared to the following reproduction success. For this, we formed 3 categories: (1) gentle behaviour, (2) anxious or resisting behaviour and (3) both anxious and resisting behaviour. Here, we use the term "anxious" for a defensive, fearful and disorientated behaviour. In contrast, the term "resisting" describes an aggressive or panicky behaviour.

RESULTS

Effects of the keeping methods

In the German captive European mink population, during 1997 to 1999 mating was impossible in a high proportion of individuals kept according to the "usual protocol". This was mostly because of a hyper-aggressive or (to a small extent) fearful behaviour (see Fig. 1). About 65 % of the males and 25 % of the females did not show any sexual behaviour during the mating season. This lack of sexual interest was observed although the physical signs showed their readiness to

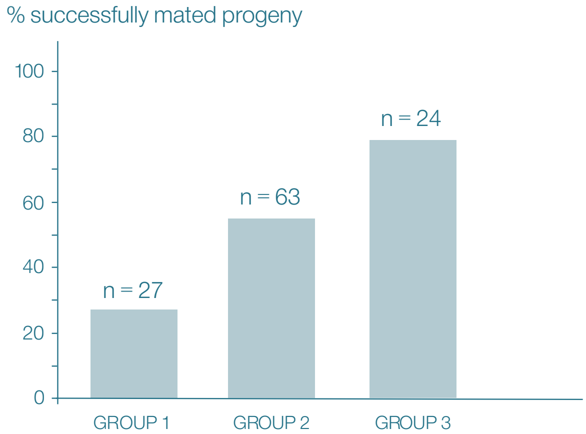


Fig. 3: Correlation between the maternal behaviour during mating attempts and the corresponding behaviour of their offspring: The progeny of gently behaving females behaves gently also to a higher proportion (group 1: 2 founder females, resisting behaviour; group 2: 3 founder females, gentle behaviour; group 3: females kept according to the "experimental method"). The differences between the 3 groups are highly significant (χ^2 = 13.73, FG = 3, $p < 0.001$).

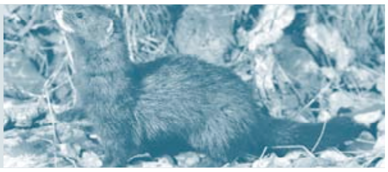
Fig. 3: Correlación entre el comportamiento maternal durante los intentos de cópula y el correspondiente comportamiento de su descendencia: La progenie de hembras con comportamiento tranquilo se comporta también de forma tranquila en una alta proporción (grupo 1: 2 hembras fundadoras, comportamiento resistente; grupo 2: 3 hembras fundadoras, comportamiento tranquilo; grupo 3: hembras mantenidas según el "método experimental"). Las diferencias entre los tres grupos son altamente significativas (χ^2 = 13,73, FG = 3, $p < 0{,}001$).

mate. Other females did show more or less severe defence during the mating attempts. Due to the fact, that experienced males finally were able to overcome their resistance and to enforce the copulation, these females are included in the ca. 55 % of successfully mated females in Fig. 1. Since the year 2000, we started with the "experimental method" of separation (see chapter 2). In their following mating seasons those individuals, which were treated in the experimental way, behaved in a striking peaceful manner towards sexual mates. This was true even in those cases, where the copulation was refused at last. Ten of fifteen tested males and all females were mated successfully (Fig. 2).

Moreover we got evidence, that also the progeny of a female, which was mated successfully without resistance, can be mated successfully to a higher proportion. This effect is most pronounced in the offspring of such dams, which were kept as sudadults according to the "experimental method" (Fig. 3).

Mating behaviour and reproduction success

If a male European mink show a hyper-aggressive or fearful behaviour, definitely no mating is possible. However, in the case of the females, a more detailed study on the consequences of their behaviour was possible. We found that anxious and/or resisting behaviour of the female during the courtship before mating results in a decreased percentage of successfully reared



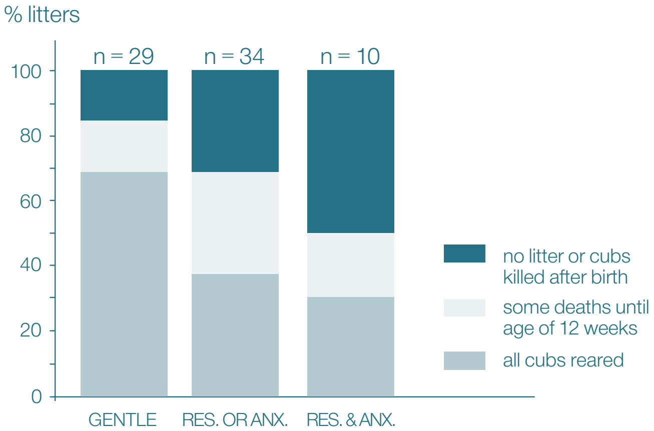


Figure 4: Correlation between the female behaviour during the courtship before mating and the reproduction success: the percentage of successfully reared litters without any losses decreases when the female behaves resisting (res.) and/or anxiously (anx.). For explanations concerning the behavioural categories see chapter 2.

Figura 4: Correlación entre el comportamiento de la hembra durante el cortejo antes de la cópula y el éxito de la reproducción: el porcentaje de camadas criadas de forma exitosa sin ninguna pérdida decrece cuando la hembra muestra resistencia (res.) y/o ansiedad (anx.). Para explicaciones sobre las categorías de comportamiento ver capítulo 2.

litters (see Fig. 4). A similar correlation was found regarding the mean number of reared cubs per litter (Fig. 5). These marked effects were found only for the courtship behaviour. Neither the female behaviour during the copulation itself nor the duration of the copulations seemed to have significant effects on the reproduction success.

Potential stress factors and reproduction success

We analyzed the effects of potential stress factors on the reproduction success. For Fig. 6, only those copulations were considered, which resulted in the birth of cubs. Concerning the transport of pregnant females to other facilities, we found no significant differences in the mean litter size (t-test: $p = 0.75$; Fig. 6a). The same was true, if the structure and/or the size of the enclosures were taken into account (data not shown). From 2001 to 2003, several behavioural studies were conducted during the mating seasons. Also this additional handling did not affect the mean litter size significantly (t-test: $p = 0.76$; Fig. 6b). Despite of a slight tendency, the same applies for the potential effect of several consecutive mating attempts with different males (t-test: $p = 0.09$; Fig. 6c).

Multiple effects can be expected, if more than one factor is acting on a given individual. In our case, no female was exposed to more than 2 potential stress factors at the same mating season. With slight tendency but no statistical significance, this led to a lowered mean litter size (Anova: FG = 3.57, F = 0.62; $p = 0.6$, Fig. 6d).

In contrast to the previous figure, Fig. 7 takes into account only those copulations, which resulted in no litter. It is obvious, that with increasing numbers of potential stress factors there was a marked increase in the number of copulations without any reproduction success.

CONCLUSIONS

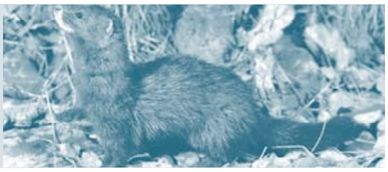
The captive breeding program for the European mink is affected by a high number of non-breeding individuals. If a male behaves hyper-aggressive, no mating will occur. For the resisting or anxiously behaving females, our results show that enforced copulations are leading to a reduced reproduction success. In addition, the behaviour of a given female seems also to influence the behaviour and therefore the reproduction success of its offspring.

We conclude, that our data verify the hypothesis that the method of keeping during the early ontogeny affects the development of social behaviour. We suggest that the hyper-aggressive behaviour may be to a minor part a problem of genetics. But mainly, the social behaviour of an European mink individual in captivity seems to be influenced (1) by the behaviour of its mother and (2) by the method of being kept after maturity. While being kept according to the "experimental method" social interactions between the litter mates seem to lead to some kind of socialization. This enables the individual to communicate with sexual mates and other conspecifics and prevent the occurrence of excessive fear or aggression. Our results are confirmed by recent observations, that wild-caught European mink males do breed more effective and show lower levels of aggressiveness than captive born ones (Maran and Põlma 2003, Põlma and Maran 2003).

As a second hypothesis we assumed, that the low mean litter size in the German captive European mink population is caused by several stress factors. Concerning this topic, our results are more differentiated. Apart from some tendencies (see Fig. 6) no significant effects on the mean litter size were found. It should be noted, that the potential stress factors considered here seem to be powerful ones and that during the centralized mating all individuals were kept under comparable conditions. On the other hand, there was a marked increase in the numbers of copulations which resulted in no success at all. We assume that stress affects the breeding success by increased numbers of failures ("get all or nothing") rather than by decreased litter sizes. This means, increasing stress would finally exceed an individually fixed "critical threshold".

ACKNOWLEDGEMENTS

The authors are grateful to Dr. E. Peters and Professor Dr. R. Schröpfer (Dept. of Ethology; University of Osnabrück, Germany) and the zoos and wildlife parks, participating in the EuroNerz e. V. project, for their cooperation and the allowance to collect data concerning the reproduction biology in their lutreola-facilities.



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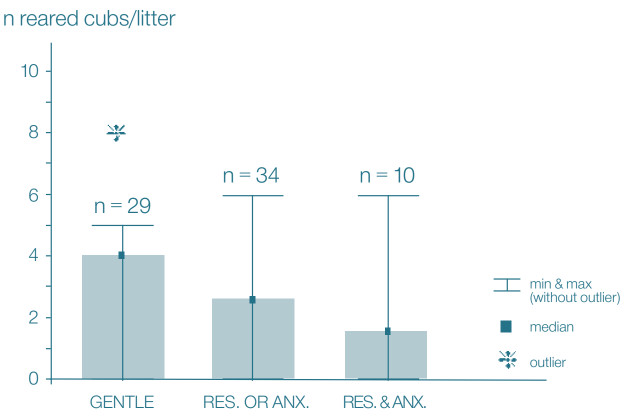


Fig. 5: Correlation between the female behaviour during the courtship before mating and the mean number of reared cubs (measured at an age of 12 weeks): mean number decreases when the female behaves resisting (res.) and/or anxiously (anx.). For explanations concerning the behavioural categories, see chapter 2.

Fig. 5: Correlación entre el comportamiento de la hembra durante el cortejo antes de la cópula y el número medio de cachorros criados (valorados a la edad de 12 semanas): la media del número decrece cuando la hembra muestra resistencia (res.) y/o ansiedad (anx.). Para explicaciones sobre las categorías de comportamiento ver capítulo 2.

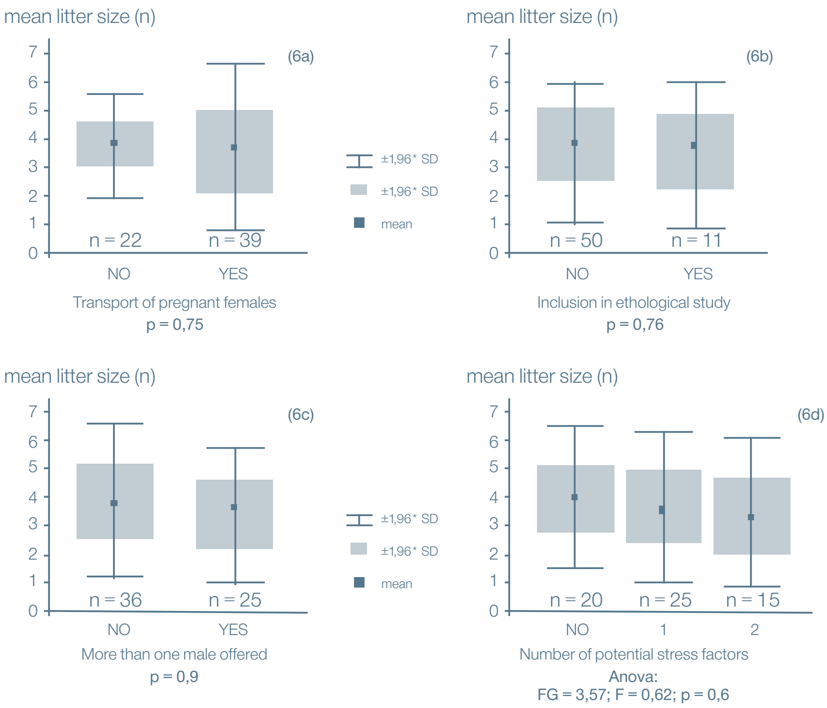
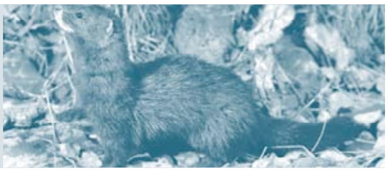


Figure 6: Effects of several potential stress factors on the mean litter size. Apart from slight tendencies (see Fig. 6c and d), no significant influences were found. Only those pairings were included, which resulted in the birth of cubs. Potential stress factors were considered only when present at the day of the first copulation in a mating season or during the following pregnancy. For legend, see Fig. 6a.

Figura 6: Efectos de algunos factores potenciales de estrés sobre el tamaño medio de la camada. A parte de ligeras tendencias (ver Fig. 6c y d), no se detectaron influencias significativas. Sólo fueron incluidos los apareamientos con resultado de nacimiento de crías. Factores potenciales de estrés fueron considerados sólo cuando estuvieron presentes en el día de la primera cópula en la época de reproducción o durante la siguiente gestación. Para la leyenda, ver Fig. 6a.



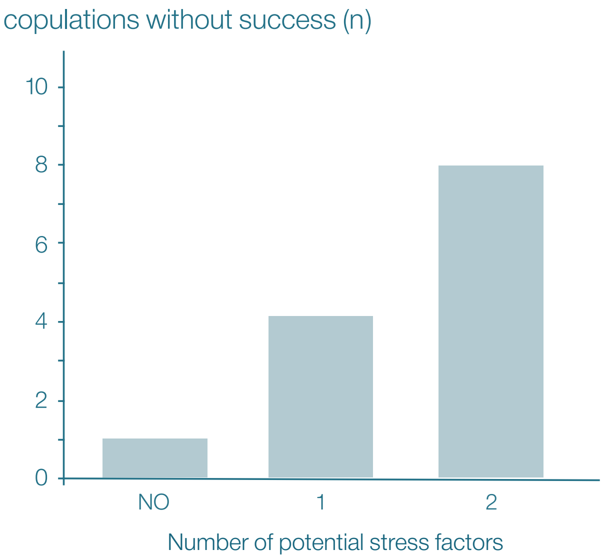


Figure 7: Effects of increasing numbers of potential stress factors on the copulation success. Only those copulations without any success were included here (for comparison see Fig. 6). Potential stress factors were considered only when present at the day of the first copulation in a mating season.

Figura 7: Efectos del incremento del número de factores potenciales de estrés en el éxito de las cópulas. Sólo se incluyeron aquí las cópulas sin éxito (para comparaciones, ver Fig. 6). Factores potenciales de estrés fueron considerados sólo cuando estuvieron presentes en el día de la primera cópula en la época de reproducción.

[Status and conservation of the European mink (*Mustela lutreola*) in France]

ESTADO Y CONSERVACIÓN DEL VISÓN EUROPEO (*Mustela Lutreola*) EN FRANCIA

RESUMEN

Al principio del siglo XX, el visón europeo (Mustela lutreola, Linnaeus 1761) era citado en Francia en 47 departamentos, aunque actualmente solo se halla presente en siete de ellos. Además, los últimos resultados del seguimiento de la población muestran que amplias zonas vacías han aparecido dendro de su área de distribución. Históricamente, la regresión de la especie fue sobre todo debida a un intensivo trampeo y a la destrucción de los hábitats. La ley francesa protege al visón europeo desde 1972, pero nuevos factores de regresión han aparecido: mortalidad por colisión con vehículos, envenenaniento secundario por raticidas anticoagulantes, capturas no intencionadas durante las operaciones de control de animales dañinos, expansión del visón americano (Mustela vison, Schreber 1777). Además, se ha encontrado que 12,2% de los animales son positivos para los anticuerpos del virus de la enfermedad Aleutiana y esta patología puede contribuir al declive de la población. En 1999, un plan de conservación fue aprobado, aunque los resultados concretos son pobres por el momento. Es urgente acelerar su establecimiento porque la población francesa de visón europeo parece a punto de desaparecer.

Palabras clave: conservación, distribución, Francia, evolución histórica, Mustela lutreola, mortalidad, regresión, visón europeo.

Running title: [Conservation of French European mink]

P. Fournier[1 and 2] and C. Maizeret[3]

[1]SFEPM, Mission Vison d'Europe, Route de Préchac, F-33730 Villandraut

[2]GREGE, Route de Préchac, F-33730 Villandraut, e-mail : pfournier@wanadoo.fr

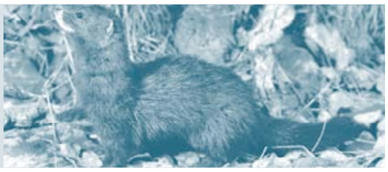
[3]Conseil Général des Landes, Impasse Montrevel, F-40025 Mont de Marsan cedex.

Pascal Fournier
Grece, Route de Préchac, F-33730 Villandraut, France
E-mail: pfournier@wanadoo.fr

SUMMARY

By the turn of the 20th century the European mink (Mustela lutreola, Linnaeus 1761) was quoted in France in 47 departments but it is now only present in 7 of them. Moreover, the lasts results of the survey of the population show that wide gaps recently appeared inside the current range. Historically the regression of the species was mainly due to extensive trapping and habitats destruction. The European mink is legally protected since 1972 but new regression factors appeared: road mortality, secondary poisoning by anticoagulants used in rodents control, accidental trappings during pest control operations, extension of the American mink (Mustela vison, Schreber 1777). Furthermore it has been showed that 12.2% of the animals are seropositives for antibodies to the Aleutian disease virus and this pathology could contribute to the decline of the population. In 1999 a conservation action plan was launched but its effects are long time coming. It is urgent to accelerate its implementation because the population seems to be on the verge of extinction.

Key words: Conservation, distribution, European mink, France, historical evolution, Mustela lutreola, mortality, regression.



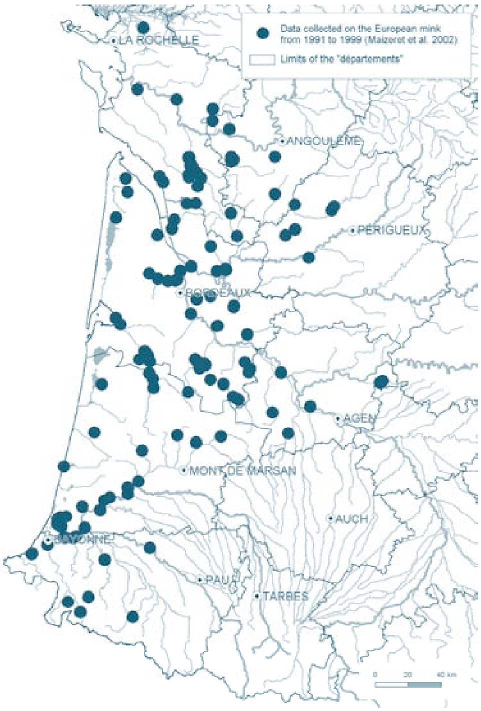


Figure 1: Data collected on the European mink distribution in France from 1991 to 1999 (Maizeret et al. 2002).

Figura 1. Datos recogidos sobre la distribución del visón europeo en Francia desde 1991 hasta 1999 (Maizeret et al. 2002).

EVOLUTION OF THE DISTRIBUTION

At the turn of the 20th century, the European mink (*Mustela lutreola*, Linnaeus 1761) was spreading over 47 departments in France and it was considered as fairly common in all the Western part of the country (de Bellefroid and Rosoux 1998). In the fifties, it had already disappeared from a great part of this range and was only present in 17 départements, all located in the West and South-West. From 1991 to 1999, a national trapping survey supported by the French Ministry of Environment (Maizeret et al. 2002) revealed that the species was only present in 7 departments of Southwestern France (Figure 1).

The survey of the population is still ongoing and, since the last four years, the trapping network collected 278 data from 173 different animals (Fournier et al. 2003). The last results (Figure 2) show that the range of the European mink should not continue to regress drastically but wide gaps appeared inside this range. In particular no animal has been trapped in the

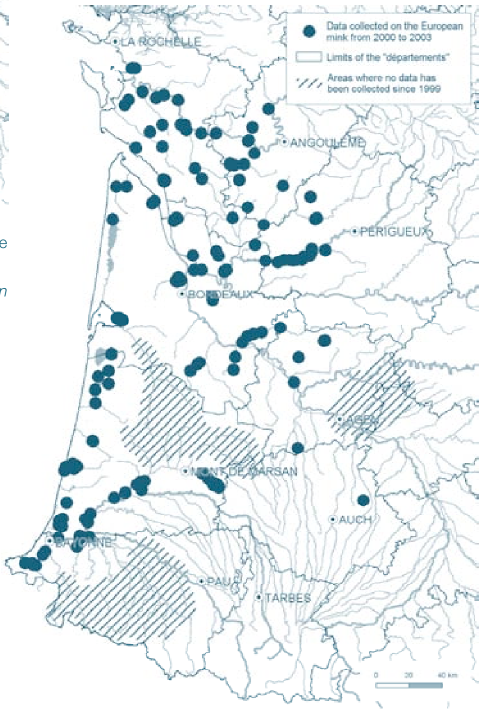


Figure 2: Data collected on the European mink distribution in France from 2000 to 2003.

Figura 2. Datos recogidos sobre la distribución del visón europeo en Francia desde 2000 hasta 2003.

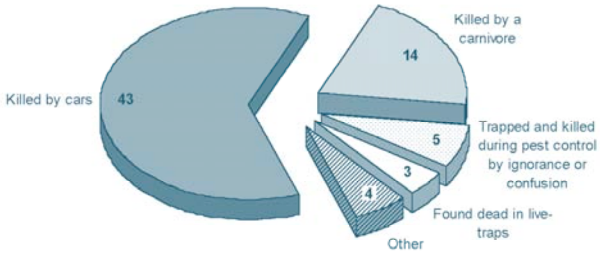


Figure 3: Causes of mortality of 69 European minks collected in France since 1990.

Figura 3. Causas de mortalidad de 69 visones europeos recogidos en Francia desde 1990.

central and eastern parts of the Landes de Gascogne region. This wide forest scattered with marshes was until recently considered as the bastion of the European mink in France. The population seems thus to be affected by an ongoing fragmentation process and it is presently impossible to know if the population units are still interconnected. Several economic axes as the Garonne or the Adour valleys cross the present distribution area and they probably contribute to accelerate the fragmentation process.

CAUSES OF REGRESSION

The historical reasons of the regression of the species are fairly obvious: since the mid of the 19th century to the second half of the 20th century, the European mink has been extensively trapped in France, for fur trading as well as to prevent damages on poultry or game wildlife. During the same time, half of the French wetlands were drained for agricultural purpose and the water quality drastically declined. The species is legally protected since 1972 and the wetland destructions have been significantly reduced. Water pollution is also decreasing, even though too slowly in most of the regions. In spite of this the European mink is still declining.

A recent study on the causes of mortality of 69 animals collected since 1990 (Fournier-Chambrillon et al. 2003) has shown that 62 % of them had been killed by cars, 20 % by carnivores and 7% by pest trappers (Figure 3). Because of obvious sampling biases, these figures cannot report the real causes of mortality of the whole population but they point out the importance of extra-mortality on a population already threatened.

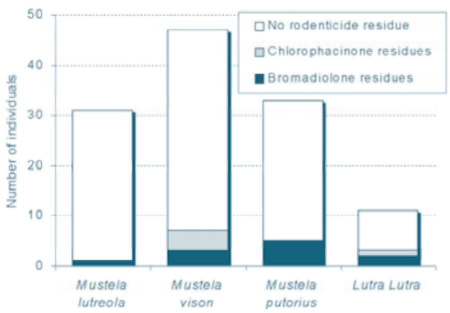
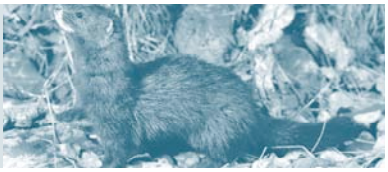


Figure 4: Results of analysis of anticoagulants rodenticides in four mustelids from south-western France.

Figura 4. Resultados de las análisis de rodenticidas anticoagulantes sobre cuatro especies de mustélidos del Suroeste de Francia.



Secondary poisoning during control campaigns of rodents using anticoagulants is probably another cause of extra-mortality (Figure 4). These campaigns concern huge areas in southwest of France and hundreds of metric tons of poisoned baits are unloaded each year in marshes and along rivers. We recently showed that 13% of the riparian mustelids found dead in nature or killed during pest control had been exposed to second poisoning by anticoagulant rodenticide (Fournier-Chambrillon et al. 2004b). In 2002 the French government banned the use of anticoagulant in agricultural pest control but a few weeks later a new government re-established this use.

Accidental trapping seems to be another cause of mortality. Trapping of carnivores and coypus (*Myocastor coypu*, Molina 1782) is a "traditional" activity in most of the French regions and several impacts on the European mink have been identified: 1) The European mink is sometimes confused with polecats (*Mustela putorius*, Linneus 1758) or American minks (*Mustela vison*, Schreber 1777), which are both on the French list of pest species: 7 % of the animals autopsied had been killed during pest control operations; 2) Accidental captures in live-trap during coypus control occur regularly and they represent 39% of our data of the distribution on the European mink. They have probably a severe impact when a female is trapped during the breast-feeding period because the traps are controlled only once a day and the survival of the litter may be compromise. The solution is easy: making a hole of 5x5 cm in the trap enables the European mink to escape and it does not affect the trapping success; 3) A lot of pest trappers use kill traps such as conibears. These traps can be released just by a contact with the bait and they are extensively used along watercourses and inside marshes were coypus are very abundant. Accidental trappings of protected species are rarely reported but there is no doubt that European minks are regularly killed during trapping control of coypus. Contacts have been initiated with associations of trappers and some of them seem to be willing to replace kill traps by live traps. However, they cannot fund the replacing of all their traps and they are asking for a financial support. This will need extensive funding because they are thousands of trappers and, as long as they will not exchange all their traps, they will use them.

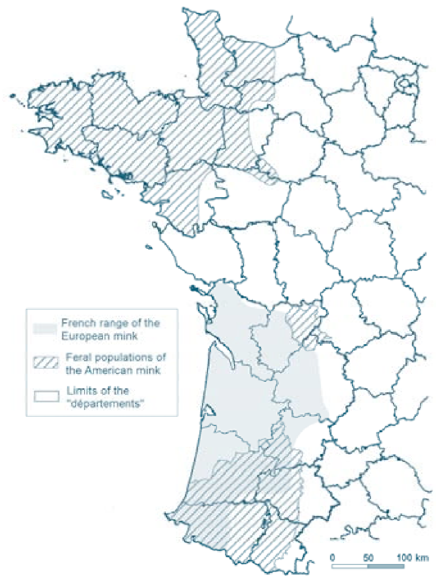


Figure 5: Distribution of feral American mink populations in France

Figura 5. Distribución de las poblaciones asilvestradas de visón americano en Francia

Feral American mink populations (Léger and Fournier 2001) are present in several regions of France (Figure 5). They cannot be the main

cause of the disappearing of the European mink because its decline started long before the introduction of the American mink. The European mink is also declining in the parts of its range where the American mink is absent. However, the American mink now expands very quickly and is a real threat for the European mink. A program has been initiated with the objective of eradicating the species almost in the range area of the European mink (Barrault et al. 2003). Trapped animals are surgically sterilised before release in order to prevent occupation of their territories by individuals coming from the surroundings. This method also allows a survey of the population by capture-recapture and prevents the trappers' loss of motivation when captures become less frequent. In 2001-2002 this program was tested in a small part of the range of the southern population of the American mink. Simulated by very good results, it has been extended to a larger area in 2002-2003 and, in 2003-2004, it will cover the main part of the population area.

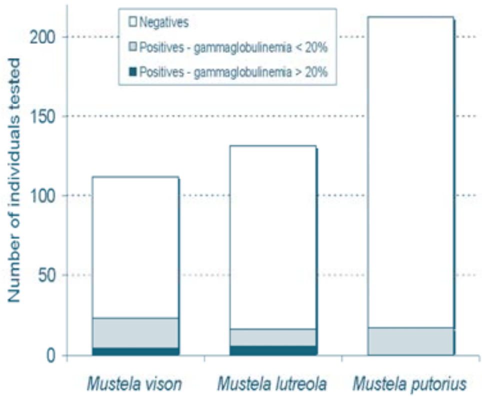


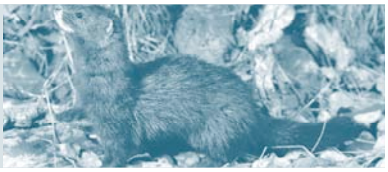
Figure 6: Occurrence of seropositive animals for antibodies to Aleutian disease virus in American mink, European mink and Polecat from France.

Figura 6. Frecuencia de animales positivos para los anticuerpos del virus de la enfermedad Aleutiana en el visón americano, el visón europeo y el turón en Francia.

A serologic survey of the Aleutian disease conducted in southwestern France (Fournier-Chambrillon et al. 2004a) showed that a lot of carnivores are seropositives for antibodies to the virus and that the American mink represents a major source of the virus with 20% of positive animals. It also showed that 12,2% of the European minks were positive, one third with a gamma globulin level over 20% (Figure 6), suggesting that the virus strain present in nature is potentially pathogenic for the species. The precise effects of this pathology on the European mink are not known but it could contribute to the decline of the population in different ways.

CONSERVATION PROGRAM

All these actions are conducted in the frame of the conservation action plan launched by the French Ministry of Environment in 1999. This plan also includes a press campaign for public awareness and a training program for wetland and river managers. A brochure gathering suitable management instructions and techniques is being edited and will be widely circulated in all the bodies and administrations involved in land management. This brochure includes four parts: 1) conservation and management of wetlands; 2) river management; 3) pest control; 4) road management.



The techniques of habitat conservation and reduction of extra mortality are currently being tested on three hydrographical systems. The first step is a survey to evaluate the different regression factors faced by the European mink locally: 1) we roughly analyse the quality of the habitats and we locate the places where there are conservation problems (lowering of the water level in marshes, intensive exploitation of flooded woodlands, excessive river bank management, strong water pollution, ...); 2) we census the districts where there are local poisoning operations of rodents; 3) we census also the trappers using kill traps; 4) we examine all the places where roads are crossing rivers and wetlands hosting European minks. We analyse the technical characteristics of the bridges to see if the animals can be forced to cross the road instead of passing underneath. We reckon that the higher is the traffic, the higher is the risk for the mink.

When this survey is completed, we meet the owners and the users of the places where problems have been identified and also the local authorities in charge of land management. We inform them of the necessity of conserving the European mink and try to find solutions to ensure the long-term conservation of the species. If necessary, we participate in the search of funding.

Most of the hydrographical systems of the European mink presence area are proposed to be integrated into the Nature 2000 network and the environment authorities started to choose local operators to establish conservation programs. We can rely on these operators because their role is precisely to implement conservation measures for species of Community interest including the European mink. Our role is thus to advise them for considering the species in their management plans.

The experiments of the method of conserving habitats and reducing extra mortality must be completed by the beginning of 2004. We are going to assess the efficiency of the proposed measures and we will progressively implement similar programs over the other hydrographical systems of the range of the European mink.

CONCLUSION

In spite of these efforts, the future of the European mink in France remains very dark. A lot of time has been lost and the effects of the conservation program are long time coming: restoration of habitats is just beginning, rodents are still legally poisoned with anticoagulants, kill traps are still widely used and the eradication of the American mink might take several years. As the European mink is still declining, it is now urgent to accelerate the implementation of the conservation plan. If effective measures are not implemented all over the range in the next few years, it will probably be too late.

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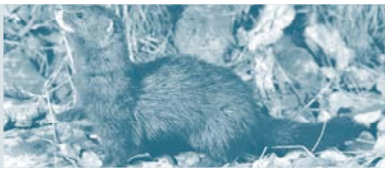
ACKNOWLEDGEMENTS

These studies were funded by the Ministère de l'Ecologie et du Développement Durable/DIREN Aquitaine, the Conseil Régional d'Aquitaine, the European Union, the Conseil Général du Gers, and the Office National de la Chasse et de la Faune Sauvage (SAGIR network: wildlife disease surveillance network).

We would like to thank the European mink networks (1991-1999 and 2000-2003), composed of: Association Curuma ; A.I. 17 ; Associations Départementales des Piégeurs Agréés de Charente, de Charente-Maritime, de Dordogne, du Gers, de Gironde, de Lot-et-Garonne, et des Pays de l'Adour ; Association pour la Défense de l'Environnement en Vendée ; Centre de découverte de la Trave ; Centre de Formation Permanente Pour Adultes de Coulounieix-Chamiers ; Centres Permanents d'Initiative à l'Environnement de Saint-Martin-de-Seignanx et du Périgord ; Charente Nature ; Cistude Nature ; Communauté de communes de Haute-Saintonge ; Conseils Généraux de Dordogne, du Gers, de Gironde, et des Landes ; Conservatoires Régionaux des Espaces Naturels d'Aquitaine et de Poitou-Charentes ; Direction Départementale de l'Agriculture et la Forêt des Pyrénées-Atlantiques ; Epidor ;



Erminea ; Espaces Naturels d'Aquitaine ; Fédérations Départementales des Chasseurs de Charente, de Charente-Maritime, des Côtes d'Armor, des Deux-Sèvres, de Dordogne, du Finistère, du Gers, de Gironde, d'Ile et Vilaine, des Landes, de Loire-Atlantique, de Lot-et-Garonne, du Morbihan, des Pyrénées-Atlantiques, des Hautes-Pyrénées et de Vendée ; Fédérations Départementales de Lutte contre les Organismes Nuisibles de Charente, de Dordogne et de Gironde ; Groupe Mammalogique Breton ; Groupe Mammalogique Normand ; Groupe de Recherche et d'Etude pour la Gestion de l'Environnement ; Institut d'Ecologie et de Gestion de la Biodiversité ; Institut de Recherche sur les Grands Mammifères ; Jalle Rivière Propre ; Ligue pour la Protection des Oiseaux ; Lycée d'Enseignement Général Agricole et Technique de Bazas ; Mairie de Biscarosse ; Maison d'Initiation à la Faune et aux Espaces Naturels ; Muséum d'Histoire Naturelle de la Rochelle ; Nature Environnement 17 ; Observatoire du Patrimoine Naturel des Pyrénées Atlantiques ; Office National de la Chasse et de la Faune Sauvage ; Orgambideska Col Libre ; Piégeurs agréés des Landes ; Parc National des Pyrénées ; Parcs Naturels Régionaux d'Armorique, de la Brenne, du Cotentin et du Bessin, des Landes de Gascogne, du Marais Poitevin, des Pyrénées Occidentales, et du Périgord-Limousin ; Réserves Naturelles de Bruges, du Courant d'Huchet, de l'Etang de la Mazière, de l'Etang Noir, des Marais d'Orx et de Saucats-La Brède ; Services départementaux de l'Office National de la Chasse et de la Faune Sauvage de Charente, de Charente-Maritime, de Dordogne, du Gers, de Gironde , des Landes, de Lot-et-Garonne, et des Pyrénées-Atlantiques ; Société Française pour l'Etude et la Protection des Mammifères ; Société pour l'Etude, la Protection et l'Aménagement de la Nature dans le Sud-Ouest ; Société pour l'Etude, la Protection et l'Aménagement de la Nature dans le Lot-et-Garonne ; Syndicat Intercommunal du Bassin Versant de la Livenne ; Syndicat Mixte d'Etude et d'Aménagement du Pays des cantons de Ribérac-Verteillac-Montagrier ; Syndicat Mixte d'Etude et Travaux pour l'Aménagement et l'Entretien du Bassin de l'Isle ; Syndicat Intercommunal d'Aménagement Hydraulique de la Tude.

We would like to thank the "American mink network" composed of: Association Départementale des Piégeurs Agréés de Lot-et-Garonne ; Conseils Généraux du Gers et des Landes ; Espaces Naturel d'Aquitaine ; Fédérations Départementales des Chasseurs du Gers et des Landes ; Maison d'Initiation à la Faune et aux Espaces Naturels ; Services départementaux de l'Office National de la Chasse et de la Faune Sauvage ; Parc National des Pyrénées ; Réserves Naturelles du Courant d'Huchet, de l'étang de la Mazière, des Marais d'Orx et de l'étang de Noir ; Société pour l'Etude, la Protection et l'Aménagement de la Nature dans le Lot-et-Garonne.

The survey of the feral American mink populations of France in 1999 was conducted by François Léger from the Office National de la Chasse et de la Faune Sauvage.

We thank Stéphane Aulagnier for the review of this text.

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[The European mink in the Romanian Danube Delta and adjacent lagoon complexes: distribution, status and conservation priorities]

EL VISÓN EUROPEO EN EL DELTA DEL DANUBIO RUMANO Y EL COMPLEJO DE LAGUNAS ADYACENTES: DISTRIBUCIÓN, ESTADO Y PRIORIDADES DE CONSERVACIÓN.

RESUMEN

El Delta del Danubio es una de las pocas áreas en el mundo en las que aún se encuentra visón europeo. La existencia de dos cráneos de visón americano, encontrados en el Delta a finales de los años 90, hacían necesario un estudio de trampeo de visones en vivo, para esclarecer la distribución y el status de ambas especies. Desde el 23 de febrero hasta el 11 de abril de 2003, se realizó un estudio de trampeo en vivo en nueve áreas diferentes de la rumana Reserva de la Biosfera del Delta del Danubio. Durante las 961 noches de trampeo se capturaron un total de 28 visones europeos, pero ningún visón americano. Se encontró visón europeo en todos los principales tipos de hábitats del delta, así como en el complejo lagunar del Sur. Sin embargo, la evidencia fue clara al constatar que el visón americano, considerado una seria amenaza para M. lutreola, habita en una parte del Delta Ucraniano del Danubio. El control de la densidad a través de trampeo se considera una herramienta de conservación para prevenir la inmigración de M. vison en otras partes del delta.

Palabras clave: conservación, Delta del Danubio, distribución, Mustela lutreola, Mustela vison, Rumanía, status.

Running title:
[The European mink in the Romanian Danube Delta and adjacent lagoon complexes: distribution, status and conservation priorities]

A. Kranz[1], A. Toman[2], K. Poledniková[1], L. Poledník[1] and J. B. Kiss[3]

[1] Department of Wildlife Biology and Game Management, University of Natural Resources and Applied Life Sciences. Peter Jordanstr. 76 A – 1190 Vienna, Austria

[2] Agentura ochrany prírody a krajiny CR, Otter Station Pavlov 54, 58401 Ledec n. S. Czech Republic

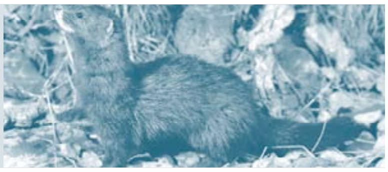
[3] Danube Delta National Institute, 165 Babadag Street, RO 8800 Tulcea, Romania

Andreas Kranz
Quellengasse, 43 A - 0810 Graz, Austria
E-mail: wild.oekologe@jagd-stmk.at

ABSTRACT

The Danube Delta is one of the very few areas world-wide, where the European mink still does occur. Two skulls of American mink, originating from the Delta in the late 1990s asked for a life trapping survey of minks in the Delta to reveal the distribution and status of both species. From 23rd of February until 11th of April 2003 a life trapping survey was carried out in nine different areas of the Romanian Danube Delta Biosphere Reserve. During 961 trap-nights a total of 28 European mink, but no single American mink were caught. European mink were found in all main habitat types of the Delta as well as in the lagoon complex in the south. However, clear evidence came to being that American mink, which are considered to be a serious threat for M. lutreola are living in one part of the Ukraine Danube Delta. A density control through trapping is considered as a conservation tool to prevent the immigration of M. vison in other parts of the Delta.

Key words: conservation, Danube Delta, distribution, Mustela lutreola, Mustela vison, Romania, status



INTRODUCTION

The European mink (*Mustela lutreola* L.) is one of the most endangered mammals in Europe. Until recently, this was not acknowledged on a European Union level, but since 2002 it is listed as a strictly protected species with priority within the annexes of the Fauna Flora Habitat directive of the European Union (92/43 EWG). The species was once widespread from northern Spain and western France throughout Central Europe towards the Ural Mountains (Youngman 1982). However, the accurate borders in the south of its distribution are uncertain and it is quite unclear, when the species disappeared from many regions. In Transsilvania (Romania) the species was already rare in the 19th century. Moreover confusions with the American mink (*Mustela vison*) may have occurred frequently since the early 20th century, when American mink farms came to being in Europe (Bauer 1960). Concerning the status of *Mustela lutreola* in the Danube Delta, Youngman (1982) referred to a personal communication and stated that there is still a very large population and that in December 1980 capturing was still going on. In the late 1990s first field trips were carried out to elucidate the status of the species in the Delta. Besides tracks and scats found, ten furs provided by trappers indicated that European mink are still living in the Delta (Gotea and Kranz 1999). From spring 2000 until autumn 2002 another seven fieldtrips were carried, another 18 European mink furs were collected from trappers and tracks and scats were found in the central and south eastern part of the Delta (Kranz et al. 2002). In autumn 2002 a check of mink skulls from the collection of the Danube Delta Museum in Tulcea revealed one American mink, which was erroneously identified as *Mustela lutreola*. It originated from the Delta near Uzlina from December 1999, an area where many mink scats were found in previous excursions. Another American mink skull was identified by M. Marinov from the Danube Delta Institute in Tulcea. It originated some 30 km west of the town Tulcea from the Danube valley. The American mink is considered as a serious threat for the European (Maran and Henttonen 1995, Sidorovich et al. 1999). A small scale experimental American mink farm had be in function in Murighiol on the southern boundary of the Danube Delta until the late 1980s and a big commercial one was operated on the Ukraine side of the Delta near Izmail until the early 1990s. Accidental escapes from such farms are one common reason for the establishment of feral mink populations in the wild. Once it had become clear that American mink may occur somewhere in the Delta, tracks surveys as carried out in the previous field trips were considered to be an inappropriate method to identify the European mink distribution, since tracks of both mink species are very similar and may not be distinguished without special experience (Sidorovich 1994). Hence a life trapping expedition was scheduled for the Romanian part of the Delta for 2003 with the following aims:

a) Trap mink in various localities of the Delta and identify the species
b) Get some indication of the mink density in the Delta as indicated by catching effort (trap nights)
c) Collect tissue samples of life trapped European mink for genetic analysis in order to identify their relatedness to European mink populations in Russia and Western Europe.

Besides these main goals, basic data such as sex ratio, weight and habitat types should be collected, if mink were caught successfully.

STUDY AREA

The Danube Delta is located on the west coast of the Black Sea on the border between Romania and Ukraine. The Danube splits into three main branches, the most northern one forms the border to the Ukraine (Fig. 1). The Romanian part of the Delta covers about 5,000 km^2 and holds more than 300 major lakes connected by natural river branches and man-made canals along an extensive hydrological gradient. The lakes range from pristine to moderately influenced by man. Geomorphologically, the Delta consists of four different zones:

a) The growing Delta due to sedimentation into the Black Sea, today, this type is only found in the Ukraine part of the Delta.

b) The fluvial, white water zone, the river floodplain in the process of being filled up. The river branches are accompanied by river levees, which are covered by forest or by pasture and are frequently exploited by man (single houses, villages, gardens). The lakes are small and shallow (0.5 m in the dry season). The visibility in the water is low due to a high load of dispersed sediments (muddy = "white" water).

c) The transitional, black water zone, characterised by extensive reed beds and large, 1-3m deep lakes; these are former lagoons in the final stage of being filled up with peat. There floating layers of fibric peat from reed with a thickness of up to 1.5 m can be found, so called plaur. The water is clear and the visibility therefore high (clear = "black" water).

d) The marine zone, characterised by the presence of parallel sandy beach barriers with shallow depressions in between.

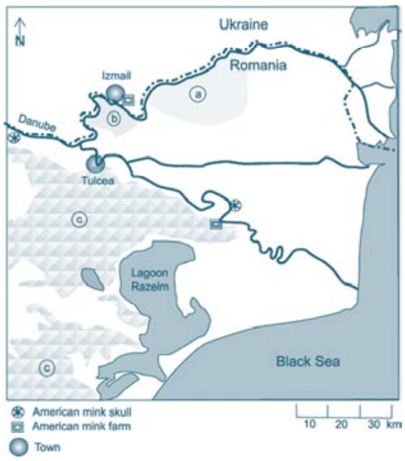
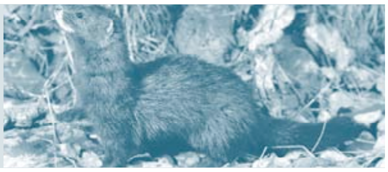


Figure 1: The Danube Delta with its three main Danube Branches, the agricultural polders Pardina (a) and Sireasa (b), the Dobrudscha Mountains (c) and the locations of former American mink farms and sites where American mink were found in the field.

Figura 1. El Delta del Danubio con sus tres principales ramificaciones, las zonas agrícolas Pardina (a) y Sireasa (b), las montañas de Dobrudscha (c) y la localización de las antiguas granjas de visón americano, así como los sitios donde el visón americano ha sido encontrado en campo.

In addition to these natural, moderately modified zones of the Delta, three man-made types of landscape exist in the Delta: the biggest are the agricultural polders, which are used for cattle grazing or maize production, followed by fish ponds and forestry polders. The biggest agricultural polders, Sireasa and Pardina (Fig. 1) in the north on the border to the Ukraine are still in function, others such as the Babina and Cernovca Bolders further east have undergone ecological reconstruction activities and are in a transient stage. Most of the fish ponds are not functioning as fish farms and are in different stages of natural re-colonisation. Adjacent to the Delta there is a lagoon complex in the south (Fig. 1). Its western and northern borders are the Dobrudscha Mountains. Towards the east there is the Black Sea separated by a narrow stripe of sand dunes and in the north-east there is the Delta itself. The climate is continental with minus



1,8°C in January and 22,2°C in August. Fresh water may be frozen in winter, but ice cover for longer periods is rare. The precipitation is about 350 mm and the evaporation is about 1000 mm/year, which causes a tendency to spontaneous salinization of humid soils (Hanganu et al. 1994).

MATERIAL AND METHODS

Prior attempts of life-trapping mink in the Delta using single large wire traps were not successful (Gotea and Kranz 1999). In order to increase the trapping success and to achieve comparability between trapping success in different countries holding *M. lutreola* populations, French and Spanish mink trappers were visited in March 2002 in order to learn their trapping technique and to take a prototype for constructing own traps. The traps used in the Delta were 50 x 16 x 16 cm single entry cage traps, baited with sardines in vegetable oil as it is done in Spain and France (e.g. Zabala et al., 2001). Animals caught were not anaesthetised, but transferred into a cotton bag. They were sexed, hair samples were taken by pincers and an ear sample was taken with scissors. Most of the animals were marked with a transponder and after weighting released at the trap site. The procedure from arriving at a trap until releasing after handling took about three minutes. Trapping was carried out between 23 February until 11 April 2003. Nine different trapping areas were selected in order to cover both, different geographical areas and different habitat types (Table 1). Trapping days depended upon trapping success and logistical reasons. Between 4 and 37 traps were set per night, they were active between 2 and 6 days in a place, rebaited with sardines every three days and controlled at least one per day (between 8 am and 11 am) by foot in the first trapping area and by a small motor boat or a canoe in the other cases.

Loc.	Name	Habitat	Date	Nights	Trap-nights	Europ. Mink	Sex M/F	Trap-nights / Europ. Mink
1	Enisala	Lagoon	23.2.-2.3.	8	130	1	1 / 0	130
2	Dovnica	Transitional Z.	4.-9.3.	6	187	6	4 / 2	31
3	Fortuna	Fluvial Z.	10.-14.3.	5	146	6	6 / 0	24
4	Dunavat	Fish pond*	19.-21.3.	3	105	8	3 / 5	13
5	Uzlina	Fluvial Z.	22.-24.3.	3	76	4	2 / 2	19
6	Perivolovca	Transitional Z.	25.-26.3.	2	58	2	2 / 0	29
7	Gorgova	Transitional Z.	27.-28.3.	2	50	0		
8	Rosu	Marine Z.	2.-4.4.	3	98	1	0 / 1	98
9	Nebunu	Transitional Z.	8.-11.4.	4	111	0		
Sum				36	961	28	18/10	

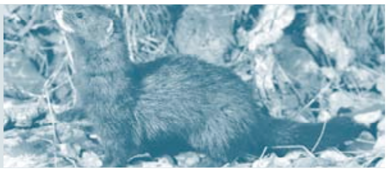
Table 1: Locations, habitats, trapping periods, trap nights and captures of European mink. The habitat types correspond with the description in the chapter Study Area, (fish pond* = abandoned fish pond).
Tabla 1. Localidades, hábitats, periodos de trampeo, nº de noches de trampeo y capturas de visón europeo. Los tipos de hábitat corresponden con la descripción del capítulo Área de Estudio. (estanque de peces = estanque de peces abandonado).*

RESULTS

Enisala was the first trapping area. It is located outside the Delta west of the Lake Razelm next to the foot hills of the Dobrudscha Mountains (Fig. 2). The habitat consists of flooded reed beds and man-made channels. Traps were set about 2 km from the lake shore. All of them were set on the ice layer in the reed. The ice layer was thick and there was no access to the open water, except small holes kept open by otters (*Lutra lutra*) and mink. The trapping area was about 300 m from the village Enisala and it was frequently visited by people walking on the ice for fishing or collecting fire wood. Trapping itself was hindered, because in the first night 13 traps were stolen and dogs frequently discovered the traps and closed them in the attempt to reach the sardines. On the arrival day, one European mink was envisaged from less than 20 m distance when approaching from a hole in the ice. The animal was identified as a *M. lutreola* by the clearly visible white upper lip. After trapping for eight consecutive nights one male European mink was caught (Table 1). Track surveys in the snow revealed mink tracks also between the trapping area and the mouth of Lake Babadag 2 km in the west. In addition mink tracks of several individuals were found in the fish pond complex east of Salcioara (Fig. 2). This area is located about 15 km south of Enisala.

The second trapping area, Dovnica (Fig. 2) was in the Delta about 10 km north of the village Crisan which is located on the middle of the three main Danube branches (Sulina Branch). The main channel (12 m wide) was not covered by ice. Traps were set along this channel on the banks which are either mostly overgrown by willow trees (*Salix fragilis*) or by reed (*Phragmites australis*) and along one side channel which was 9 m wide, showing similar bankside structure like the other one. The hinterland of the channels are thousands of hectares of monotonous flooded reed beds with a few single small lakes. The area belongs to the transitional, black water zone. It is far from human settlements and not disturbed by people or boat traffic. On the arrival day, one mink was seen scavenging from a hopper swan (*Cygnus olor*), which was lying on the bank of the main channel. There were several dozens more dead swans in the area providing food for various carnivores and white tailed eagles (*Haliaetus albicilla*). One male European mink was caught at the already mentioned swan carcass in the first night and a female European mink was caught in the following night in the same trap. Another female and male European Mink were caught in another trap and two more in other traps (Table 1) during a total of sixconsecutive nights.

Fortuna was the third trapping area (Fig. 2). It is located in the very centre of the Delta just south of the big lake Fortuna. The area belongs to the fluvial white water zone getting the water through a channel from the 2 km distant Sulina Branch, one of the three main Danube Branches. It is characterised by a dense network of channels and small lakes. Ice did not restricted the access along the channels, but still covered the big Lake Fortuna. On the first day, some hunters were in the area shooting water fowl, but on the following days, there were no other people nor dogs. Traps were set along the banks of these mostly 10 m wide channels. They were covered by willow trees or reed and sometimes reedmace (*Typha angustifolia*). The hinterland was medium



old or old willow forest. From the first trap night onwards, six European mink were caught during five nights (Table 1). One mink escaped from a trap by destroying the cage.

The next trapping area was Dunavat (Fig. 2). It was located from the west of the Lake Razelm (lagoon complex) eastwards along 20 and 10 m wide ice free channels in area of abandoned polders and fish farms. The banks, where the traps were set, were overgrown by reed and single willow bushes and the hinterland consisted of flooded red stands. Right in the trapping area, there was a fishermen house with several people and free running dogs. During three nights, three male and five female European mink were caught along the main channel right from the mouth of the Razelm Lake 10 km inland.

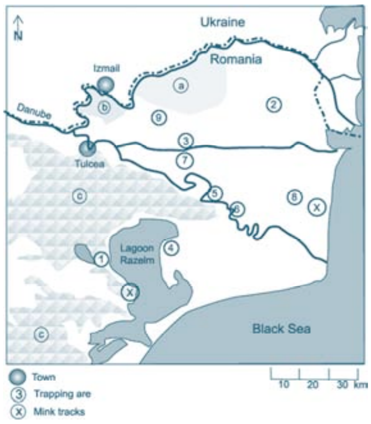


Figure 2: Trapping areas during 2003: 1 = Enisala, 2 = Dovnica, 3 = Fortuna, 4 = Dunavat, 5 = Uzlina, 6 = Perivolovca, 7 = Gorgova, 8 = Rosu and 9 = Nebunu; sites indicate with x, where additional mink tracks were found in 2003.

Figura 2: Áreas de trampeo durante 2003: 1 = Enisala, 2 = Dovnica, 3 = Fortuna, 4 = Dunavat, 5 = Uzlina, 6 = Perivolovca, 7 = Gorgova, 8 = Rosu and 9 = Nebunu; en los sitios indicados con x se encontraron huellas adicionales de visón en 2003.

Uzlina was the fifth trapping area (Fig. 2). It is located in the immediate vicinity of the southern main Danube Branch near the village Murighiol, where the experimental fur farm of the Danube Delta National Institute holding also *M. vison* was in function in the 1980s. Uzlina is the origin area of the American mink skull detected in the Danube Delta Museum. The habitat belongs to the fluvial zone, but it is heavily affected by human land use, mainly grazing of cows, horses and pigs. The latter one over-dig almost any square meter of land which is not permanently flooded by water. Abandoned or semi-abandoned dogs and cats are also plentiful. In addition there is one hotel in Uzlina and several holiday resorts. Motor boat traffic is common. It is one of those parts of the Delta which are easily reached from the main land by driving by car to Murighiol resulting in an increased pressure of tourism (anglers and bird watchers). Besides the main Danube Branch, there are 10 m wide channels, willow tree forests, small lakes and reed marshes, creating a rich and picturesque landscape. Traps were set during three nights along the channels and within the partly flooded *Salix fragilis* woodland. In total, two male and two female European mink were caught (Table 1), both, along the channels and in the woodland. One successful trap was 100 m from the nearest holiday resort set on a bank overgrown by *Tamarix ramosissima.*

Perivolovca was the next trapping area, about 20 km downstream the Danube from Uzlina (Fig. 2). It was not located right at the main Danube Branch, but north, along two dead end channels, 6 and 10 m wide and free of ice during the trapping period. The hinterland consisted of partly flooded even-aged woodland. The channels were revisited by fishermen who put fykenets there. During two nights, two European mink were caught and one more was seen from a short distance crossing the Channel by swimming, the white upper lip was clearly visible.

The next trapping area was Gorgova situated right in the middle between the southern and the central main Danube Branch. The habitat belongs to the transitional zone of the Delta. It is characterised by large reed beds, floating reed (plaur) and medium to large lakes (Lake Gorgova). Traps were set along short natural branches interconnecting lakes and along the lake shore. Most of the area did not show any or very little signs of human activity or presence. It was the beginning of the vocal activity of amphibians (Fig. 3) and big reed fires were going on in some adjacent areas. During two nights no mink were caught (Table 1). However, tracks and scats indicated that the area is inhabited by mink.

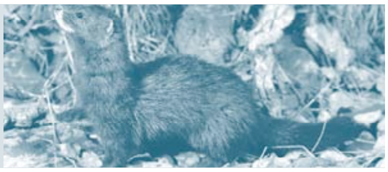
Rosu was the only trapping area in the marine zone of the Delta. It was located south of the Lake Rosu along canals crossing former sandy beach barriers (Grindul Ivancea etc.). The hinterland consists of shifting sands, pasture and reed. In the trapping area, there was one single hut inhabited by people, cattle and dogs. One female European mink was caught in a cage trap within three nights of trapping and one European mink was identified when swimming over a channel. In addition plenty of mink tracks were found about 5 km eastwards in the marine zone 3 km from the Black Sea.

The last trapping area, Nebunu (Fig. 2), was the one located most in the west of the Delta. The area belongs mainly to the transitional zone, consists of large open woodlands and a very dense network of natural branches and channels interconnecting lakes of various size and patches of reed and reedmace. The area is about 15 km from the Fortuna trapping area. There is one hut, permanently inhabited by people. During four nights (111 trap nights), no mink was caught (Table 1).

Besides these 28 European mink, 12 Stoats (*Mustela erminea*) and one weasel (*Mustela nivalis*), several *Rattus norvegicus*, *Pica pica*, *Gallinula chloropus* and *Turdus merula* were caught in the wire box traps, but no single American mink nor a polecat (*M. putorius*). Signs of *Lutra lutra*, tracks, sign heaps and excrements were plentiful in all 9 trapping areas. Badger (*Meles meles*) sets and tracks were found on the edge of the Delta and in one case inside. In Fortuna, one wild cat (*Felis silvestris*) was seen and field signs (latrines and tracks) of racoon dogs (*Nyctereutes procyonoides*) were common in some areas. Jackals (*Canis aureus*) were found in the marine zone and in the lagoon complex around Lake Razelm. The average weight of male European mink caught was 493 grams (n = 17) ranging from 620 to 1.250 grams, the weight of females was on average 473 (n = 9) ranging from 380 – 550 grams. The trapping success (Fig. 3) and the sex ratio of captured European mink (Table 1) varied considerably between the trapping areas.

DISCUSSION

The life trapping action in late winter, early spring 2003, carried out in the Biosphere Reserve of the Romanian Danube Delta revealed a numerous European mink population in the central, eastern and southern part of the Delta. This was indicated by the generally high trapping success. Low trapping success in the first trapping area (Enisala) and in April, may be more the result of the ice cover and the appearance of frogs (plenty of food available), than differences of



mink densities, since tracks and scats indicated that mink were in the areas. The sex ratio of captured mink was biased towards males, this may have come to being because it was mating season, when males are particularly active. Despite two skulls of American mink originating from the Romanian Danube Delta from recent years, no American mink were caught. The polecat is also absent in the Delta, whereas other small Mustelids (weasel and stoat) are found even in the most aquatic parts of the Delta. Otters are numerous as well. It appears that until present the European mink was able to occupy its original niche in the guild of Mustelids. However, M. Smut from the Academy of Sciences of the Ukraine, working in the Ukraine part of the Danube Delta reported in autumn 2003 that there exists an American mink population east of Izmail north of the agricultural polder Pardina (Fig. 1). According to him, this population has established a population in the wild which covers an area of about 30 x 5 km. east of that area, European mink still do occur on the Ukraine side of the Delta. It may well be that the Pardina polder, not providing suitable habitat for mink, hindered the immigration of American mink to the Romanian part of the Delta. It might also be that in the north of the Romanian Delta, there are already American mink. These areas were not fully covered by the trapping survey in 2003, but it will be done in 2004.

Despite the fact that the European mink population is still in a vital status, it appears to be critically threatened by the American mink, obviously living in a still restricted area in the north of the Delta. It is uncertain, whether any trapping effort aiming at eradicating the species would be successful, but it might decrease the population to a level which stops immigration to areas occupied by the European mink. Density control of the American mink is possible (Sidorovich and Polozov 2002, Nordström et al. 2003) and may save the native European mink. Besides the American mink menace, by-catch in leghold traps set for muskrats (Ondatra zibethicus), and free ranging dogs may be considered as threats for the European mink population living in the Danube Delta. Whereas it might be possible to reduce by-catch by promoting selective traps, any dog control in the Delta appears difficult. The presence of mink in all main habitat types of the Delta indicates that habitat requirements itself are not a limiting factor yet.

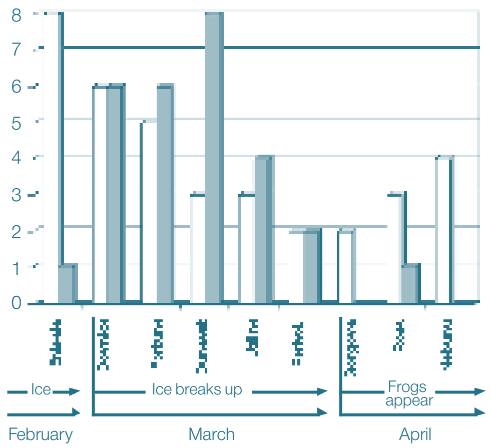


Figure 3: Duration of trapping in the nine trapping areas (white bars), number of European mink caught (grey bars) and the stage of ice and the appearance of frogs as possible factors influencing trapping success.

Figura 3: Duración del trampeo en las nueve áreas de trampeo (barras blancas), número de capturas de visón europeo (barras grises) y la época de hielo y la aparición de ranas como posibles factores de influencia en el éxito del trampeo.

ACKNOWLEDGEMENTS

The life trapping mink survey conducted in the Danube Delta in 2003 was financed by an EU grant through the DELWET Centre of Excellence Project of the Danube Delta National Institute in Tulcea. Money for life traps, transponders and small material was provided through WWF Germany, Auen - Institut in Rastatt. We are therefore most thankful to the scientific director of the Danube Delta Institute, Dr. Mircea Staras and the general director, Dr. Romulus Stuca, to Dr. Erika Schneider from WWF Germany, then to Dr. Grigore Baboianu, director of the Danube Delta Biosphere Administration, who supported us with people and accommodation, further to Dr. Radu Suciu, who gave valuable advice for collecting and storing genetic material. Last but not least we are grateful to the crew of the houseboat Merisor and to Tanase Ceicu and Sorin for their invaluable assistance, help and good mood.

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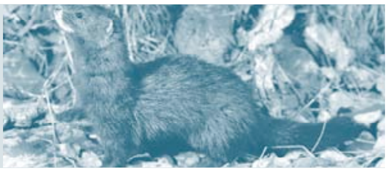

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[Recovery Plan for the European Mink (*Mustela lutreola* L.) in La Rioja (Spain)]

PLAN DE RECUPERACIÓN DEL VISÓN EUROPEO (*Mustela Lutreola*) EN LA RIOJA (ESPAÑA)

RESUMEN

La Comunidad Autónoma de La Rioja es una región de 5.034 km^2, que se sitúa en la cuenca superior del río Ebro, en la que habita una de las principales poblaciones occidentales del visón europeo (Mustela lutreola Linnaeus, 1758.). Dentro de esta región se han censado alrededor de 100 ejemplares adultos de visón, debido en gran parte a que no existen en ella poblaciones estables de su competidor alóctono, el visón americano (Mustela vison Schreber, 1777), aunque algunos ejemplares de esta especie invasora han sido colectados recientemente, procedentes de regiones limítrofes.

Consciente de la delicada situación de la especie en el conjunto de su población occidental, el Gobierno de La Rioja lo incluyó en el Catálogo de Especies Amenazadas de la Flora y Fauna Silvestres de La Rioja, con la categoría de En Peligro de Extinción.

En marzo de 2002, se aprobó su correspondiente Plan de Recuperación, con una vigencia inicial de 6 años, que establece normativa y medidas para prevenir y combatir los factores regresivos que afectan a la especie en la región; dentro de este plan, se establecen una serie de Áreas de Interés Especial, que pretenden preservar las zonas más valiosas. Los

Running title:
[Recovery Plan for the European Mink in La Rioja (Spain)]

L. Lopo[1], J.C. Ceña[2] y M. Pallarés[3].

[1,3]D.G. de Medio Natural. Gobierno de La Rioja. C/ Prado Viejo, 62 26.071 - Logroño (Spain).

[2]C/ Estambrera, 13-3ºB, 26.006 - Logroño (Spain).

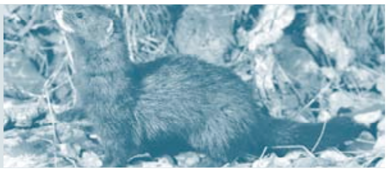
Luis Lopo
D.G. de Medio Natural. Gobierno de La Rioja
C/ Prado Viejo, 62
26071 Logroño (Spain)
E-mail: fauna.flora@larioja.org

ABSTRACT

The Spanish region of La Rioja is a region of 5,034 km^2, that is located in the Upper Ebro River Basin, where one of the largest western population of the European mink (*Mustela lutreola* Linnaeus, 1758) lives. Within this region, about one hundred specimens have been registered. It is mainly due to the lack of stable populations of the alien competitor the American mink (*Mustela vison* Schreber, 1777), although some specimens of this invasive species have been recently collected, coming from bordering regions.

The Government of La Rioja, aware of the difficult situation of the species within the whole Western population, included it in the Regional List of Threatened Species, with the category of "Endangered of Extinction".

In March, 2002, the Recovery Plan was approved, adopting regulations and measures to prevent and fight against regressive factors affecting the species in the region; within this plan, a series of



Special Interest Areas have been settled down, in order to preserve the most valuable zones. The goals persecuted by the plan are the following ones:

- To contribute to maintain the genetic and ecoethological characteristics of the taxon.
- To avoid the establishment of American mink populations.
- To prevent and fight pathologies.
- To reduce the level of polluting agents in the habitat of the taxon.
- To reduce non-natural mortality.
- To prevent and correct problems caused by loss of genetic variability.
- To preserve the habitat of the taxon.
- To contribute to its international conservation.
- To establish a checking and monitoring program of the regional population.
- To promote the scientific research, as well as the knowledge and the social sensitivity towards the species.

This plan has financial support from the European Commission, by the Life–Nature Project “Conservation of the European Mink in La Rioja” (NAT/E/7331).

Key words: American Mink, Conservation, European Mink, La Rioja, Life–Nature, List of Threatened Species, Mustela lutreola, Mustela vison, Recovery Plan.

INTRODUCTION

European mink (*Mustela lutreola* L.) is a small riverine carnivore that has disappeared, in the last two hundred years, from almost all European countries that made up its historical distribution area.

objetivos perseguidos por el plan son los siguientes:

- *Contribuir a mantener sus características genéticas y eco-etológicas.*
- *Evitar el asentamiento de poblaciones de visón americano.*
- *Prevenir y combatir patologías.*
- *Reducir el nivel de contaminantes en su hábitat.*
- *Reducir la mortalidad no natural.*
- *Prevenir y corregir problemas por pérdida de variabilidad genética.*
- *Conservar el hábitat.*
- *Contribuir a su conservación internacional.*
- *Establecer un programa de seguimiento y control.*
- *Promover la investigación científica, así como el conocimiento y la sensibilidad social hacia la especie.*

El plan cuenta con el apoyo financiero de la Comisión Europea, a través del Proyecto Life–Naturaleza denominado “Conservación del Visón Europeo en La Rioja” (NAT/E/7331).

Palabras clave: Catálogo de Especies Amenazadas, Conservación, La Rioja, Life–Naturaleza, Mustela lutreola, Mustela vison, Plan de Recuperación, visón europeo, visón americano.

Nowadays we just know the existence of relevant populations in some areas of Northern Spain and Southwest of France (Western nucleus) and in certain areas of Russia, Belarus and the Danube delta, at the North of Moscow (Eastern nucleus).One of the best conserved populations in the whole world is located in this Western nucleus, on the Upper Ebro River basin (Spain), which includes a lot of territory of La Rioja region. This situation is due, partially, to the lack of stable populations of American mink.

The European mink is considered one of the most endangered animal species of Europe; this seems to be closely linked to the invasion of its habitat by its competitor, the American mink (*Mustela vison*, Schreber), an alien species that competes with it in reproduction, breeding, feeding and habitat use, and which could be a pass on diseases.

In La Rioja the species is catalogued as "Endangered of Extinction" (Regional List of Threatened Species, Decree 59/1998, October 9th) and in 2002 the Recovery Plan for the European mink in La Rioja (Decree 14/2002, March 1th) was approved by the Government of La Rioja, in order to:

Previous status assessment of the species in the region;

Establish objectives and determine actions to mitigate or prevent regressive factors.

FINALITY AND GOALS

The purposes of the Plan of Recovery are:

- long term conservation of the population within this region, as well as the demographic, genetic and ecoethological properties of the taxon;
- protection and improving of its habitat.

This recovery will be obtained when:

A) The population of La Rioja fulfilled the following conditions:

1ª) Adjusted demographic and corological parameters:

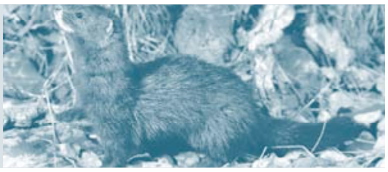
1ª.A. Total population quantity of, at least, 150 adults.

1ª.B. Average density equal or superior to 0.34 units adults/km of river.

1ª.C. Stable distribution on the fluvial basins of the Ebro, Tirón, Oja, Najerilla, Iregua, Leza and Cidacos rivers.

2ª)Conservation of the genetic viability, without incidence of degenerative processes such as hybridisation, endogamy or loss of genetic variability.

3ª) Cease of the risk of suffering affections of serious incidence, derived mainly from the possible introduction of American mink. These affections are:



3ª.A. Transmission of pathologies and epizootic.

3ª.B. Territorial and reproductive competition.

3ª.C. Ecological competition and direct aggression.

B) The evolution undergone by the European Western population of European mink, and mainly by the rest of the Iberian population, was favourable.

The general goals persecuted by the plan are the following ones:

- To contribute to the long term preservation of genetic and ecoethological characteristics of the species, using in necessary case ex- situ conservation measures.
- To come up and to act against the problems derived from the reduction of the genetic variability of the population.
- To establish a checking and monitoring program of the populations.
- To prevent and to fight against affections by epizootic and other pathologies.
- To reduce the non-natural mortality affecting the species.
- To avoid the establishment of populations of American mink in the Rioja.
- To avoid the risk of genetic absorption of the species by populations of other mustelids, specially by ferret (*Mustela putorius furo* Linnaeus, 1758).
- To reduce the pollution levels in its habitat.
- To promote the progression of its habitat, avoiding the fragmentation and the reduction of the riparian vegetation and fomenting the good biophysic status of aquatic masses.
- To contribute to the conservation of the species on international scale.
- To promote the scientific research on aspects related to the conservation of the European mink.
- To increase the knowledge and the sensitivity of the society towards the problem of conservation of this species.

WORKING AREAS

The working areas of this Plan are the actual natural distribution of this species within the region, as well as its possible zones of future expansion.

Geographically, this scope includes the hydrographic network and other humid zones, as well as the lateral bordering land strips, in surroundings of 5 meters, of the Tirón, Oja, Najerilla, Iregua, Leza, Cidacos and Ebro rivers, within the region. This means 389 linear kilometres of shore.

Within this territory, high-priority zones of conservation are considered as Special Interest Areas (SIA) , fluvial sections used as a refuge or raising areas by the species.

On the other hand, special emphasis will be put in the areas included within the Sites of Community Importance (SCIs) – Natura 2000 Network, in which streams the species lives:

1) “Sotos y Riberas del Ebro” (S.C.I. ES2300006), specially created for the protection of the species. 600 Has. of streams.

2) “Sierras de La Demanda, Urbión, Cebollera y Cameros” (S.C.I. ES2300001). 74 Has. of streams.

3) “Peñas de los ríos Iregua, Leza y Jubera” (S.C.I. ES2300004). 22 Has. of streams.

The attached map (Figure 1) shows the zones of natural distribution of the species within the region, as well as the Special Interest Areas stablished in the plan and the limit of the SCIs in whose streams the species lives.

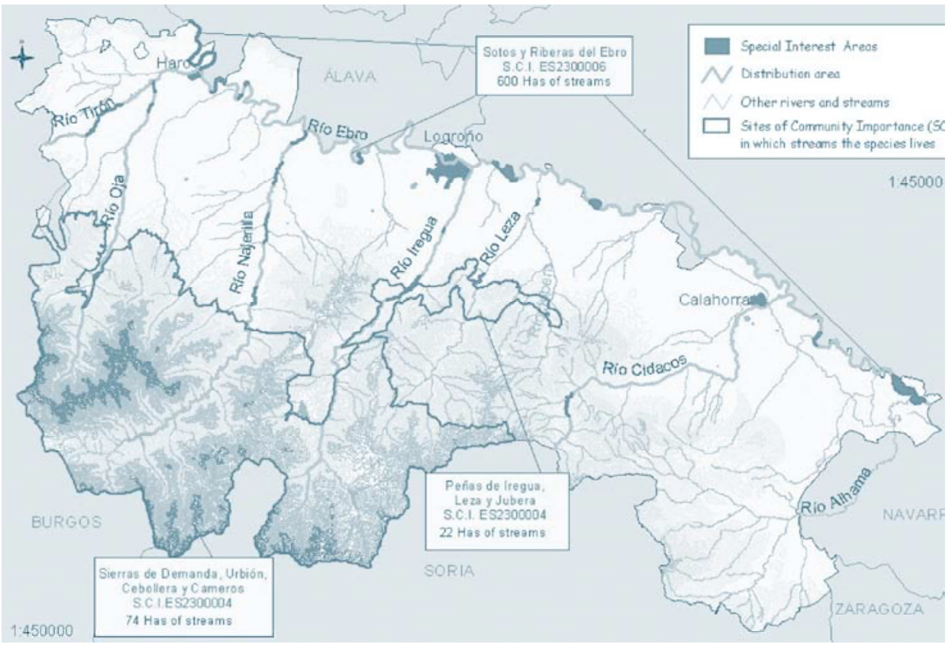
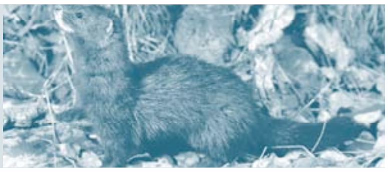


Figure 1. Working areas for the Recovery Plan in La Rioja



DURATION OF THE PLAN

The period of use of the plan will be 6 years (until 5/3/2008). The performances will be annually defined, by means of operative programs. After that, the fulfilment of the objectives will be valued, through of the analysis of the conservation status of the species.

ANALYSIS AND EVALUATION OF THE PREVIOUS SITUATION

Main threats

- These are the main threats that affects the population:
- Atomisation of the population by isolation of the Eastern nucleus and the limited distribution of this Western population.
- Lost of genetic variability and/ or genetic absorption by hybridisation with other mustelid species, like ferret (*Mustela putorius* L.).
- Competition with the American mink (habitat, reproduction, vector of diseases).
- Accelerated destruction of its habitat, by contamination, modification of streams, reduction of the riparian vegetation, etc.
- Diseases affection with special incidence of the Aleutianan Disease of Mink (ADV).
- Low scientific knowledge of the species, specially about the interaction with the American mink and the fight against it, as well as incidence and treatment of pathologies.
- High pollution by bioaccumulative organochlorinated compounds.
- Non-natural mortality, fundamentally by road accidents.

Situation in La Rioja

POPULATION
In 2002, 100 adults were counted, which means the 20% of Spanish population.

DISTRIBUTION
The European mink is widely distributed among 440 kilometres of streams on the basin of the following rivers: Ebro, Tirón, Oja, Najerilla, Iregua, Leza and Cidacos (Figure 1). This whole area covers less than 9 km^2, because the species is mainly associated to high-density vegetation areas next to the watercourse (riparian and/ or thicket areas, reeds).

ABUNDANCE
The average density is computed in 0,25 adult minks/ kilometre of stream, although it varies between different streams; the maximum is registered in the upper areas of the Ebro and Tirón rivers, also in the lowest course of the Najerilla river (0,65 adults/Km), medium in the Oja, Iregua and Leza rivers (0,2-0,4 adults/Km) and minimum in the Cidacos river (0,1 adults/Km), only occupied seasonally.

EVOLUTION

Until recent times it has had a good conservation status, but lately the beginning of serious affections has been detected: the territory has begun to be invaded by populations of the American mink coming from nearby regions and the 25-30% of the studied specimens are ADV - positive (Aleutian Disease Virus).

MAIN MEASURES ADOPTED IN THE PLAN

Checking and monitoring

Periodic Checking and monitoring Program of the population in the different occupation areas within the region.

- Monitoring measures.
  Radio tracking works in certain areas, in order to value the demographic parameters, poblational structure, habitat use and incidence of affections.

- Checking measures
  - Sampling and estimation of specimens by direct trapping and indirect evidences
  - Sampling analysis in order to:
    - Detect possible diseases, with special attention to Aleutian Disease Virus (ADV).
    - Check pollutant levels (DDTs, PCBs and HCHs) in excrements and corpses.
    - Check genetic pollution by intrusion of wild ferret (*Mustela putorius*) characters, lost of genetic variability and consanguinity

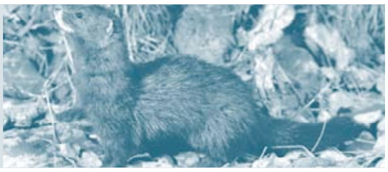
Creation of a record of all animals, captured dead or alive, and conservation of corps or rests, as well as graphic documents.

Conservation

Banning of certain specific activities.

- Skin trade of wild mustelids coming from this region.
- Possession and use of massive or non-selective trapping procedures (snares, traps, baits, jails, etc.) for the capture of wild carnivores within Special Interest Areas.
- Capture specimens from local population to use in reintroduction or reinforcement in other ones (except small amounts for breeding in captivity)

Analysis of sites of risk on roads, hydroelectric power plants and other trap-spaces.



Adoption of mitigation measures.

- Possible adoption of hunting, fishing and sports regulations on rivers.
- Banning of possession, trades and transport of live American mink specimens, breeding and/or introduction in its environment.
- Development of eradication campaigns of the American mink specimens.
  Made in the time of dispersion of young specimens (September to December) and with special attention in zones where incipient populations exist (upper Najerilla river basin) and possible routes of penetration from bordering regions: basins of the Arlanza, Arlanzón and Tirón rivers, bordering with Burgos; Zadorra, Bayas and Ebro rivers (in Haro), being contiguous with the Basque Country.
- Promotion of activities for the reduction of pollutant wastes within its habitat.
  With special interest on the reduction of:
  Bioaccumulative pollution of industrial or agricultural origin.
  Pesticides and other toxins.
  Related PCDDs, PCDFs, PNCs and aromatic compounds.
  Organic compounds.
- Study of Special Interest Areas for the species.
- Requirement for environment impact affection analysis and adoption of mitigation measures in certain projects.

  Works of longitudinal substructure and hydraulic adaptation (canalisation, dredging, breakwaters, talus adecuation, etc.) affecting to more than 50 meters of natural stream (except in urban areas) will be avoided within Special Interest Areas.

  Highways and other road designs will be avoided within Special Interest Areas.

  Hydrologic works (dams or such) and hydroelectric power plants, increasing water level 2 meters over average level, or involving course derivation of more than half flow. Environmental Impact Assessment required within Special Interest Areas.

  Clear felling of spontaneous trees. It is considered to be incompatible with species preservation within Special Interest Areas.

  Extracting and using non-biotic resources, along more than 50 meters of watercourse. It is considered to be incompatible with species preservation within Special Interest Areas.
- Catalogue of existing river barriers setting of an improvement plan.
- Regulation of flow augmentation, preventing sudden or abnormal increases in flow or droughts or out of season flows.
- Habitat restoration in a high quality area for the European mink.

30 Ha of riparian vegetation, owned by the Government of La Rioja, included within the Site of Community Importance "Sotos y Riberas del Ebro" (ES2300006) –Natura 2000 Network-, are being managed to recuperate areas occupied by barren land and Populus sp. plantations. Activities:

Extraction of non-native trees

Stub treatment to avoid regrowth

Plantation of native trees and bushes

Opening of a perimeter way to fix the boundaries of the land, for plantation management and educational activities.

Supported by LIFE (Budget: 72.121 €)

Research

Establishment of channels of support to the investigation, specially on the following subjects:

a) Mechanisms of interaction between the populations of European and American mink.

b) Control and biological fight against wild populations of American mink.

c) Causes of mortality of non-natural origin.

d) Improvement of the habitat and regulation of advantages, as well as infrastructure adjustment.

e) Eco-toxicological pathologies and affections: diagnosis, prevention and control.

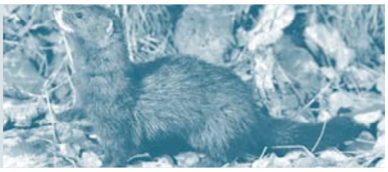
f) Systematic-genetic characterisation of the taxon and the hybridisation with other species of Mustelids.

g) Maintenance and reproduction in captivity, ex- situ training of young specimens and techniques of reintroduction.

h) Relation with other threatened species of aquatic fauna, specially with the Pyrenean desman (*Galemys pyrenaicus*, Geoffroy) and the white-clawed crayfish (*Austropotamobius pallipes*, Lereboullet).

Collaboration in supra-regional research programs on distribution, status, biology, ecology and conservation of the European mink.

Collaboration in joint projects of investigation and management with the bordering regions, with special consideration to the population living in both borders of the Ebro river.



Education and divulgation

Didactic and sensibilization campaign about the species.

Elaboration of didactic and divulging material, co-ordinately with the other implicated regions.

Education of Forestry Agents from La Rioja.

Maintenance of a web site about Life-Nature Project.
www.larioja.org/ma/biodiversidad/fauna/vison/vison.htm

International Conference on the Conservation of the European Mink.
In collaboration with a foundation associated to a local financial organisation (Fundación CajaRioja).

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Conservation of the European mink (*Mustela lutreola*) in La Rioja (España). Report 2002. Dirección General de Medio Natural. Gobierno de La Rioja.

[Captive Breeding Program of European Mink in Spain: El Centre de Pont de Suert]

PROGRAMA DE REPRODUCCIÓN EN CAUTIVIDAD DEL VISÓN EUROPEO EN ESPAÑA: EL CENTRO DE PONT DE SUERT

RESUMEN

El visón europeo (Mustela lutreola) es una de las especies de carnívoros más amenazadas. Su distribución actual está restringida a una pequeña fracción de su rango histórico. La creación de un stock de ejemplares en cautividad procedentes de la población occidental y el inicio de un programa de cría son esenciales para su conservación.

Los objetivos del programa son: a) mantener un stock de visones europeos en cautividad procedentes del núcleo occidental, b) reproducción en cautividad para mantener el material genético, c) investigación aplicada, y d) creación de un Banco de Reserva Genética (crioconservación de tejidos y gametos o embriones).

El programa implica: a) creación de Centros de Cría, con un stock cautivo distribuido en varios centros con alta capacidad y separados, b) captura de 20 ejemplares fundadores, c) programas genéticos y demográficos con ola población cautiva, y d) desarrollo de protocolos sanitarios.

Palabras clave: cría en cautividad, visón europeo, Ex-situ, Mustela luteola, España.

Running title: [Breeding Program of European Mink in Spain]

S. Mañas[1,5], S. Palazón[1,2], J. Ruiz-Olmo[1], T. Maran[3], W. Festl4 and C. Seebass[4]

[1]Departament de Medi Ambient i Habitatge, Generalitat de Catalunya, Dr. Roux, 80, 08017 Barcelona, Spain.

[2]Dpto. de Biologia Animal, Vertebrats, Facultat de Biologia, Universitat de Barcelona, Avda. Diagonal, 645, 08028 Barcelona, Spain.

[3]Foundation “Lutreola”, Tallinn Zoo, Paldiski Road 145, 13522 Tallinn, Estonia.

[4]EuroNerz e.V., Borgloher Str. 13, D-49176, Hilter a. T.W. Germany.

Sisco Mañas.
Departament de Medi Ambient i Habitage, Generalitat de Catalunya
Dr. Roux, 80 - 08017 Barcelona, Spain
Phone number: +34 93 567 4200 - Fax number: +34 93 280 2924
E-mail: francesc.manas@gencat.net

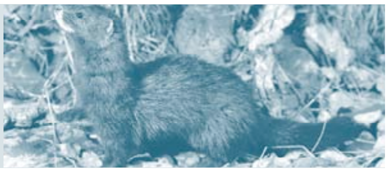
ABSTRACT

The European mink (*Mustela lutreola*) is one of the most endangered carnivore mammals. Its distribution is now restricted to a small fraction of the historical range. The creation of a captive stock of animals from western population and start of captive breeding was considered essential for its conservation.

Aims of the program are: a) the maintenance of a stock of captive European minks from the western population, b) breeding captive animals to maintain genetic material, c) applied research, and d) creation of a Bank of Genetic Resources (cryoconservation of tissues and gametes or embryos).

The programme involve: a) creation of Breeding Centres -captive stock distributed among several separate centres with high capacity, b) capture of 20 founders specimens from the wild, c) genetic and demographic programmes with the captive population, and d) development of health protocols.

Key words: Captive breeding, European mink, Ex-situ, Mustela luteola, Spain.



INTRODUCTION

European mink (*Mustela lutreola*) is one of the most endangered carnivore mammals in the word (IUCN 2002). Although the species was once widely distributed throughout Europe (Youngman 1982), its distribution is now restricted to a small fraction of its historical range. This fast process of extinction has led to a very precarious world situation for the species. At the beginning of the 21st century, there is still a population in the western nucleus (France and Spain), one in the north and centre of Russia, in Belarus and in the delta of the River Danube (Romania) (Tumanov 1999, Saveljev and Skumatov 2001a, Palazón et al. 2002, Maizeret et al. 2002, Macdonald et al. 2002). Complete causes of this dramatic decrease are still unclear (Maran and Henttonen 1995).

A variety of different conservation strategies has been started in several areas of its historical distribution range with the aim of protecting European mink population (Festl et al., 2001; Saveljev and Skumatov 2001b; Maizeret et al. 2001; Sidorovich and Polozov 2002; Macdonald et al. 2002). Conservation strategies involve captive breeding and reintroduction projects.

Western population is also in a precarious status. In France, the population of European mink is threatened by the American mink (*Mustela vison*) from the north and the south-east. In addition, it is also disappearing from its central distribution area, for reasons that are, as yet, still unknown. In this country there is a Recovery Plan that is currently under way. In Spain, the disappearance of the European mink from some small areas is closely related to the appearance and presence of wild populations of American mink.

The minks in France and Spain belong to the *Mustela lutreola biedermanni* subspecies (Matschie 1912); they are paler and have fewer white marks on their chests. This subspecies has yet to be confirmed, however, for the moment it is considered to be valid.

Recent studies on phylogeny of the European mink (Davison et al. 2000, Michaux et al. 2003) seem to show that there are certain differences that would advise, at least for the moment, to keep its populations from the East of Europe separated from that ones from the West in preservation programmes, captive breeding or reintroduction.

There are currently various institutions that maintain European minks in captivity from the north-eastern nucleus of the species, mainly in one European Endangered Species Programme (European breeding plans for endangered species, EEP Programme).

One of the preservation priorities of the European mink and of this Breeding Program is carrying out genetic studies. We need to document the model of genetic variation of the species to determine the level of separation existing between the different populations (Spanish, French, Romanian and Russian) and define the Evolutionarily Significant Units (ESU) to be maintained. Depending on the result of these studies, which should be carried out by different laboratories, and their acceptance by the international scientific and conservationist community, either a single breeding line or two separate breeding lines will be maintained, one for the eastern

population - EEP already in existence - and the other for the western population - specimens from Spain and France. The existence of either one or two lines being bred in captivity has great implications for the strategy of preservation and on the plans and guidelines of this Breeding Program.

The fact that there is no stock of captive specimens from the western population means the situation is highly vulnerable. Due to the high risk of extinction and lost of genetic material, creation of a captive stock of animals and begin of the captive breeding was considered essential for their conservation.

AIMS

The major aim of this program is the recovery and long-term preservation of the species, assuming that the basis for preservation should be centred on the work carried out "in situ". The captive breeding program will serve as a genetic reserve, to preserve the maximum quantity of genetic material for as long as possible, to support the preservation actions in the natural environment and to help to increase social awareness of the needs of the species to be able to survive.

Aims of the program are:

1. The maintenance of a stock of captive European minks that come from the western stock, to preserve it from the risk of extinction and to face the extreme vulnerability of the species in the wild. This implies the creation of a captive genetic reserve.

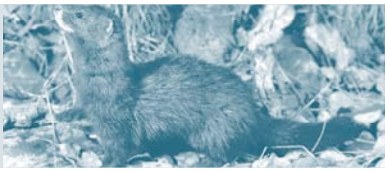
2. Breeding captive animals to preserve the genetic diversity of the species and to produce individuals, which are able to survive and reproduce in nature and which are therefore suitable for population reinforcement or for reintroductions within the distribution area of the species.

3. Applied research all the important aspects for the preservation of the species and those that are difficult to study in animals living in the wild.

The simultaneous creation of a Bank of Genetic Resources in order to preserve the greatest proportion of genetic variability in case of possible catastrophes. In this "genetic safe" biological material (cryoconserved tissues and gametes or embryos) will be stored, with the aim of representing the maximum proportion of genetic variability present in the population.

CAPTIVE BREEDING PROGRAM

Until the results of the genetic structure of the species, an exclusive Breeding Program for specimens from the western population will be maintained provisionally, though co-ordinated by the existing one (EEP). There are currently no specimens from the western nucleus of the species in captivity. Founder individuals need to be caught directly from the wild, and should be caught in areas where the removal of specimens will influence the source population as little as possible.



The captive breeding program involves:

1. Creation of Breeding Centres. Captive stock distributed among several separate centres with high capacity to minimize any risk. If all the animals would be kept in one centre there would be a risk that the entire captive population could be wiped out in a short time by infectious illnesses or environmental catastrophes.

2. Capture of 20 founders specimens in a good state of health from the wild. A demographic study will determine ages, "sex-ratio" and time and areas in which the impact of the removal of specimens on the population will be lowest. If it is considered that a single ESU is to be preserved, 20 specimens represent an acceptable number from the point of view of being representative in the international studbook. On the other hand, if it is decided to carry out a separate breeding line, this number - with the future inclusion of a few more specimens - could be enough to lead to a large-scale project.

3. Genetic and demographic programmes with the captive population. Genetic and demographic handling plays a fundamental role in maintaining captive populations. The purpose of the handling is to retain maximum allelic diversity, to prevent, as far as possible, consanguinity and to decrease the possibilities of starting a depression due to endogamy. A plan must be devised to establish the goals of the genetic handling of the breeding programme: the percentage of the genetic variability existing in nature that can be preserved in the founder population and what proportion of males and females must be kept in captivity to reach and maintain the goals established. It is important to promote work related to the genetics of wild populations and to genetically characterise all the individuals of the captive population. To establish more ideal crosses and to refine genetic handling, the founder animals need to be genotyped. The demographic objectives of the captive population will depend on the results of the genetic studies and of the ESU to be preserved. In the case of a single ESU, the specimens in the stock will be added to the existing studbook of specimens originating from the eastern population and if there are to be separate breeding lines, the number of founder animals and the number of stock centres must be increased to reach a population of 400-500 captive specimens to maintain the heterozygosity of the population for 100 years at a level of 90-95%.

Development of health protocols with regard to the inclusion of new specimens in the stock, maintenance in captivity, exchange-transfer of specimens between centres and projects to reintroduce-reinforce the population. If we assume that possibly one of the main threats to the species in its natural environment are pathological problems (Mañas et al., 2001) preventive work on health aspects must be a maximum challenge in the breeding project. It is important to determine the health risks associated with the entire programme of preserving the captive species. On the other hand, the state of health of a captive population is critical for its welfare, its reproduction success and its long-term survival. The aim is to maintain the captive population in an optimal state of health and to prevent the transmission of disease between the wild population and that one in captivity and between the various captive stocks.

Initially, the breeding programme will be organised following the structure of the Regional European Breeding Programmes (EEPs). Depending on the results of the genetic studies and the evaluation made by the scientific community, all the animals in the existing EEP will be included or a separate breeding line will be maintained, promoting the co-ordination with France to maintain a single studbook of the species.

EL PONT DE SUERT BREEDING CENTRE

Currently, there is a LIFE Project that contemplates as one of its main activities, the construction and creation of a stock of European mink in captivity in El Pont de Suert (Lleida, NE Spain). However, this effort should be jointly shared with other future captive breeding centres which should be created to safeguard the species in Spain and France.

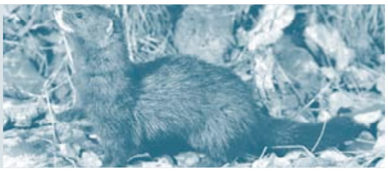
The founder individuals will go through an initial quarantine in their place of origin until the results of the health tests have been obtained, and then another later quarantine at the Breeding Centre before joining the stock. All the animals that are seropositive for ADV will be released back into the place from which they were caught.

The property destined has an area of 2,970 m^2 and will be divided into two sections: the mink enclosures and the annexed building. The centre will be designed so that the animals can be handled causing as little stress as possible and to maximise the health measures to prevent, as far as possible, the introduction of illnesses.

Mink enclosures will be built for 56 adult specimens (56 outdoor naturalised installations with riverbank vegetation and running water). Each enclosure will have an outdoor area (16 m^2 per installation) as well as an indoor area (nesting boxes). The enclosures that will be built will be adapted so that they can be divided into two smaller enclosures of 8 m^2 depending on the future needs of the centre. The total number of single animals that could be maintained in the future would be 112, in 8 m^2 enclosures.

Annexed building (management and research centre) will have a surface area of 140 m^2 with study room, lavatories, kitchen, and the handling facilities: quarantine, treatment, hospitalisation and surgery rooms, as well as a storeroom, an autopsy room, with an independent exterior entrance.

To safeguard the assumed subspecies from western mink population it will be necessary to create new centres with large capacity, to start a breeding programme in France with capture of new founders and the co-ordination of animals from western population as a single captive population.



ACKNOWLEDGEMENTS

This Breeding Program was made inside the European Mink Working Group (Wild Fauna and Flora Committee, National Commission for the Protection of Nature) with the recommendations of all their members.

The construction of a breeding centre and the maintenance of a captive European mink stock is included in the Life Project for the Preservation of the European Mink in Catalonia (LIFE02NAT/E/8604), co-ordinated with other Life projects in progress proposed by the Autonomous Governments of La Rioja (LIFE00NAT/E/7331), Junta de Castilla-León (LIFE00NAT/E/7299) and Álava (LIFE00NAT/E/7335) in which the Ministry of the Environment participates as a partner.

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[Conservation of the European mink, *Mustela lutreola*, in Estonia: an update 2001 -2003]

CONSERVACIÓN DEL VISÓN EUROPEO EN ESTONIA: ACTUALIZACIÓN 2001-2003

RESUMEN

Los esfuerzos de conservación del visón europeo en Estonia datan de principios de los 80. Las actividades siempre han incorporado dos componentes complementarios: conservación ex situ y conservación in situ. Las actividades principales anteriores a 2001 se han centrado en el establecimiento de un programa de cría, la evaluación del status del visón europeo en Estonia y las acciones preparatorias para el establecimiento de poblaciones en las islas estonas Hiiumaa y Saaremaa. Entre 2001 y 2003 la conservación ex situ ha continuado sobre todo con las actividades iniciales, reproduciendo anualmente 40 – 60 jóvenes para el programa de cría y proyecto de puesta en libertad. El número de animales en el servicio de cría ha sido de 105 – 108 animales. Los parámetros genéticos de la población EEP han mejorado desde el año 2000. Los animales seleccionados fueron previamente condicionados antes de su puesta en libertad y en el año 2003, se procuró una atención especial a los resultados del enriquecimiento medioambiental para mejorar la calidad del comportamiento de los visones nacidos en cautividad. También se le ha dado mucha importancia a la mejora de la gestión genética del stock cautivo, tanto en Tallinn como en Europa.

Running title:
[Conservation of the European mink in Estonia]

TIIT MARAN

Foundation LUTREOLA at Tallinn Zoo. Paldiski road 145. Tallinn 13522. ESTONIA

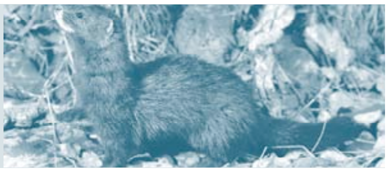
tiit.maran@tallinnlv.ee - tiit.maran@lutreola.ee

ABSTRACT

The European mink conservation efforts in Estonia date back to early 1980s. The activities have always incorporated two mutually supportive components: ex situ and in situ conservation. The main activities before 2001 have been focusing on the establishment of conservation breeding program, evaluation of the European mink status in Estonia and preparatory actions for establishment of island populations in two Estonian islands Hiiumaa and Saaremaa.

In 2001 – 2003 the ex situ conservation has mostly continued the earlier activities reproducing annually 40 – 60 young for breeding program and release purposes. The number of animals in breeding facility has been 105 – 108 animals. The genetic parameters of the EEP population have improved since 2000. The animals selected were preconditioned before release and in 2003, deeper attention was paid to environmental enrichment issues to improve the behavioral quality of captive born mink. High importance has also been given to the improvement of genetic management of captive stock both in Tallinn and in Europe.

In 2001 – 2003, altogether 155 mink were released in Hiiumaa Island. The survival has been low, being slightly higher than 10% for the next breeding season. The mortality of females seems to be much higher than that of the males. Such a high level of mortality complicates the establishment of the island population.



Therefore during the last years the main focus has been in applying of various release methods to increase the survival of females in the wild. In the future, the emphasis will be in testing various methodologies of release as well as preconditioning to increase the level of survival and thus reaching to the establishment of wild population in Hiiumaa. Once this aim is achieved, the operation for the establishment of next island population in the largest Estonian island Saaremaa (2400 km^2) will be launched.

KEY WORDS: *Mustela lutreola*, re-introduction, conservation, captive breeding, Estonia, eradication, *Mustela vison*.

INTRODUCTION

The aim of present study is to provide an overview about the efforts for conservation and restoration of the European mink in Estonia. The review focuses on the activities in 2001 – 2003 since the earlier activities have been described shortly elsewhere (Maran, 2003). However, to provide a general framework for the activities during 2001 – 2003, we also provide the aims of our effort and also short retrospective of the European mink conservation efforts since early 1980s.

AIMS AND OBJECTIVES

The global goal-setting for the European mink conservation efforts in Europe (Maran, 2003)[1] has been defined as follows:

- Establishment and maintenance of an all-European captive population consisting of 200 effectively breeding individuals divided between a number of facilities. This would secure the maintenance of 90% heterozygosity for 100 years and would require the actual overall carrying capacity in captivity between 364 – 693.

[1]This attempt to define the conservation target is made under the assumption that the European mink can be regarded as a single Evolutionary Significant Unit, although recent studies, though they have not been able to detect remarkable genetic differences, suggest separate management of the eastern population and the French/Spanish population (Davidson, et al, 2000). If this recommendation is supported by new studies and evidences and if time and allocated funds allow to put forward far more sophisticated goals, provided definition of target should be applied to both populations.

Entre 2001 y 2003, se liberaron 155 visones en la Isla de Hiiumaa. La supervivencia ha sido baja, ligeramente superior al 10% para la próxima temporada de cría. La mortalidad de hembras parece mucho mayor que la de los machos. Tal tasa de mortalidad complica el establecimiento de la población en la isla. Por lo tanto, durante el pasado año el principal objetivo ha sido la aplicación de varios métodos de puesta en libertad para incrementar la supervivencia de las hembras en libertad. En el futuro, el énfasis se pondrá en experimentar con varios métodos de liberación, así como en el acondicionamiento previo para aumentar el nivel de supervivencia, para así conseguir establecer de la población silvestre en Hiiumaa. Una vez se haya alcanzado este objetivo, se abordará la operación para el establecimiento de la próxima población isleña en la mayor isla de Estonia, Saaremaa (2400 km2).

PALABRAS CLAVE: Mustela lutreola, reintroducción, conservación, cría en cautividad, Estonia, erradicación, Mustela vison.

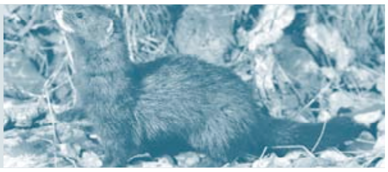
- 10 wild (or restored) populations in sites with a sufficient amount of suitable habitats inaccessible for American mink and with protection measures applied to prevent the impact of other possible causes of extinction (hunting prohibited and habitats protected)
  - the wild populations consisting of, as a minimum, the total of 1500 individuals participating in breeding (this will secure the maintenance of 90% of the initial heterozygosity for 200 years),
  - at least 30 – 40 breeding individuals in each site (a guarantee that these island populations will not vanish due to demographic stochasticity),
  - populations situated as evenly as possible over the historical range of the species (with 10 island populations the species is not likely to vanish due to environmental stochasticity and unpredictable catastrophic events).

The objectives for the conservation of the European mink in Estonia stem from the global aims. These are formulated in the European mink recovery plan in Estonia 2000 – 2004 (Maran, 2000):

- Ex situ: (1) Construction of a Special Breeding Facility for the European mink with the capacity of 200 animals; (2) Establishment of a captive population consisting of 200 individuals; (3) maintenance a favorable genetic and demographic structure of the stock and its behavioral identity; (3) integrated management of the Tallinn captive stock within the European mink EEP Program.
- In situ: (1) Establishment of two island populations from captive-born founders:
  - Population of min. 168-233 individuals in Hiiumaa Island (1000 km^2);
  - Population of min. 168-233 individuals on Saaremaa Island (2500 km^2);
  - Securing of the survival of these newly established wild populations on both islands through the relevant conservation measures.

RETROSPECTIVE OF CONSERVATION EFFORTS IN ESTONIA IN 1980 - 2000

a. Conservation of the European mink date back to early 1980s, when Tallinn Zoological Gardens undertook steps to assess the status of the European mink Estonia and to identify the actions feasible in Estonia for conservation of the species. Two possible directions were foreseen: captive breeding at Tallinn Zoo and establishment of island sanctuaries in Estonian large islands, especially Hiiumaa Island.



b. The first founders for captive breeding purposes were caught in Estonia in 1982. The first breeding occurred in 1986 and the regular breeding was achieved for mid-1990s (Figure 1). In 1998 the construction of new special breeding facility for the European mink was started to provide space for 200 animals. In 1994 -2000 the collaboration with the Central Forest Biosphere Reserve in conservation of the species resulted in 14 new founders, which are forming the most valuable part of the EEP population.

c. In 1992, the European mink EEP (European Endangered Species Program) under aegis of European Association of Zoos and Aquaria was launched to promote, integrate and coordinate the European mink conservation breeding in Europe, but also the in situ conservation. Tallinn Zoo and foundation LUTREOLA are coordinating this program and the conservation breeding in Tallinn forms a substantial part of the all-European Program: almost half of the overall European captive stock, which reached in 31.12.2002 to 224 individuals is hosted by Tallinn. Since the start of the EEP program also the European mink studbook has been kept. That incorporates not only the data about the animals in the European mink EEP Program, but all the known and available data on the European mink captive breeding since first known captive breeding event in 1933 in Moscow Zoo. At present, records of 1283 animals are registered in the studbook.

d. In 1980-s a study on the status of the species in Estonia was undertaken revealing the drastic change in the status: earlier widely spread European mink was present only in the north and northeast of the country; other parts were invaded by alien American mink (Maran, 1991). The last confirmed record of the European mink in Estonia dates back to 1996. Since then the original wild populations can be regarded to be extinct.

e. In 1997, a pilot study was undertaken in Hiiumaa (1000 km2) with the main aim to reveal the number of alien American mink there and to estimate the feasibility of a plan to eradicate this species and to start with establishment of European mink island population.

f. In 1998, the operation for eradication of the American mink in Hiiumaa was launched. First, the local hunters were involved, but later the Belarus researchers under the supervision of Dr. Vadim Sidorovich took over and completed this task for the beginning of 2000. Altogether 53 American mink were caught, 2 of them after the end of eradication operation. No signs of the alien mink have been detected since then.

g. In 2000, an experimental release of 17 European mink was undertaken. The main aim of the experiment was to gain information on the ways the captive born animals behave in the wild, the time needed for adaptation of the animals into wild, the effect of preconditioning and the main causes of mortality. All the animals were radio-collared. Half of the animals were preconditioned before release.

The main results of the experimental release were the following:

1. The adaptation period to the wild ranges from 1 to 1.5 month (n=5, min 25 days; max 72 days; median 31 days; mean 41,2 (95% CI 16.961 to 65.439).

2. The overall pattern of behavior of the animals during adaptation period consists of following components (MacDonald et al., 2002 and unpublished data):

a. Animals stay the first days after release close to the release site.

b. Thereafter animals undertook long movements through various biotopes and habitats often dangerous for mink (e.g. human settlements with dogs); this will last more than month an average.

c. For the end of adaptation period the mink tend to stay close to the running water seldom moving further than 50 meters from it and will form the home range. The average size of the home range was 3,04 km (95% CI 1,77 to 4,30 km; n=5; min 1,8; max 4,6; median 2,9; SD 1,016).

3. Three causes of mortality was identified: other carnivores (5 cases), bird of prey (1 cases), human (1 case). The mortality rate during the adaptation period remained between 33% - 77% with decline towards the end of the adaptation period.

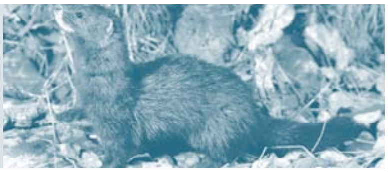
4. At least three animals survived until the end of the year and two were wild caught at the end of winter in 2001.

CONSERVATION EFFORTS IN 2001 – 2003

In this three-year period the in situ and ex situ operations have been more integrated than ever before: the aims and operations ex situ have been greatly defined by the needs of in situ operations in the wild; the steps undertaken in the wild were mostly shaped and limited by the possibilities provided by the ex situ operations.

Ex situ action: Conservation breeding

The capacity of the facility in Tallinn maintains maximum of 105-120 animals. We have calculated considering (1) the efficiency of breeding operation, (2) the needs of release, (3) the demographic parameters of the captive population and (4) the capacity of the facility, that the objective to produce every year 40-60 young is likely to keep our conservation operations on the safe side. Though, the ways to optimize the joint genetic management both of the captive stock and re-introduction needs a further elaboration.



The reproduction in the facility at Tallinn Zoo has been within these limits (Table 1). The pairs for breeding have been selected on the bases of genetic parameters and with the help with analyzing software accompanying with SPARKS studbook database (Single Population Analyses & Records Keeping System; www.isis.org) and PM2000 (www2.netcom.com/~pm2000/). The genetic status of the European mink captive population managed by European mink EEP Program under the aegis of European Association of Zoos and Aquaria has been improving since 2000 (table 2). As the maintenance of sound captive population is of utmost importance for the conservation of the European mink and serves as a "warranty" for survival of the species even if the remaining original wild populations will entirely vanish, it has been decided that the requirements of the captive population to maximize and maintain its genetic diversity must be superior to the requirements of re-introduction operations. Therefore, only surplus animals of lower genetic value were decided to use for re-introduction until the ways to optimize the needs of both, the genetic requirements of conservation breeding and the re-introduction, have been elaborated.

The animals selected for release have been trained whenever possible, though in 2003 it was performed only partially. General features of pre-conditioning have been the following:

1. minimum possible contact with keepers,
2. provision of live prey available in the wild
3. training of swimming, diving and fishing
4. enrichment of the interior of enclosures with natural objects
5. conditioning of anti-predator behavior with domestic dog.

In 2001, 28 mink out of 41 were trained before release. During three-weeks period preceding the release the animals were provided a live prey they can find in the island: frogs, *Rana temporaria*, fish, *Carassius carassius*, rodents, *Apodemus flavicollis*, *Rattus norvegicus*, *Apodemus agrarius*, *Clethrionomys glareolus*, but also live partridges and chicken as a part of regular zoo diet. They were also provided diverse natural interior for getting used to natural environment (stones, stunts, tunnels, etc). The standard nest box was removed from enclosure so that animals had to build its own burrow(s). The animals were tested about the ability to swim, dive and catch fish. Those, without this ability, were specially trained. To increase the human avoidance behavior in mink the non-transparent fences were constructed between the service corridor and the enclosures; the husbandry after the animals was reduced to minimum possible. To effectuate the anti-predator behavior the mink were conditioned with domestic dogs: the dogs were given a chance to attack the mink in its enclosure in the way the mink could escape into its burrow. This was done only once to avoid the possible habituation of mink to the presence of larger carnivore.

The same scheme of training was applied also in 2002. In addition, three large 100-m^3-enclosures with fully natural interior were constructed. These were used for females selected for release.

In 2003, the provision of the live prey was impossible, as the exceptionally cold winter lasted so long that it was impossible to perform the proper training with live prey. Also, the training of animals in spring in swimming, diving and fishing could not be performed for the same reason. Hopefully, the training performed in the year 2002 still had its effect for animals released in 2003.

In 2003, apart from the training of the animals selected for release, serious attention was paid for behavioral enrichment for all mink in facility. The idea was to try to increase the overall fitness of the animals in the facility and, this way, also contribute to the survival of the mink once they have been released in the wild. Various elements were tested for enrichment: (1) adding regularly new elements into the enclosure like stunts, tubes, leaves; (2) hiding food into various places; (3) regularly changing the interior of the enclosure; (4) moving the elements (e.g. tubes and stunts) of the enclosure from one animal to another; (5) making temporary muddy ponds into the enclosure; (6) providing the pile of woodchips stained with the urine of the rats; (7) reducing visual contact with keepers; (8) providing live food etc.

The means, which had something to do with the olfactory signals (of its kind or of the prey species), seemed to be the most efficient. For the interior furnishing, the most important items seem to be the tubes and stunts or anything else, which increases the possibility of hide, and the presence water. Also, the live food is important for the behavioral enrichment of the mink. The stereotyped movements of animals decreased significantly with decrease the visual contact with keepers.

In situ actions in 2001: release

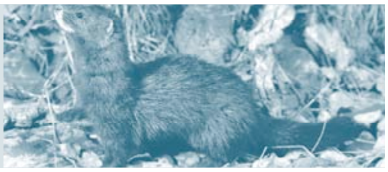
The data on the number of animals released in 2000-2003 are provided in table 3.

Plan for release in 2001 was shaped according to the experience gained in 2000. Altogether 41 (20 males and 21 females) animals were released. A lot of attention was paid to collect information about the size of the home range, the patterns of daily activity, the length of daily movements and the feeding habits of released mink (unpublished data).

Although the initial results of the release were quite encouraging and the mortality during adaptation period seemed to remain between 33 – 77 % like in 2000, the results of monitoring next spring (2002) revealed something unexpected: only 6 animals were detected in the wild (5 males and 1 female) with one of the males from release 2000.

Three important conclusions with serious implications to future re-introduction can be drawn from the experience of the 2001 release:

1. The survival of the mink for the next breeding season depends on the level of mortality occurring during the adaptation period and the mortality during winter. The overall survival for the next year tends to be around 10%. That is far too low for quick establishment of the island population.



2. Most of the mortality occurs during adaptation period, when the animals are moving through biotope uncommon and unsuitable for them biotopes (like heath, human settlements etc).

3. The mortality of the females seems to be higher than that of males. Although both in 2000 and 2001 almost equal number of males and females were released (table 2), as far as the available data suggest, for spring 2001 all the surviving animals were males. For spring 2002 only one of the six monitored mink was female. Therefore the survival of females seems to be the most critical issue in process of establishment of island populations.

In situ action in 2002: release

Considering the cutback in survival of the mink released in 2001 it was decided to re-evaluate the release technique used so far. The following was decided to conduct: to increase the overall survival of mink for the next breeding season by all possible means focusing especially on attempts to (1) reduce the mortality of females before breeding in the wild, and (2) reduce the animal's tendency to leave from riparian zone during adaptation period.

To gain success the following aspects were incorporated to the methodology of release:

(1) Release of pregnant females. The use of pregnant females is controversial due to the expectedly higher mortality of pregnant females after release. Despite of this, it was decided to release approximately half of the females after they were conceived in the breeding facility and to compare their mortality with that of the non-pregnant females. In case of success, this approach would allow increasing the number of wild-born mink quickly and would also reduce the impact of the mortality during adaptation period.

(2) Release of females in their nest-boxes. To avoid the animals leaving from riparian zone, the animals were released with special nest-box provided for them approximately month before release. This nest-box was dug into the bank of the watercourse with animal in side and there after the exit from the box was open for the animal. This was hoped to keep the animals from leaving their habitat during the first month of adaptation.

(3) Release of surplus juveniles in the autumn. With this additional release it was hoped that the number of surviving animals for the next breeding season in the wild will be higher.

The results of the release in 2002 can be summarized as follows:

1. We could not detect a difference between the survival of pregnant and non-pregnant females.

2. Young from at least three litters born in the wild were discovered in August 2002, evidencing the success of pregnant females.

3. At least half of the females released in nest-box stayed close to the nest box in riparian zone for at least a month.

4. During the monitoring session in early 2003 six animals were live-trapped (5 males and a female and one male from release in 2001). None of the re-trapped animals was from the litter born in 2002 in the wild. Although it is likely that not all the surviving mink were live trapped, the actual number of surviving European mink could not be much higher than in 2001 – the survival was around 15%.

The low survival rate can partly be explained by exceptional drought in the summer of 2002 followed by very cold and long winter. The drought was the worst since 1975 (Põdra & Maran, 2003) and almost all the watercourses dry entirely. The following exceptionally severe and long winter resulted in streams freezing to the bottom and that was likely to reduce the survival of mink even more.

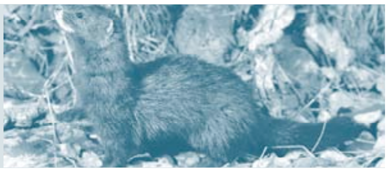
Despite of this, it is clear that the survival stays relatively low even with the new methods employed. It all indicates that the establishment of the wild population is a long process and for better success new methodologies for pre-conditioning and for release have to be applied and tested.

In situ action in 2002: feasibility study in Saaremaa Island

The intention to establish in the future an island population for the European mink also in the second large island in Estonia, the Saaremaa Island (~2.400 km^2) require detailed knowledge about the island: potential capacity suitable habitats, availability of food resources and identification of possible problems. For that purpose a feasibility study was conducted in 2001 -2002 in that island (Maran & Põdra, 2002). Dr. Vadim Sidorovich with its participation greatly contributed to success of the field activities. The main results of the study are the following:

- The capacity of the island in winter falls between 150 -300 European mink
- There is no viable population of American mink, *Mustela vison*, in Saaremaa
- The areas with most suitable habitats for the European mink were identified.
- The prey items available for the populations are the fish (numerous), small mammals (especially *Arvicola terrestris*, which is very numerous in Saaremaa), crayfish (*Astacus astacus*). The amphibians have surprisingly low abundance in the island.
- Two problem areas were identified:
  - Very high number of fox, *Vulpes vulpes*, raccoon dog, *Nyctereutes procyonoides* and pine marten *Martes martes*. This is likely to increase the mortality of released European mink.
  - Unsubstantiated worry of some local inhabitants that the released European mink would terminate the viable population of river crayfish, Astacus astacus in Saaremaa Island.

The feasibility study provided us important guiding information for design of the release operation in Saaremaa, but also, it was the first round of acquainting the local stakeholders with our plans.



In situ action in 2003: release and preparation of management plan

In 2003, a record number of animals were released (Table 3). The same pattern was used: the main release in late spring including pregnant females and supplementary release of surplus juveniles in early autumn. In previous years, it seemed that animals born and kept in larger enclosures (100 m^2 or more) were more likely to survive. Therefore four females selected for release were kept in these enclosures, conceived there and released after 10 – 14 days of pregnancy. In autumn, 11 out of 18 released juvenile were born in large enclosures and were released in time of their assumed natural dispersal.

The main concern with the release in 2003 is that also this year the draught was remarkable, which is likely to have a negative impact to the survival of the animals. The results of the release 2003 will become available only after the survey in late winter 2004 has been completed.

Along with the continuing release process in 2003, the substantial share of resources was devoted for preparation of the action plan for the European mink in Hiiumaa Island 2004 – 2008 (Põdra & Maran, 2003). The action plan envisages the activities needed for the further establishment of the European mink island populations and for long term maintenance of it thereafter. In the course of this activity also detailed data were collected in the field about the quality and capacity of the habitats, but also the food resources, like the status of fish, amphibians and the grayfish. These performed studies allowed us to estimate more precisely the potential number of European mink in the island. According to the new data the presently available habitats in Hiiumaa provide space for 50 – 92 individuals in winter and 80 – 109 individuals in summer. This number is somewhat lower than our earlier calculations estimated. This number can be increased with relatively simple habitat restoration to 63 – 117 in winter and probably much more for summer period. Therefore, the actions plan provides the list of restoration activities needed to improve the overall quality of running water habitats and to restore these ones deteriorated by the land reclamation activities in Hiiumaa Island in the past. The action plan also identifies the core (source) areas for the European mink, which have to be protected in the framework of Natura 2000 Network. It also foresees activities to mitigate the possible conflict situations with the stakeholders. For long-term management of the island population the action plan foresees the permanent position of species conservation expert at the Administration of Hiiumaa Protected Area, whose main duty is the management of the European mink population in Hiiumaa (and later perhaps also in Saaremaa Island).

DISCUSSION AND CONCLUSIONS

The conservation efforts in 2001 – 2003 have been less effective than assumed. The experience gained has shown that the process of establishment a new wild population with the captive born founders is a complicated and long process. It cannot be achieved by short project based approach, but long-term commitment is needed. Also, as currently used approaches for release have not been sufficiently feasible, the new methodologies have to be tested in the course of action. The main “bottleneck” in the way to success seems to be the low survival rate of released females, so this issue has to be addressed in testing the new methodologies first of all.

It is also obvious that deeper integration of the ex situ and in situ tools form a ground for new and possibly more successful approaches.

In ex situ, two directions for further actions have been foreseen Estonia: (1) increase of the overall behavioral "quality" of the animals and to reverse the negative impact of captive conditions as much as possible to the behavioral repertoire of the species and (2) further development of the pre-release training.

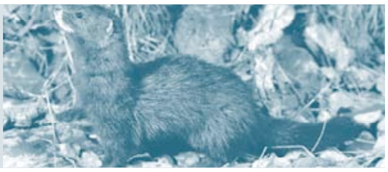
For improvement of behavioral "quality" a special attention have to be paid to further behavioral enrichment. For this purpose various ways to diversify the conditions for animals in captivity, including the husbandry routine, were tested in 2003, and the same is among planned activities for 2004 and 2005 as well.

To improve the pre-release training, the main issues to be tackled are the improvement of training of anti-predator behavior and the ways how to secure the natural prey items for the animals during longer time period before release, but also how to provide for the animals the more natural opportunities to seek and hunt the prey species.

In more general terms, one of the urgent issues in need of solution is the elaboration of conceptual framework how jointly manage the captive population and the release operation in terms genetic and demographic requirements. Without that a danger exists that via the release operation valuable genes will be flushed out from captive population.

To reduce the mortality rate among the released mink various release methodologies (including also the captive maintenance and pre-conditioning of the animals) have to be tested. One way to reduce the mortality of released females during winter might be to re-trap them in late autumn, to keep them in captivity until next spring and release again into the same location (either conceived or not in captivity). This approach will be tested in 2004 – 2005. In addition, to the already used release techniques, the applicability of soft release methodology will be tested in 2004. For that purpose 1 - 3 temporary enclosures are planned to construct in Hiiumaa in mink biotopes. The females will be housed into these enclosures early spring, they will be conceived and the offspring will be kept there until their assumed natural dispersal time. Then gates will be opened but the feeding will be continued. The young will be radio-collared, which provides the opportunity to monitor the behavior of the juveniles during dispersal into the wild.

The main cause of mortality in Hiiumaa has been other carnivores like fox, domestic dogs and pine martens. Yet, it is obvious that the larger carnivores can not be regarded as the only cause of the death during adaptation period, but in reality there is a set of factors having an impact to the survival of the mink, like initial inability of released mink to efficiently exploit the food resources, inexperience in restricting its movements to the riparian zone and inexperience to hide from the predators. All these factors make the released mink a likely target for other carnivores. To reduce the impact of larger carnivores an experimental campaign is foreseen starting with 2005 with local hunting organizations to reduce the number of medium-sized carnivores in Hiiumaa Island.



The actions undertaken so far have shown that the establishment of wild population of mink with founders of captive origin is a complicated task and not achievable within a time-limits of typical project. We believe that for gaining success a long-term commitment is needed and lots of testing and experimenting of various methodologies are still required. We feel that, once the success has gained and the best methodologies are identified, the result will not be only a viable population in Hiiumaa Island (and also in Saaremaa Island), but also knowledge and experience gained can later easily and less costly be applied to similar situation elsewhere in Europe.

PARTNERS AND SUPPORTERS OF THE CONSERVATION OPERATIONS

During a period of 2001 -2003 the project has been run under the aegis of EU LIFE Program (Project No LIFE2000NAT/EE/7081). In addition, several other institutions have been contributed to the success of the project: Tallinn Zoo (Estonia), Zoos Help Foundation (the Netherlands), Rotterdam Zoo (the Netherlands), Estonian Environmental Investment Center (Estonia), Administration of Hiiumaa Protected Areas (Estonia), Bernhandine Foundation (the Netherlands), Denver Zoological Society (USA), Thoiry Zoological Park (France), Apenheul Primate Park (the Netherlands), Helsinki Zoo (Finland), Zoological Society for the Conservation of the Species and Populations (Germany).

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[Trapping of European mink (*Mustela lutreola*) and other carnivores in Spain]

COLOCACIÓN DE TRAMPAS PARA EL VISÓN EUROPEO (*Mustela Lutreola*) Y OTROS CARNÍVOROS EN ESPAÑA.

RESUMEN

En el periodo 1990-2003 se trampeó en muchas localidades del norte y nordeste de España. El principal objetivo de estos trampeos fue la captura de carnívoros de medio y pequeño tamaño, especialmente del visón europeo Mustela lutreola, siendo realizados en Cataluña, Cantabria, Navarra, Burgos, Álava y La Rioja.

La metodología fue, principalmente, el uso de estaciones de trampeo (10 trampas situadas a lo largo de las orillas de los ríos durante 10 días). Las trampas "en vivo" fueron diferentes (cepos con protección, trampas de hierro y de madera) en le comienzo, pero posteriormente se uniformizó al uos de cajas trampas de hierro.

En total, se colocaron 28.851 trampas noche (13.064 en Cataluña: Barcelona, Tarragona and Gerona) y 15.787 en el norte de España (Cantabria, Navarra, La Rioja, Burgos y Álava). La mayoría de las trampas (> 80 %) fueron colocadas entre octubre y abril. Se capturaron 148 visones europeos, 87 visones americanos Mustela vison, 9 turones Mustela putorius, 1 armiño Mustela erminea, 9 comadrejas Mustela nivalis, 38 garduñas Martes foina, 71 ginetas Genetta genetta, 31 gatos domésticos Felis catus y 9 carnívoros indeterminados.

Running title:
[Trapping European mink in Spain]

Santiago Palazón[1,2], Jordi Ruiz-Olmo[1], Joaquim Gosálbez[2], Laura Arjona[2], Toni Batet1, Yolanda Melero[2], Asun Gómez[3] and Elena Rafart[2].

[1]Environment Department, Generalitat de Catalunya, Dr. Roux, 80, 08017 Barcelona, Spain.

[2]Animal Biology Department, Barcelona University, Avda Diagonal, 645, 08028 Barcelona, Spain.

[3]Bajada al Molino, 14, 09400 Aranda de Duero, Spain.

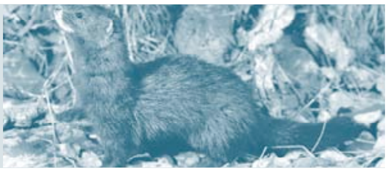
Santiago Palazón
Environment Department, Generalitat de Catalunya
Dr. Roux, 80 - 08017 Barcelona, Spain
E-mail: santiago.palazon@gencat.net

ABSTRACT

During the period 1990-2003 we trapped on many locations in the northern and north-east Spain. The main goal of these trappings was to capture small and mid-size carnivores, especially the European mink *Mustela lutreola*, being carried out in Catalonia, Cantabria, Navarre, Burgos, Alava and La Rioja.

Methods were, mainly, the use of trapping stations (ten traps set along riverbanks stream for ten days). The live-capture traps were different (protected ceps and iron and wooden box traps) at the beginning, but later we changed to use just iron box traps.

In total, 28,851 traps per night (13,064 in Catalonia: Barcelona, Tarragona and Gerona) and 15,787 in northern Spain (Cantabria, Navarra, La Rioja, Burgos and Alava) were placed. Most of traps (> 80 %) were placed between October and April. We captured



148 European minks, 87 American minks *Mustela vison*, 9 polecats *Mustela putorius*, 1 stoat *Mustela erminea*, 9 weasels *Mustela nivalis*, 38 Stone martens *Martes foina*, 71 Spotted genets *Genetta genetta*, 31 domestic cats *Felis catus* and 9 undetermined carnivores. Besides 381 other species of mammals, especially hedgehogs, rats and mice, were captured.

The type of trap and the methodology of trapping stations was the most appropriated method to capture a major percentage of European minks (56.7 % of carnivores captured), with a percentage of capture of 0.94, a mink for 107 traps night, on the Autonomies Communities (northern Spain) where this species range. Besides, it was the most efficient to capture semi-aquatic mustelids, displacing for riverbanks of rivers and waterbodies –minks and polecats- (0.85 %), a semi-aquatic mustelid for 118 traps night.

Key words: Trapping, European mink, carnivores, Spain.

Además, se capturaron 381 otras especies de mamíferos, especialmente erizos, ratas y ratones.

El tipo de trampa y la metodología de estaciones de trampeo fue el método más apropiado para capturar el mayor porcentaje de visones europeos (56.7 % de los carnívoros capturados), con un porcentaje de captura de 0.94, un visón europeo por cada 107 trampas noche, en las Comunidades Autónomas (norte de España) donde se encuentra esta especie. Además, fue la más eficaz metodología para capturar mustélidos semi-acuáticos, que se desplazan por las orillas de los ríos y zones húmedas –visones y turones- (0.85 %), un mustélido semi-acuático por cada 118 trampas noche.

Palabras clave: Trampeo, visón europeo, carnivoros, España.

INTRODUCTION

Live-trapping is a method needed to carry out studies on small and medium size carnivores, included to know their distribution, and estimate and manage their populations. The nocturnal and elusive lifestyle of these mammals made it necessary. For instance, the tracks and scats of European polecat, European and American minks are very similar (Sidorovich 1994) and when they share the same distribution, trapping is the only method to know the presence of these species. Trapping is widely used by researchers and managers in order to capture mammals for census and population management (Sutherland 1996). The European mink *Mustela lutreola* is the most endangered mustelid in Europe. The study of distribution, the status and the ecology of this species was the aim in northern Spain. Whereas, the capture of American mink *Mustela vison* and the study of distribution, the status and the ecology of European polecat *Mustela putorius* were the aims in north-east Spain (Catalonia). Much information about the trapping of carnivores was compiled for 14 years in northern Spain.

MATERIAL AND METHODS

During the period 1991-2003, many locations in the northern and north-east Spain, were trapped. The main goal of these trappings was to capture small and mid-size carnivores, especially *Mustela lutreola*, *Mustela vison* and *Mustela putorius* being carried out in Catalonia (Barcelona, Tarragona and Gerona) and northern Spain (Cantabria, Navarra, Alava, Burgos and La Rioja).

The trapping station (ten traps set along riverbanks stream for ten days, and spaced at least 100 metres apart) was the method used. The live-capture traps were different (protected snares –Victor Coil- and iron and wooden box traps) at the beginning, but later we have changed to use just iron box traps -15 x 15 x 60 cm-. Sardines, meat and eggs were the baits used. Besides, fried oil scent was used to lure the carnivores at the entrance to the traps.

The study area was divided in northern Spain and Catalonia (Fig. 1), because in northern Spain the aim was the capture of *Mustela lutreola* and in Catalonia the aim was the capture of *Mustela vison* and *Mustela putorius*. Besides, the presence of Mustela lutreola in Catalonia is very scarce, just in the south. The results were studied according to this division of the study area. Chi-square was used to compare the capture of carnivores (sex, age and day of capture).

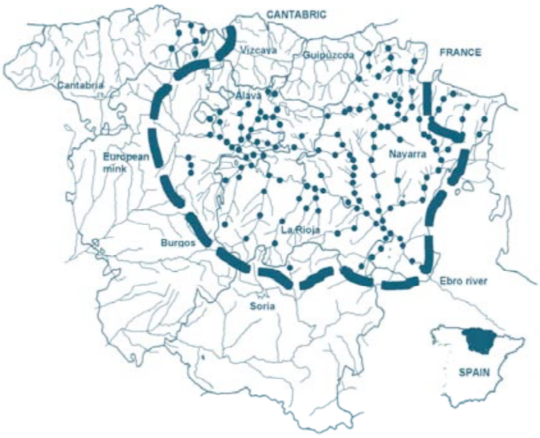


Figure 1. Location of trapping stations on study area: northern Spain.

Figura 1. Localización de las estaciones de trampeo en el área de estudio: norte de España.

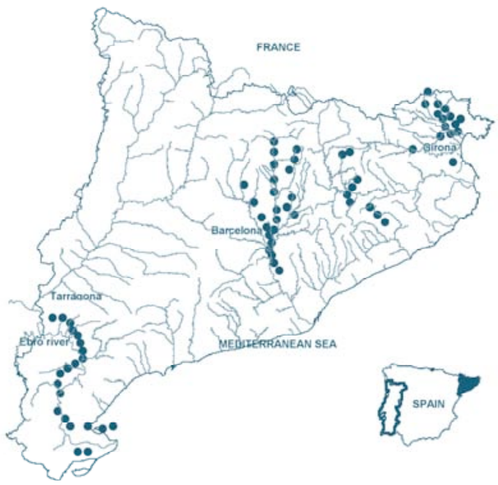
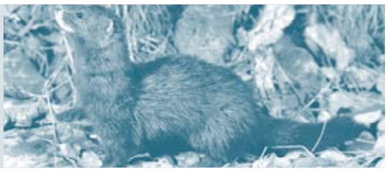


Figure 2. Location of trapping stations on study area: Catalonia.

Figura 2. Localización de las estaciones de trampeo en el área de estudio: Cataluña.



RESULTS

Three hundred and eighty six trapping stations were placed, with 28,851 traps night. Seven hundred and eighty four mammals (2.72 % = 2.72 mammals per 100 traps night) were captured, which 404 were carnivores (1.40 %). Besides, 148 *Mustela lutreola*, 87 *Mustela vison* and 9 *Mustela putorius*, 1 stoat *Mustela erminea*, 9 weasels *Mustela nivalis*, 38 Stone martens *Martes foina*, 71 Spotted genets *Genetta genetta*, 31 domestic cats *Felis catus* and 9 undetermined carnivores were captured. All together, minks and polecats were 243 animals (0.85 %).

In Catalonia, 136 trapping stations were placed, with 13,064 traps night. One hundred and thirty five carnivores were captured: 81 *Mustela vison* (60.0 % of carnivores), 5 *Mustela putorius* (3.7 %), 13 *Martes foina* (9.6 %), and 23 *Genetta genetta* (17.0 %). The minks and polecats were the 63.7 %.

In northern Spain, 250 trapping stations were set, with 15,787 traps night. Two hundred and sixty one carnivores were trapped: 148 *Mustela lutreola* (56.7 % of carnivores captured), 1 *Mustela vison*, 4 *Mustela putorius*, 24 *Martes foina* (9.2 %), and 48 *Genetta genetta* (18.4 %). The minks and polecats were the 59 %.

In the two study areas, the minks (European mink, American mink and polecat) trapped were 244 (60.7 %), the Stone martens were 38 (9.45 %) and the Spotted genets were 71 (17.7 %).

In the two study areas together, the minks (European mink, American mink and polecat) trapped were 244 (60.4 %), the Stone martens were 38 (9.4 %) and the Spotted genets were 72 (17.6 %). The percentage of carnivores captured was different according to sex and age (Table 2). More males than females of carnivores ($p = 0.005$), minks ($p < 0.001$), and *Mustela lutreola* ($p < 0.001$) (Fig. 3) were captured. More adults than youths of carnivores ($p < 0.001$), minks ($p < 0.001$), and *Mustela lutreola* ($p < 0.001$) were trapped. Only *Mustela lutreola* ($p = 0.03$) and *Mustela vison* ($p = 0.003$) were more captured during the first five days of trapping. Between October and March were the months with highest percentage of mink captures (1.04 % in northern Spain). In contrast, between April and September the percentage was 0.2 % in the same area (Fig. 3).

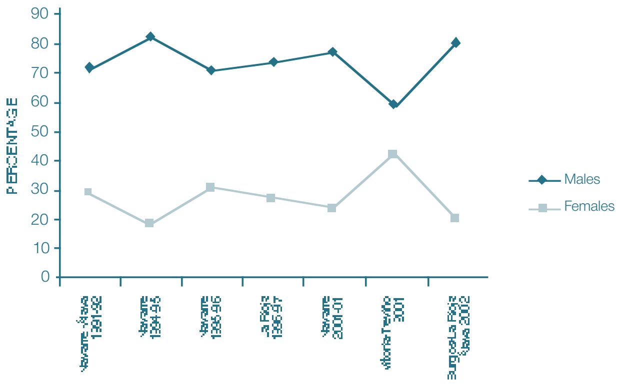


Figure 3. Comparison of the different percentage of Mustela lutreola males and females captured for this trapping period in northern Spain

Figura 3. Comparación de los diferentes porcentajes de machos y hembras de Mustela lutreola capturados durante este periodo de trampeo en el norte de España.

DISCUSSION

The type of trap and the methodology of trapping stations was the most appropriate method to capture a higher percentage of European minks (56.7 % of carnivores captured), with a percentage of capture of 0.94, a mink per 107 traps night in northern Spain, where this species ranges. Besides, it was the most efficient method to capture semi-aquatic mustelids (European mink, American mink and polecat), displacing along the banks of rivers and water-bodies. After they, Spotted genet and Stone marten were the small and medium size carnivores more captured.

The next trappings must be carried out between October and March, when the trapping effort must be more intense if the capture of minks is the objective. At the beginning of this period, is the dispersal season of young minks. At the end of this period is the mating season, when the males are easier captured, because they present higher activity. Besides, the trapping must be avoided when the females of European mink are pregnant or caring the offspring (from April to September).

In other studies carried out in northern Spain (Zabala et al. 2001), the capturability of European mink and the efficiency of capture were also higher in winter. Two factors are important: scarcity of potential preys and food, and ethological changes during the mating season, especially males (Zabala et al. 2001). Although, mustelids usually show a wider trophic niche, winter is the season with the season with the most severe conditions for them.

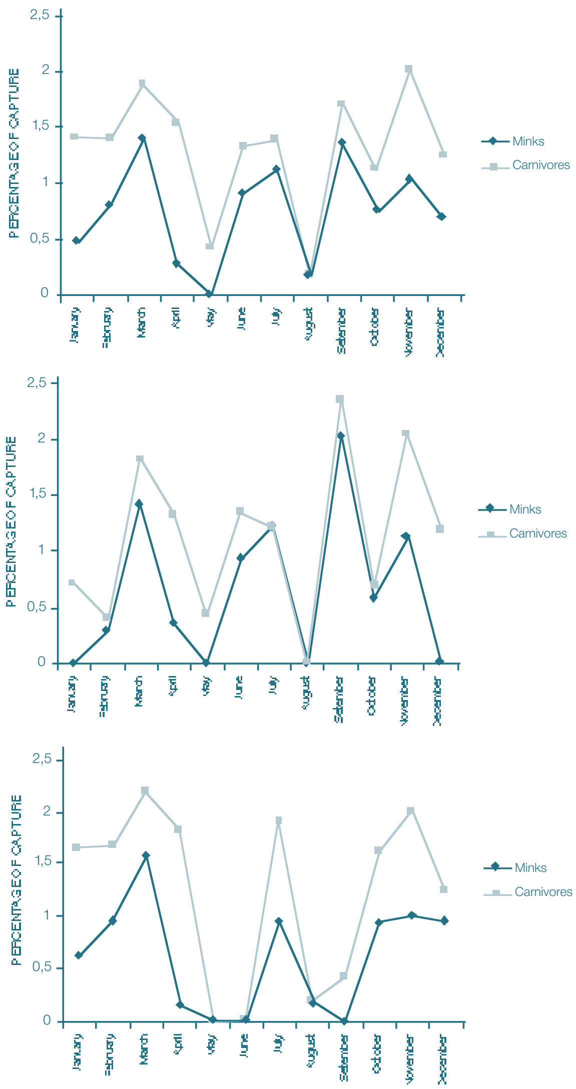
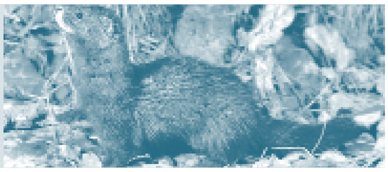


Figure 4. Comparison of the different percentage of capture of minks (M. lutreola, M. vison and M. putorius) and carnivores captured by months in Spain (up), Catalonia (centre) and northern Spain (down).

Figura 4. Comparación de los diferentes porcentajes de captura de visones (M. lutreola, M. vison y M. putorius) y carnívoros capturados por meses en España (arriba), Cataluña (centro) y norte de España (abajo).



For these years the percentage of males captured, especially minks (between the 60 and 80 % of European mink captured), was higher. On the contrary, the females were lesser captured (between 20 and 40 % of European minks captured). The males have a larger home range, greater movements and higher activity rate than females. So, males are more captured than females (King 1975, Simms 1979, Buskirk and Lindstedt 1989). When males are more captured than females, don't mean that males are more abundant and the females more scarce. The likelihood of place a trap inside of a male home range is higher.

The great difference observed between young and adult captured, especially in minks (European and American mink, and polecat) is due to quick growth of minks. With three months, European minks reach the adult size (Maran and Robinson 1996). The higher youth mortality is also a cause of that difference. At last, the placing period of higher percentage of traps influences to capture more adult minks than youth ones.

ACKNOWLEDGEMENTS

This research was funded by Spain Environment Ministry, Government of Navarra, Government of La Rioja and Generalitat of Catalonia. We also grateful to Governments of Cantabria and Alava. The trappings during 2001-2003 were carried out within European mink conservation project in La Rioja (LIFE: 00NAT/E/7331), Burgos (LIFE: 00NAT/E/7299), Alava (LIFE: 00NAT/E/7331) and Catalonia (LIFE: 02NAT/E/8604) and they were supported by European Union, Environment Ministry, Government of La Rioja, Government of Castilla and Leon, Government of Alava and Generalitat of Catalonia.

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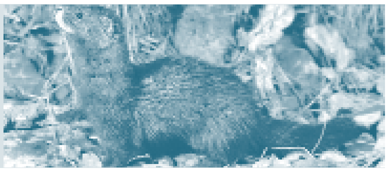
Zone and year	Number Stations	Traps night	Nº and % Captures Carnivores	Nº and % Captures Minks	Nº and % Captures M. lutreola	Nº and % Captures M. vison
Barcelona 1991	10	1,330	16 1.20	0	0	14 1.05
Navarra 1991-92	71	1,775	25 1.41	8 0.45	8 0.45	0
Álava 1992	2	209	4 1.91	2 0.96	2 0.96	0
Navarra 1994-95	71	5,106	91 1.78	37 0.72	36 0.71	0
Tarragona 1995	13	929	9 0.97	0	0	0
Navarra 1995-96	12	1,246	35 0.28	27 2.17	27 2.17	0
La Rioja 1996-97	22	1,884	21 1.01	16 0.85	16 0.85	0
Barcelona 1999	10	988	10 1.11	1 0.10	0	1
Tarragona 1999	10	799	1 0.13	0	0	0
Girona 2000	33	3,429	14 0.41	5 0.15	0	0
Navarra 2000-01	45	3,189	45 1.41	33 1.03	32 1.00	0
Cantabria 2000	6	477	2 0.42	0	0	0
Alava 2001	9	759	14 1.84	13 1.71	11 1.45	0
Treviño 2001	1	140	3 2.14	1 0.71	1 0.71	0
Girona 2002	14	1,040	7 0.67	1 0.09	0	1 0.10
Burgos 2002	1	132	3 2.27	0	0	0
Burgos-La Rioja-Álava 2002	10	870	18 2.07	16 1.83	15 1.72	1 0.11
Barcelona 2002	17	1,395	36 2.58	34 2.44	0	34 2.44
Girona 2002	2	246	9 3.66	5 2.03	0	5 2.03
Tarragona 2002-03	9	1,101	3 0.27	0	0	0
Barcelona 2003	17	1,601	27 1.68	25 1.56	0	25 1.56
Girona 2003	1	206	10 4.85	6 2.91	0	6 2.91
TOTAL	386	28,851	403 1.40	244 0.85	148 0.51	87 0.30

Table 1. Zones, years and number of trapping stations, number of traps night and percentage of carnivores, minks (European minks, American minks and European polecats), European mink Mustela lutreola and American mink Mustela vison captured.

Tabla 1. Zonas, años y número de estaciones de trampeo, número de trampas noche y porcentaje de carnívoros, visones (visón europeo, visón americano y turón europeo), visónes europeos Mustela lutreola y visones americanos Mustela vison capturados.



	SEX		AGE		DAY OF CAPTURE	
	Males	Females	Youths	Adults	< 5 days	> 5 days
Nº Carnivores	151,0	106,0	30,0	215,0	192,0	167,0
% Carnivores	58,7	41,3	12,2	87,8	53,5	46,5
Nº Minks	124,0	50,0	24,0	139,0	105,0	106,0
% Minks	71,3	28,7	14,7	85,3	49,8	50,2
Nº *M. lutreola*	82,0	27,0	5,0	104,0	69,0	46,0
% *M. lutreola*	75,2	24,8	4,6	95,4	60,0	40,0
Nº *M. vison*	35,0	21,0	20,0	25,0	30,0	57,0
% *M. vison*	62,5	37,5	44,4	55,6	34,5	65,5

Table 2. Number and percentage of carnivores, minks (European minks, American minks and European polecats), Mustela lutreola and Mustela vison captured, according to sex, age and day of capture.

Tabla 2. Número y porcentaje de carnívoros, visones (visones europeos, visones americanos y turones europeos), Mustela lutreola and Mustela vison capturados, según el sexo, la edad y el día de captura.

[Changes in the distribution of the European mink (*Mustela lutreola*) in Navarra, Northern Spain]

CAMBIOS EN LA DISTRIBUCIÓN DEL VISÓN EUROPEO (*Mustela lutreola*) EN NAVARRA, NORTE DE ESPAÑA.

RESUMEN

Desde que la presencia del visón europeo fue descubierta en los años 60, esta especie ha sido encontrada habitando la mayoría de ríos de Navarra. Durante los años 90, realizamos varios trampeos en el río Ega para testar una nueva metodología y asegurar su distribución. Su presencia fue finalmente confirmada en 1992, cuando capturamos seis visones. Después dos estudios de trampeo fueron realizados en la mayor parte del territorio de Navarra. El método utilizado fue las estaciones de trampeo (10 trampas de reja colocadas cerca del agua, a lo largo de 1 km de curso fluvial, durante 10 días). Este método fue concertado con nuestros colegas franceses en 1991.

El primer estudio tuvo lugar en 1994-95 (71 estaciones de trampeo) y el segundo en 2000-01 (45 estaciones de trampeo). Además, cada cita o indicios encontrados de visón europeo fueron recopilados para completar los resultados. Como resultado de este trabajo, capturamos 33 visones (26.8 % de las estaciones de trampeo) en el primer studio y 30 visones (46.7 %) en el segundo. La presencia de visón europeo fue detectada en 31 U.T.M. (10 x 10 km) cuadrículas y en 549 km de río en el primer estudio y en 37 U.T.M. (10 x 10 km) cuadrículas y en

Running title:
[Distribution of the European mink in Navarra]

SANTIAGO PALAZÓN[1,2], JORDI RUIZ-OLMO[1] AND JOAQUIM GOSÁLBEZ[2].

[1]Environment Department, Generalitat of Catalonia, Dr. Roux, 80, 08017 Barcelona, Spain.

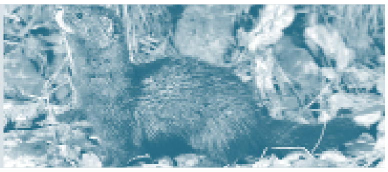
[2]Animal Biology Department, Barcelona University, Avda Diagonal, 645, 08028 Barcelona, Spain.

Santiago Palazón
Environment Department, Generalitat of Catalonia
Dr. Roux, 80 - 08017 Barcelona. Spain
E-mail: santiago.palazon@gencat.net

ABSTRACT

Since the European mink presence was discovered in years 60s, this species has been found inhabiting the most of rivers in Navarre. During the 90s, we carried out several trapping operations on river Ega basin in order to test a new methodology and to assess its distribution. Its presence was finally confirmed in 1992, when we captured six minks. After this, two trapping surveys were carried out on the most territory of Navarre. The used method was the line-trapping –trapping station- (10 iron-traps placed close of water, along -1 km- of river stream, for ten days). This method was concerted with French colleagues in 1991.

The first survey took place during 1994-95 (71 trapping stations) and the second, during 2000-01 (45 trapping stations). Besides, every European mink records and tracks found were compiled to complete the results. As a result of this work, we captured33 minks (26.8 % of trapping stations) during the first survey and 30 minks (46.7 %) during the second one. The presence of European mink was detected in 31 U.T.M. (10 x 10 km) squares and on 549 km of river during the first survey, and in 37 U.T.M. (10 x 10 km) squares and on 1,014 km of river during the second one.



The European mink was set on rivers Ebro, Alhama, Ega, Urederra, Arga, Arakil, Larraun, Basaburua, Ulzama, Aragón and Irati (Mediterranean basin) and rivers Bidasoa, Baztán, Urumea, Añarbe, Leizarán and Araxes (Atlantic basin). During the second survey the European mink presence was detected on several streams (Aragon, Alhama and Arga rivers) where the species was not detected during the first one. It seems to indicate a small increase of range, towards South-East and East, to free places of a competitor species, as the American mink. Further studies could confirm this expansion, but also the increase of the American mink.

Key words: European mink, distribution, changes, Navarre, Northern Spain.

INTRODUCTION

The European mink is the most endangered small carnivore in Europe (Schreiber et al., 1989). Currently, there are three populations of European mink in Europe: Russia, Danube Delta and Western Europe (south-western France and northern Spain). The presence of European mink in Spain was discovered during the 1950s in Basque Country (Rodriguez de Ondarra 1955). Ten years later, its presence was detected in a small river of Navarre (Rodríguez de Ondarra 1963). During the 70s, the species was found in Ega and Arakil rivers (Purroy 1974, Senosiaín and Donázar 1983, Mendiola and Castién 1989). During the 90s, were carried out several trapping operations on river Ega basin in order to test a new methodology and to assess its distribution. Its presence was finally confirmed in 1992, when six minks were captured (Palazón 1998). After this, two trapping surveys were carried out on the most territory of Navarre (Palazón et al. 1995, 2001).

STUDY AREA

This study was carried out on rivers of Navarre, northern Spain. The study area includes both the Mediterranean and the Atlantic regions. The Mediterranean and Atlantic are the prevailing climates, with transition areas. Located in the Mediterranean region, the Ebro (922 km long)-, is the largest flowing river in Spain. The

1,014 km de río en el segundo.

El visón europeo se hallaba en los ríos Ebro, Alhama, Ega, Urederra, Arga, Arakil, Larraun, Basaburua, Ulzama, Aragón e Irati (cuenca Mediterránea) y Bidasoa, Baztán, Urumea, Añarbe, Leizarán y Araxes (cuenca Atlántica). Durante el Segundo estudio, la presencia de visón europeo fue detectada en varios tramos fluviales (ríos Aragón, Alhama y Arga) donde la especie no fue detectada durante el primero. Ello parece indicar un pequeño incremento de la distribución, en dirección sudeste y este, hacia zonas libres de una especie competidora, como es el visón americano. Más estudios podrían confirmar esta expansión, aunque también la del visón americano.

Palabras clave: visón europeo, distribución, cambios, Navarra, norte de España.

Ebro river and their tributaries have a low volume of water during the summer and a high volume of water during the rainy season. The mean temperature of this area ranges between 2°C and 19 ºC, and average rainfall is between 350 mm and 1,600 mm. The rivers in the Atlantic region flow to North, close to French border. These rivers are short, narrow and have steep gradients. The mean temperature of this area ranges between 1°C and 16 ºC, and the average rainfall is between 700 mm and 2,700 mm.

MATERIAL AND METHODS

The used method was the line-trapping –trapping station- (10 iron-traps placed close to water, along -1 km- of river stream, for ten days). This method was agreed with French colleagues in 1991. One trapping station was set on one U.T.M. (10 x 10 km) square.

The first survey took place during 1994-95 -70 trapping stations on 70 U.T.M. (10 x 10 km) squares (Fig. 1) (Palazón et al. 1995) and the second, during 2000-01 -45 trapping stations on 47 U.T.M. (10 x 10 km) squares- (Fig. 2) (Palazón et al. 2001). Besides, every European mink records and tracks found were compiled to complete the results.

RESULTS

As a result of this work, 33 minks (26.8 % of trapping stations) were captured during the first survey and 30 minks (46.7 %) during the second one. The presence of European mink was detected in 31 U.T.M. (10 x 10 km) squares and on 574 km of river during the first survey (Fig. 3), and in 37 U.T.M. (10 x 10 km) squares and on 1.014 km of river (Fig. 4) during the second survey.

During the first survey, European mink was set on rivers Ebro, Alhama, Ega, Urederra, Arga, Arakil, Larraun, Basaburua, Ulzama, Aragón and Irati (Mediterranean basin) and rivers Bidasoa, Baztán, Urumea, Añarbe, Leizarán and Araxes (Atlantic basin). During the second survey the

Figure 1. Location of trapping stations placed on rivers of Navarra in the first survey: 1994-1995.

Figura 1. Localización de las estaciones de trampeo colocadas en los ríos de Navarra durante el primer estudio: 1994-1995.

Figure 2. Location of trapping stations placed on rivers of Navarra in the second survey: 2000-2001.

Figura 2. Localización de las estaciones de trampeo colocadas en los ríos de Navarra durante el segundo estudio: 2000-2001.

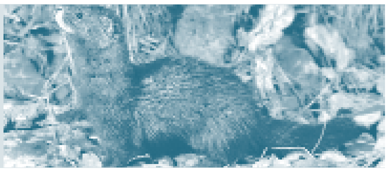


Figure 3. Distribution of European mink Mustela lutreola in Navarre during 1994-1995.

Figura 3. Distribución del visón europeo Mustela lutreola en Navarra durante 1994-1995.

Figure 4. Distribution of European mink Mustela lutreola in Navarre during 2000-2001.

Figura 4. Distribución del visón europeo Mustela lutreola en Navarra durante 2000-2001.

European mink presence was detected on several streams (Aragon, Alhama and Arga rivers) where the species was not detected during the first one.

DISCUSSION

The increase (76.7 % of range) of European mink range in Navarre, five years later, seems to indicate a small spread towards south-east and east. The reasons of this increase could be: to water streams where the riverbanks have wide and dense riparian forests, to places where water pollution is low and to free places of competitor species, as the American mink. Is this increase the end of expansion process of European mink since XIXth century? Since beginning of XIXth century, European mink has increased its distribution from northern France to northern Spain, where it arrived during the first decades of XXth century (Rodríguez de Ondarra 1955). Has European mink arrived at the end of that expansion process? Shall start a population and distribution decline? Shall be that decline more pronounced because of presence of American mink, loss of riparian habitats, and the appearance of a new diseases, the Aleutian Mink Disease (ADV)? Whereas European has increased its distribution along Aragon basin, it has decreased along Atlantic rivers (Bidasoa-Baztan, Urumea-Añarbe, Leizarán and Araxes). New studies need be carried out in the future, to confirm this expansion in Mediterranean basins, but also the possible disappearance of this species in Atlantic rivers. Also, it's very important, to study the presence or the increase of American mink in Navarre. From other side of Pyrenees, in France, American mink could cross the border easily. The first record of this invasive species was found in Bidasoa river in 2001.

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ACKNOWLEDGEMENTS

This research was funded by Spain Environment Ministry and Goverment of Navarra. We want grateful the help of Enrique Castién, Javier Ochoa, José María López-Martín, Sisco Mañas, Oscar Arribas, Elena Rafart and Jordi Palazón.

[Habitat use and selection of European mink (*Mustela lutreola*) in Navarre and La Rioja, northern Spain]

USO Y SELECCIÓN DEL HÁBITAT DEL VISÓN EUROPEO (*Mustela lutreola*) EN NAVARRA Y LA RIOJA, NORTE DE ESPAÑA

RESUMEN

Un estudio sobre el uso y la selección del hábitat fue realizado mediante dos metodologías. Primero, mediante estaciones de trampeo, situadas a lo largo de los ríos de Navarra y La Rioja (uso del hábitat) y visones capturados. Segundo, utilizando radioseguimiento (selección del hábitat: comparación del uso observado / uso esperado). Para el primer método, veinte variables del hábitat fueron estudiadas, y comparamos los datos de las estaciones con resultados positivos y negativos de presencia de visón europeo. Para el segundo método, once variables del hábitat fueron estudiadas.

El estudio del uso del hábitat mostró que los visones europeos fueron a menudo encontrados en cursos fluviales con: profundidad del agua mayor de 0,5 m, velocidad del agua más o menos media, nivel nulo o bajo de contaminación aparente, cobertura vegetal de árboles y arbustos mayor del 25 % de superficie, las especies de árboles más frecuentes en el bosque de ribera son los alisos, olmos, sauces, álamos y chopos, anchura de la vegetación de ribera mayor de 2 m, altitud entre 200 y 400 m, y nivles de precipitación mayores de 1.200 mm.

Running title:
[Habitat of European mink in Northern Spain]

SANTIAGO PALAZÓN[1,2], JORDI RUIZ-OLMO[1] AND JOAQUIM GOSÁLBEZ[2].

[1]Environment Department, Generalitat of Catalonia, Dr. Roux, 80, 08017 Barcelona, Spain,
[2]Animal Biology Department, Barcelona University, Avda Diagonal, 645, 08028 Barcelona, Spain.

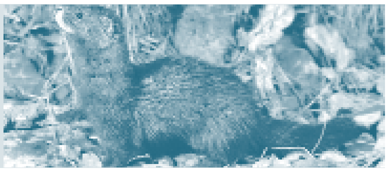
Santiago Palazón
Environment Department, Generalitat of Catalonia
Dr. Roux, 80 - 08017 Barcelona. Spain
E-mail: santiago.palazon@gencat.net

ABSTRACT

A study on the habitat use and selection by the European mink was carried out by means of two methods. Firstly, by means of trapping stations, placed along the rivers of Navarre and La Rioja (use of habitat) and captured animals. Secondly, using radiotracking (habitat selection: comparison of observed use / expected use). For the first method, twenty habitat variables were studied, and we compared data for positive and negative sites. For the second method, eleven habitat variables were studied.

The study of habitat use have shown that European minks were often found in stretches with: water depper than 0.5 m, water speed more or less mean rank, level of apparent pollution null or low, plant covering of trees and shrubs, plant covering more than 25 % of surface, the tree species more frequent at riverbank forest were alders, ash trees, willows and black poplars, riverbank forest wider than 2 m, altitude between 200 and 400 m, and rain levels higher than 1,200 mm.

European mink selected positively some few habitat variables. For instance, the stony areas and slopes as type of riverbanks, plant coverings between 25 and 75 % of surface, the riverbank



forest width between 3 and 5 m, the presence of willows and, high diversity of plant species. The sandy slopes and the riverbanks with roots, plant coverings lesser than 25 %, the riverbank forest narrower than 3 m, the presence of black poplars and low diversity of plant species, were negatively selected by European mink.

Key words: European mink, habitat, use, selection, Northern Spain.

INTRODUCTION

European mink inhabits on freshwater habitats, especially rivers, lakes and marshes. It didn't usually move away more than 100 m from theses ecosystems (Stroganov 1962; Youngman, 1982), although it can do it (Zuberogoita and Zabala 2003a, 2003b). It inhabits between brambles and shrubs, in the dense vegetation of riparian forest (Lodé 1992, Palazón and Ruiz-Olmo 1997, Palazón 1998, Maizeret et al. 1998). In Central and Eastern Europe is cited in elevations ranking between 0 and 200 m a.s.l. (Youngman 1982). Two types of study were carried out: first, on European mink range in Navarra and La Rioja, northern Spain; second, in a stream of Ega river -39,5 km-.

STUDY AREA

The first study: Three zones are differentiated: Bidasoa basin (T mean = 12-13 ºC), Mountain middle zone (T mean = 8-10 ºC) and Ebro basin (strong changes between 21-23 ºC -T mean summer- and 4-5ºC -T mean winter-). The humidity increases towards North and an Atlantic flora is appearing, influencing on fauna. The dryness increases towards South, with typical Mediterranean fauna (Palomo and Gisbert 2002). There is three types of riparian forests: a) Small rivers without vegetation, upon of 800 m a.s.l. b) Scarce groves, with a narrow line of trees (*Alnus glutinosa*) and dense shrubs. c) Important groves projecting over the depopulated and dried landscape. Gradation of rainfall is decreasing towards South, from 3,000 mm to 400 mm. The elevation ranged from 50 m (Bidasoa basin) and 200 m (Ebro basin) to 1,500 m a.s.l.

El visón europeo seleccionó positivamente unas pocas variables del hábitat. Por ejemplo, las zonas rocosas y los taludes como tipo de orillas, la cobertura vegetal de entre 25 y 75 % de superficie, la anchura del bosque de ribera de entre 3 y 5 m, la presencia de sauces y la alta diversidad de especies de plantas. Los taludes de arena y las orillas de río con raíces, la cobertura vegetal menor del 25 %, los bosques de ribera más estrechos de 3 m, la presencia de chopos y la baja diversidad de especies de plantas, fueron negativamente seleccionados por el visón europeo.

Palabras clave: visón europeo, hábitat, uso, selección, norte de Spain.

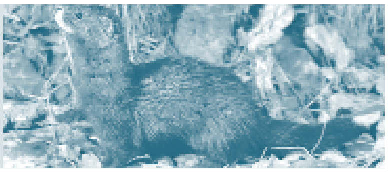
The second study was located on a 35 km length stretch of the river Ega in Navarre (latitude: 42º24'N - 42º39'N; longitude: 1º59'O), the study area includes three of 10 x 10 km U.T.M. squares (30TWN80, 30TWN81, 30TWM89). It is set within a Mediterraneam hydrophilic geoseries of irrigated land. The average annual rainfall ranged between 400 mm and 600 mm and the altitude ranged between 315 m and 395 m a.s.l. The northern part of the stream studied is situated in a dry climate *Quercero S. rotundifoliae*. This dominant landscape reaches the river in numerous points of the study zone. The riverbank forest was dominated by *Alnus glutinosa*, *Populus alba* and *P. nigra*. In the southern half, the study area is located in the *Rhamno lycioidis-Querceto S. cocciferae* series and the riverbank forest is formed by *Populus alba*, *P. Nigra*, *Salix alba*, *Fraxinus angustifolia* and *Ulmus minor*. The area is surrounded by non-irrigated arable (mainly cereal crops) land in the north and by irrigated land in the south.

The river presents some degree of pollution, due to a nearby industrial estate, several villages and a paper factory, causing the waters of the river to contain relatively high levels of organochlorine compounds (López-Martín et al. 1994). The recent opening of several water-treatment plants has reduced the pollution levels. Besides, the self-cleansing of the river permits acceptable levels of water quality. Only, in summer, when the water level drops significantly, levels of dissolved oxygen are quite low.

METHODOLOGY

First study: Comparative study of habitat among positive (presence of M. lutreola) and negative (non presence) trapping stations. From every station 20 variables were studied: 1) Width of river bed (< 10, 10-20, > 20 m), 2) Average depth of river (< 0.5, 0.5–1, 1-2, > 2 m), 3) Speed of water (quick, mean, slow), 4) Status of riverbanks (disturbed and naturals), 5) Type of river edges (rocks, stones, gravels, sands, mud, roots, rocky slopes and sandy slopes), 6) Grade of apparent pollution of water (null-low, mean and high), 7) Type of plant covering (grass, trees, shrubs and helophitic), 8) Grade of plant covering of trees (0-25, 25-50 and 50-100 %), 9) Grade of plant covering of shrubs (0-25, 25-50 and 50-100 %), 10) Most frequent tree species (ash, alder, willow, black and white poplars, and elms), 11) Width of riparian forest (< 2, 2-5, 5-10 and > 10 m), 12) Variety of riparian forest (low, mean and high), 13) Use of surroundings river (non irrigated land, irrigated land, natural forest, reforestation vegetation, fields and houses), 14) Elevation (< 300, 300-400, 400-500 and > 500 m a.s.l.), 15) Rainfall (< 600, 600-1,200 and > 1,200 mm), 16) Potential vegetation of surroundings (oak grove, beech grove, gall-oak grove, evergreen oak grove, kermes oak grove), 17) Ombroclimatic zone (hiper-humid, humid, sub-humid, higher dry, lower dry), 18) Bioclimatic region (Eurosiberian and Mediterranean), 19) Bioclimatic level (eucolino, submontano, lower supramediterranean, higher mesomediterranean). 20) Biogeographic region (Atlantic and Mediterranean). To compare the station with or without presence of European mink, Chi-Square was used.

Second study: With the data obtained from a radio-tracking study on 11 minks, a study of habitat use and selection was carried out. Every home range was divided in 0.1 x 0.1 km squares.



Inside these squares, eleven habitat variables on two riverbanks were studied: 1) Status of riverbanks (disturbed, natural; with plants, without plants), 2) Presence of stony and sandy slopes, 3) Types of river edges (rocks, stones, gravels, sands, mud and roots), 4) Type of plant covering (grass, trees, shrubs, helophitic and no plant covering), 5) Grade of plant covering of trees (0-25, 25-50, 50-75 and > 75 %), 6) Width of riparian forest (< 3, 3-5, 5-10, >10 m), 7) Most frequent tree species (ashes, alders, willows, black and white poplars, and elms), 8) Most frequent shrub species (), 9) Diversity of trees (low, mean and high), 10) Diversity of shrubs (low, mean and high), 11) Types of human noses. The observed and expected use, among males, females and all together, was compared by Chi-Square.

RESULTS

First study: Any of the 20 habitat variables between positive and negative trapping stations was significantly different. However, some positive trends were observed In the trapping stations with European mink presence (Fig. 1): width of river bed between 0 and 20 m, average depth of river larger than 1 m, disturbed riverbanks, grade of apparent pollution between null and low, grade of tree plant covering higher than 25 %, ash, alders, willows and black poplars as most common tree species, riparian forest width higher than 10 m, forests, fields and non irrigated lands as use of surroundings river, elevation between 200 and 400 m a.s.l., rainfall higher than 1,200 mm and Atlantic region .

Second study: The results obtained didn't indicate a trend in the selection by minks of some habitat characteristics (Table 1). There was a selection of habitat about: banks with vegetation, stones and stony slopes as type of banks, 25-75 % of plant covering, 3-5 m as width of riparian forest, low diversity of tree species and high diversity of shrubs in the riparian forest.

DISCUSSION

In the Mediterranean basin, European mink inhabit on different habitat than the rest of Europe (Youngman 1982). Here, European mink even could be founded in a dry and high elevation zones. It was associated to riparian habitats and other freshwater places. Sometimes minks can move away to rivers (Zuberogoitia and Zabala 2003a, 2003b), for instance, individuals in the course of dispersion. European mink needed banks with a variety of vegetation, with slopes, rocks and stones (Camby 1990, Lodé 1992, Maizeret et al. 1998). The plant covering must be abundant and diverse, and the width of riparian forest bigger than 5 meters. In this habitat, European mink could find potentials preys (terrestrial, aquatic and semi-aquatic) and shelter to rest and move. For reproduction process, it preferred zones with the maximum values of habitat (typology, diversity, covering and width of vegetation). So, the limitation of habitat to the presence of European mink was the low availability of potential preys and shelters for resting sites and dens.

Due to the poor results obtained in the present study, is necessary to carry out more studies about abiotic factors that influence on the selected and used habitat by European mink (microhabitat and macrohabitat). It's necessary the application of a Geographic Information System (GIS) for all known data in Spain.

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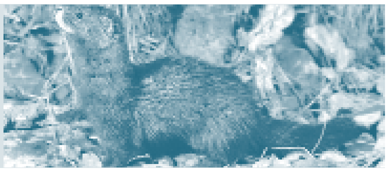
ACKNOWLEDGEMENTS

This research was funded by Spain Environment Ministry and Goverment of Navarra and Government of La Rioja. We also grateful to help of E. Castién, J. Ochoa, J.M. López-Martín, O. Arribas, E, Rafart, J. Palazón, J.C. Ceña, A. Ceña and I. Moya.



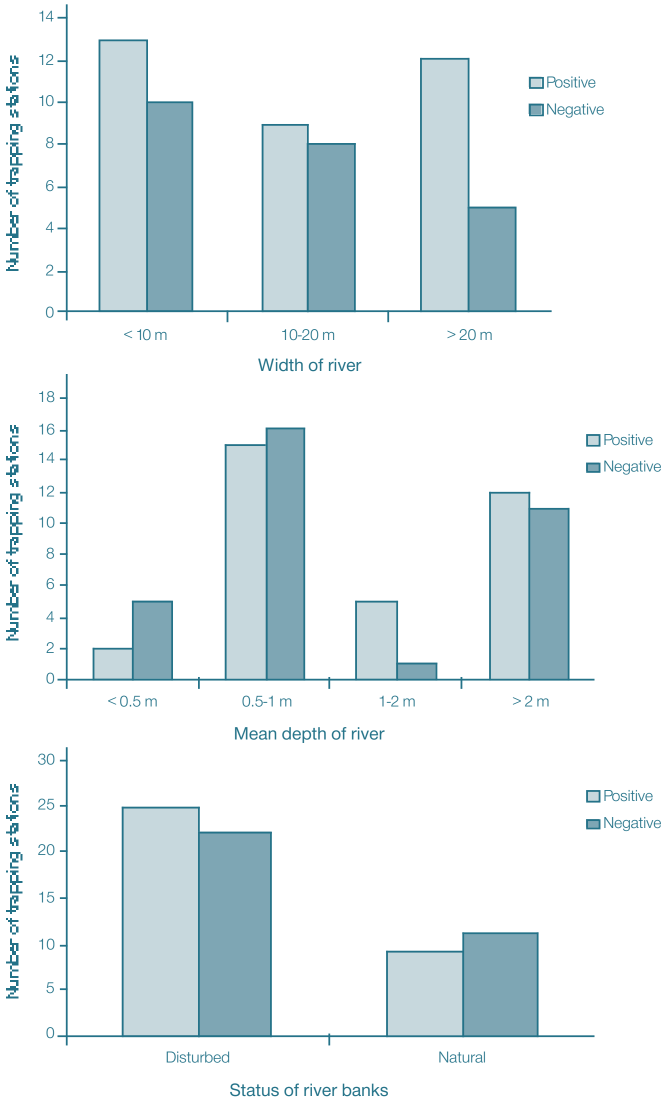
	Males		Females		Minks	
Variables of habitat	Use	Significance	Use	Significance	Use	Significance
Status of riverbanks: df = 1		$\chi^2 = 17,29$		$\chi^2 = 55,27$		$\chi^2 = 69,28$
Natural	–	**	–	**	–	**
Disturbed	+	**	+	**	+	**
Types of river edges: df = 6				$\chi^2 = 57,39$		$\chi^2 = 50,47$
Stones					+	**
Roots			–	**	–	**
Stony slopes			+	**	+	**
Sandy slopes			–	**	–	**
Grade of plant covering: df = 3		$\chi^2 = 32,16$		$\chi^2 = 24,98$		$\chi^2 = 60,09$
< 25%	–	**			–	**
25-50%	+	**	+	**	+	**
50-75%	+	**	+	**	+	**
>75%	–	**	–	**	–	**
Width of riparian forest: df = 3		$\chi^2 = 10,52$		$\chi^2 = 10,33$		$\chi^2 = 21,39$
< 3 m	–	*			–	**
3-5 m	+	*	+	*	+	**
5-10 m						
>10 m			–	*	–	**
Most frequent tree species: df = 4		$\chi^2 = 16,34$		$\chi^2 = 12,17$		$\chi^2 = 17,93$
Alder						
Ash	–	**	+		+	**
Willow	+	**		*	–	**
Black poplar	+	**	–	*		
Diversity of trees: df = 5		$\chi^2 = 15,11$		$\chi^2 = 20,19$		$\chi^2 = 74,59$
0 sp.	+	**	+	**	+	**
1 sp.			+	**	+	**
2 sp.	–	**				
4 sp.			–	**		
>4 sp.					+	**
Diversity of shrubs: df = 4				$\chi^2 = 18,78$		
2 sp.			–	**		
3 sp.			+	**		
4 sp.			+	**		
>4 sp.			+	**		

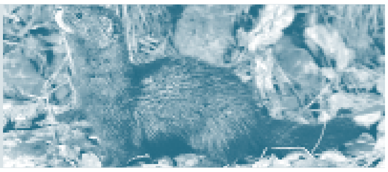
Table 1. Selection of the different habitat characteristics by males, females and all together European minks in the Ega river, Navarre. (* $p < 0.05$, ** $p < 0.01$).

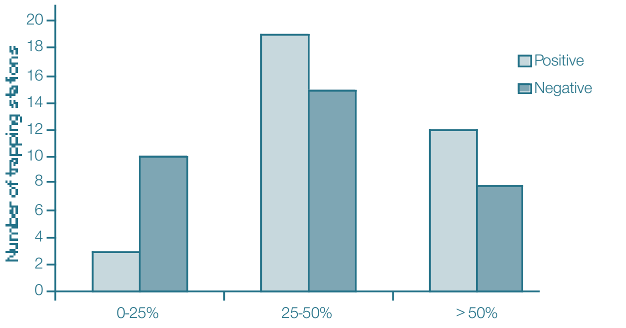
Tabla 1. Selección de las diferentes características del hábitat por machos, hembras y todos los ejemplares juntos de visón europeo en el río Ega, Navarra. ($p < 0,05$, ** $p < 0,01$).*

Figure 1.- Comparison of several habitat variables between positive and negative trapping stations in the first study to determine the presence of Europe mink.

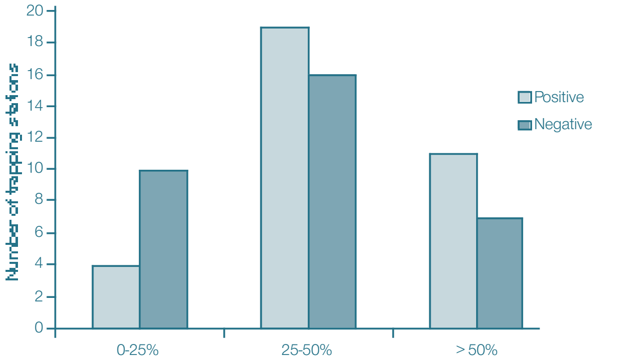
Figura 1.- Comparación de varias variables del hábitat entre las estaciones de trampeo con resultados positivos y negativos de presencia de visón europeo durante el primer estudio realizado.



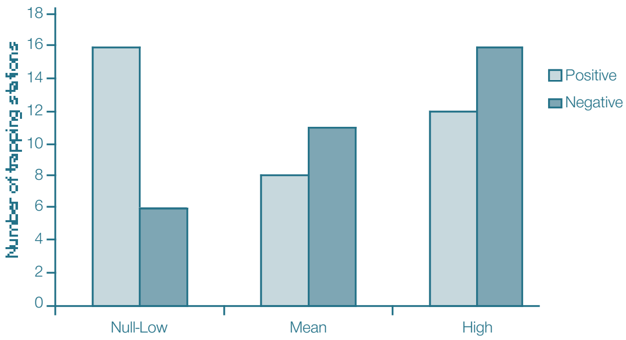




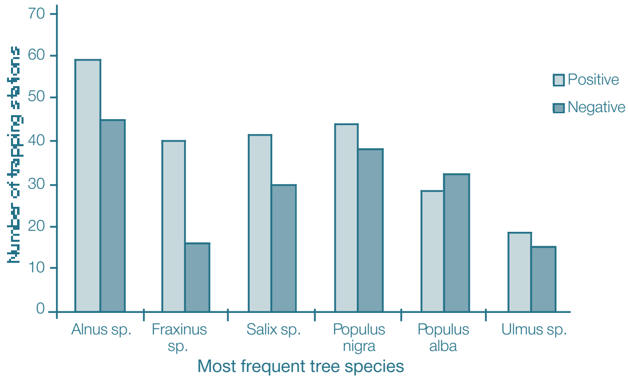
Grade of plant covering of trees

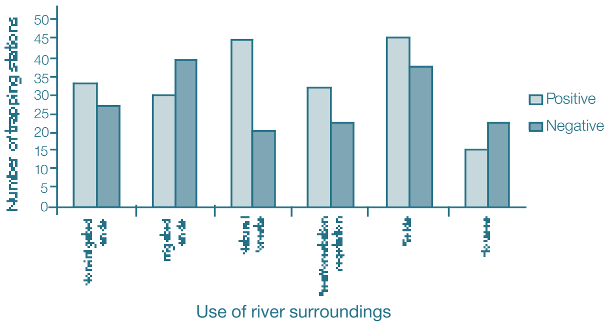


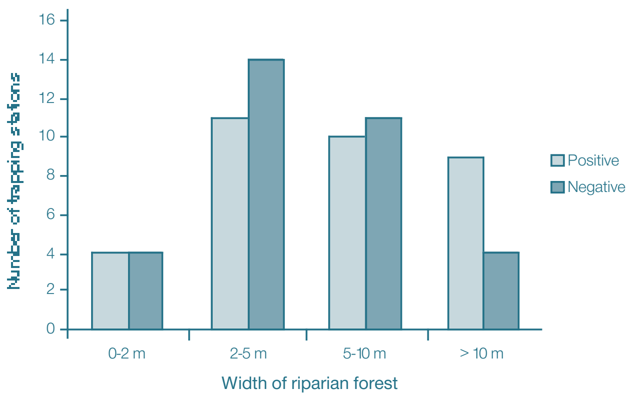
Grade of plant covering of shrubs

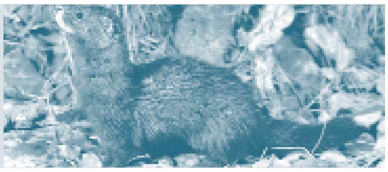


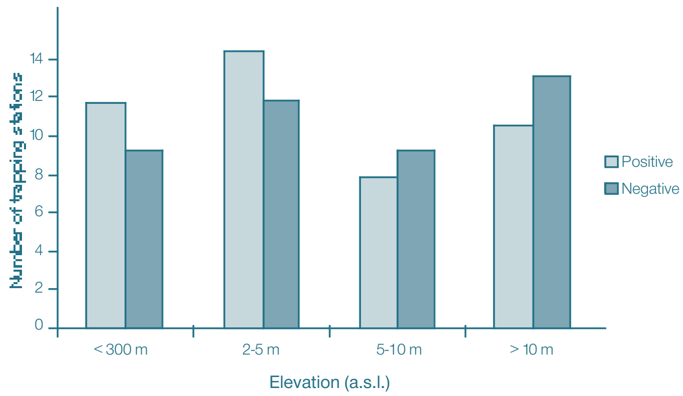
Level of aparent pollution

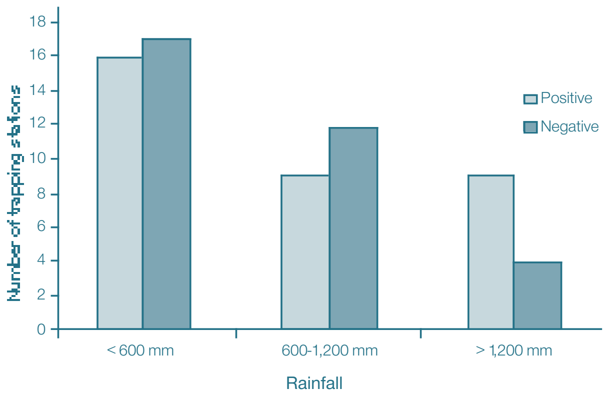

Number of trapping stations
70
60
50
40
30
20
10
0
Alnus sp.
Fraxinus sp.
Salix sp.
Populus nigra
Populus alba
Ulmus sp.
Most frequent tree species
Positive
Negative

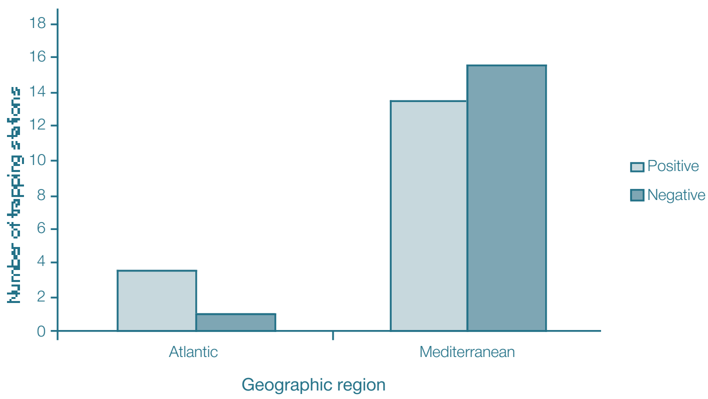

Number of trapping stations
50
45
40
35
30
25
20
15
10
5
0
Positive
Negative
Use of river surroundings


Number of trapping stations
16
14
12
10
8
6
4
2
0
0-2 m
2-5 m
5-10 m
> 10 m
Width of riparian forest
Positive
Negative




Number of trapping stations
0
2
4
6
8
10
12
14
< 300 m
2-5 m
5-10 m
> 10 m
Elevation (a.s.l.)
Positive
Negative


Number of trapping stations
0
2
4
6
8
10
12
14
16
18
< 600 mm
600-1,200 mm
> 1,200 mm
Rainfall
Positive
Negative


Number of trapping stations
0
2
4
6
8
10
12
14
16
18
Atlantic
Mediterranean
Geographic region
Positive
Negative

[Body and skull morphology of European mink (*Mustela lutreola*) in northern Spain]

MORFOLOGÍA CORPORAL Y CRANEAL DEL VISÓN EUROPEO (*Mustela Lutreola*) EN EL NORTE DE ESPAÑA

RESUMEN

La morfología externa y las medidas del cuerpo, del cráneo y del báculo fueron estudiadas de 100, 18, y 6 ejemplares de visón europeo, respectivamente. Estas muestras fueron recopiladas desde 1990 hasta 2003, procedentes de Navarra, País Vasco, La Rioja y Cataluña. Los patrones de manchas blancas en la piel también fueron estudiadas. El peso, seis medidas corporales, 33 medidas craneales y la longitud del báculo fueron anotadas

Los visones europeos españoles presentaron un patrón de pelaje marrón "chocolate" muy uniforme. Solo el 1,6 % de los visones presentaron alguna mancha blanca en el abdomen y el 16.4 % mostraron algunas canas blancas en la piel. El patron de la mancha blanca del labio inferior fue muy variable y es muy diferente para cada individuo, todo lo contrario que la mancha blanca del labio superior.

El peso medio de los machos fue 813 g (rango = 585-1.065, SD = 106,2) y 484 g (rango = 340-675, SD = 69,8) el de las hembras. La longitud total (TL) de machos fue 540 mm (rango = 440-580, SD = 24,6) y 466 mm (rango = 400-500, SD = 20,97) de las hembras.

Se encontró una correlación positiva entre el peso y las diferentes medidas externas estu-

Running title:
[European mink morphology in Spain]

Santiago Palazón[1,2], Jordi Ruiz-Olmo[1] and Joaquim Gosálbez[2].

[1]Environment Department, Generalitat of Catalonia, Dr. Roux, 80, 08017 Barcelona, Spain, santiago.palazon@gencat.es.
[2]Animal Biology Department, Barcelona University, Avda Diagonal, 645, 08028 Barcelona, Spain.

Santiago Palazón
Environment Department, Generalitat of Catalonia
Dr. Roux, 80 - 08017 Barcelona. Spain
E-mail: santiago.palazon@gencat.net

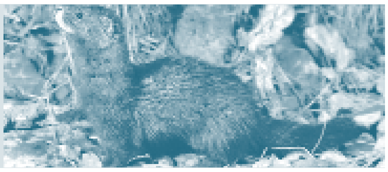
ABSTRACT

The external morphology, and body, skull and baculum measurements were studied from 100, 18, and 6 European minks, respectively. These samples were compiled since 1990 to 2003, from Navarre, Basque Country, La Rioja and Catalonia. White spot patterns in skins were examined. The weight and six body measurements were noted, and 33 skull measurements and baculum length, were noted.

Spanish European mink showed a brown "chocolate" fur pattern very uniform. Only 1.6 % of minks presented some white spot in the abdomen and 16.4 % showed some white hairs in the skin. The pattern of white spot in low lip was very variable and it was different for each mink, all the contrary that white spot in upper lip.

The mean weight for males was 813 g (range = 585-1,065; SD = 106.2) and 484 g (range = 340-675; SD = 69.8) for females. The total length (TL) for males was 540 mm (range = 440-580; SD = 24.6) and 466 mm (range = 400-500; SD = 20.97) for females.

A positive correlation between weight and different external measures studied (TL, Head-Body, Tail, Hind Foot, Fore Foot and



Ear) was found. The sexual dimorphism index (size) was very important. Males weighed 68.3 % and measured (TL) 15.9 % more than females.

Two functions (males and females), to find and adjust the European mink Body Condition Index (BCI), were obtained. And a significant difference in BCI between "healthy" and "weak" minks was confirmed.

About skull measurements, the main differences found were for CBL, MB, ZB and BCB, showing a great sexual dimorphism in skull size (length and width). Besides, these measurements were positively correlated with the body measurements.

A lower size in body and skull measurements of Spanish European minks in front of other studied European populations was verified.

Key words: European mink, morphology, body, skull, baculum, Spain.

INTRODUCTION

For more than 10 years, a lot of samples of European mink were compiled in northern Spain. With the body and skull morphology data was carried out a small study. The differences between males and females measurements were studied. And the differences between the Spanish, French and eastern European populations were also compared. There is some old data about body and cranial measurements of European minks from France (Camby 1990, Lodé 1995, Maizeret et al. 1995), and countries of Eastern Europe –Russia, Finland, Poland, Romania, Caucasus- (Youngman 1982, Sidorovich 1997).

MATERIAL AND METHODS

The external morphology, and body, skull and baculum measurements were studied from 100 (68 males and 32 females), 18 (8 males and 10 females) and 6 males of European mink, respectively. These samples were compiled since 1989 to 2003, from Navarre, Basque Country, La Rioja and Catalonia. White spot

diadas (TL, Cabeza-Cuerpo, Cola, Pie posterior, Pie anterior y Oreja). El índice del dimorfismo sexual (tamaño) fue muy importante. Los machos pesaron un 68,3 % y midieron (TL) un 15.9 % más que las hembras.

Se obtuvieron dos funciones (machos y hembras) para encontrar y ajustar el Índice de Condicion Corporal (BCI) al visón europeo. Se confirmó una diferencia significativa en el BCI fue encontrada entre los visones "sanos" y "débiles".

Sobre las medidas craneales, las principales diferencias encontradas fueron para CBL, MB, ZB y BCB, mostrando un gran dimorfismo sexual en el tamaño del cráneo (longitud y anchura). Además, estas medidas estuvieron positivamente correlacionadas con las medidas corporales.

Los visones europeos españoles tuvieron un tamaño menor en las medidas corporals y craneales frente a otras poblaciones estudiadas de visón europeo.

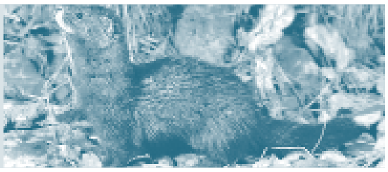
Palabras clave: visón europeo, morfología, cuerpo, cráneo, báculo, España.

patterns in skin were examined. The weight and six body (Total length, Head + Body length, Tail length, Hind foot length, Fore-foot length and Ear length) measurements were notes (Table 1), and eight skull (Condylobasal length –CBL-, Mastoide breadth –MB-, Zygomatic breadth –ZB-, Bicondylar breadth –BCB-, Mandibular length –ML, First molar upper breadth –M1B-, First molar lower breadth –m1B- and Fourth premolar lingual length –P4LL- measurements, more the baculum length, were noted (Table 2). To compare the weight and the measurements, analysis of variance was used.

Males	Weight	Total length	Tail length	Hind foot length	Fore foot length	Ear length
N	68	67	67	66	64	61
Mean	813.37	540.42	164.21	63.28	81.95	22.19
SD	106.17	24.06	10.28	3.59	5.19	1.62
Range	585-1,065	440-580	130-185	54-82	61-93	18-25
Females	**Weight**	**Total length**	**Tail length**	**Hind foot length**	**Fore foot length**	**Ear length**
N	32	29	30	28	26	27
Mean	483.84	466.05	140.96	53.34	69.08	19.47
SD	69.81	20.93	9.61	3.10	3.20	1.37
Range	340-675	400-500	120-170	50-60	61-75	17.22

Table 1. Sample size (N), mean, standard desviation (SD) and range (minimum-maximum) of body measurements (g and mm) of European mink males and females from northern Spain.

Tabla 1. Tamaño muestral (N), media, desviación estandar (SD) y rango (mínimo-máximo) de las medidas corporales (g y mm) de los machos y hembras de visón europeo procedentes del norte de España.



Males	CBL	MB	ZB	BCB	ML	M1B	m1L	P4LL
N	7	7	7	7	7	8	8	8
Mean	63.32	30.76	36.26	16.95	37.02	5.92	7.73	7.09
SD	1.52	0.99	1.52	0.62	1.30	0.25	0.22	0.18
Range	59.2-65.9	29.2-32.0	33.5-37.9	16.0-17.9	34.4-38.5	5.6-6.2	7.3-8.1	6.7-7.4
Females	**CBL**	**MB**	**ZB**	**BCB**	**ML**	**M1B**	**m1L**	**P4LL**
N	7	7	7	7	9	9	9	10
Mean	59.96	27.87	31.86	15.73	32.73	5.21	6.92	6.41
SD	1.55	0.84	0.53	0.43	1.10	0.11	0.17	0.10
Range	54.4-59.2	27.2-29.4	31.0-32.6	15.1-16.5	30.8-34.1	5.0-5.4	6.5-7.1	6.2-6.6

Table 2. Sample size (N), mean, standard desviation (SD) and range (minimum-maximum) of skull measurements (mm) of European mink males and females from northern Spain.

Tabla 2. Tamaño muestral (N), media, desviación estandar (SD) y rango (mínimo-máximo) de las medidas crameales (mm) de los machos y hembras de visón europeo procedentes del norte de España.

RESULTS

Spanish European minks showed a brown "chocolate" fur pattern very uniform. Only 1.6 % of minks presented some white spot in the abdomen and 16.4 % showed some white hairs in the skin. The white spot pattern of lower lip was a identify characteristic. It can be useful to distinguish different minks, all the contrary that white spot in the upper lip.

The mean weight for males was 813.4 g (range = 585-1,065; SD = 106.2) and 483.8 g (range = 340-675; SD = 69.8) for females. The total length (TL) for males was 540.1 mm (range = 440-580; SD = 24.6) and 466.0 mm (range = 400-500; SD = 20.9) for females (Table 1) (Fig. 1).

A positive correlation between weight and different body measurements (Total length, Head + Body length, Tail length, Hind Foot length, Fore Foot length and Ear

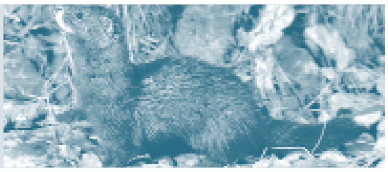
length) was found. The sexual dimorphism index, in size, (SDI = size of male/size of females) was very high. It was 1.68 and 1.16 in the Weight and Total length, respectively. Males weighed 68.3 % and measured (Total length) 15.9 % more than females. This difference was significant ($F = 258.9$; $p < 0.0001$). Two functions (males and females), to find and adjust the European mink Body Condition Index (BCI) were obtained. For males, BCI = Weight/3.20 · Total length$^{2.22}$ and for females, BCI = Weight/2.38 · Total length$^{2.11}$.

The average length of baculum was 36.54 mm (SD = 1.28; range = 34.94 − 38.06; n = 6).

About skull measurements, the main differences found were for CBL, MB, ZB and BCB, showing a sexual dimorphism index of skull size (length and width) similar to body measurements (1.11 for CBL and 1.10 for MB). The difference of both skull measurements between males and females was significant (CBL: $F = 32.9$; $p < 0.0001$) (MB: $F = 30.0$; $p < 0.001$). Besides, all these measurements were positively correlated with the body measurements.

	Spain		France		Eastern Europe	
Males	N	Mean	N	Mean	N	Mean
Weight	68	813.4	56	876.55		
Head+Body Length	67	375.9	46	373.94	16	366.2
Tail length	67	164.2	46	161.6	15	149.2
Hind foot length	66	63.3	33	62.82		
Females	N	Mean	N	Mean	N	Mean
Weight	32	483.8	24	562.8		
Head+Body Length	30	326.2	12	332.46		
Tail length	30	141.0	12	139.16		
Hind foot length	28	53.3	12	54.59		

Table 3. Comparison of European mink body measurements (g and mm) among different European populations.
Tabla 3. Comparación de las medidas corporales (g y mm) de visón europeo entre diferentes poblaciones europeas.



DISCUSSION

The pattern of white spot in Spanish European mink is very mixed and it can work as individual distinctive. The frequency of other white spot on fur is low (1.6 %), comparing with Eastern (50 %) and French (10 %) populations (Van Bree and Saint-Girons 1966).

In mammals, the weight of adult minks changes with age, season and the body condition of every individual (Kruuk and Conroy 1987, 1991, Ruiz-Olmo 1995). In mustelids, this variation is much lesser than the difference between the average weigh of adults of each sex (Moors 1980). Besides, when European minks reach the three months of age, their size is similar to adult individuals (Maran and Robinson 1996).

The larger is the size of male, smaller is the sexual dimorphism. Besides, the species of polygamous carnivores tend to higher sexual dimorphism than the monogamous species (Gittleman 1984, Dunstone 1993). In the genus Mustela (the smallest species of mustelids) the sexual dimorphism is very pronounced. On the contrary, Ralls (1977) defends that larger species are more sexually dimorphism than smaller species.

While in mammals, the evolutionary trend is increase the size, in mustelids the evolutionary trend is reduce the size (King 1989). The body size is related with coexistence of similar species (King 1989). The small size gives advantages and disadvantages to mustelids. King (1989) thinks that disadvantages are larger.

El metabolism increases because of small body size, predator feeding, cold climate and high activity (McNab 1989). All those are elements of small mustelids. In mustelids, the metabolism is 20 % higher than the expected in mammals of that size (Iverson 1972).

The advantages of small size are bigger muscular strength and higher predator efficiency. The disadvantages are increase of metabolism and oxygen consumption, higher energy cost in movements, small capacity of thermal regulation, quick loss of body heat due to relation surface/volume (Kruuk 1995) –accentuated by semi-aquatic habits of European mink and aquatic and semi-aquatic mammals are longer than terrestrial ones, the relation surface/volume is higher (Estes 1989)-, higher predation by other species of carnivores and, uncertain reproduction (King 1989).

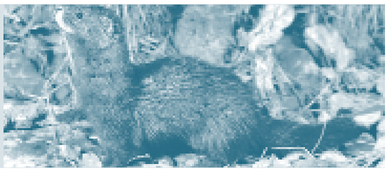
The difference of size between males and females avoid the overlap. There are three theories to explain the high sexual dimorphism in small mustelids:

1. Model of repartition of trophic resources, reducing the intersexual competition (Powell 1979).

	Spain		France		Eastern Europe I		Eastern Europe II	
Males	N	Mean	N	Mean	N	Mean	N	Mean
CBL	7	63.32	38	63.17	61	63.86	44	63.94
MB	7	30.76	37	31.03	61	31.18	44	31.31
ZB	7	36.26	38	36.46	61	35.99	44	35.85
BCB	7	16.95	8	16.40	61	17.24	44	17.28
ML	7	37.02	39	37.57	61	37.45	44	37.48
M1B	8	5.92	8	5.49	61	5.52	44	5.53
m1B	8	7.73	8	7.45	61	7.63	44	7.63
P4LL	8	7.09	8	6.67	61	6.96	44	7.01
Females	N	Mean	N	Mean	N	Mean	N	Mean
CBL	7	56.96	6	59.68	44	58.90		
MB	7	27.87	6	33.33	44	28.56		
ZB	7	31.86	6	37.92	44	32.15		
BCB	7	15.73			44	15.88		
ML	9	32.73	6	28.62	44	34.02		
M1B	9	5.21			44	5.10		
m1B	9	6.92			44	7.07		
P4LL	10	6.41			44	6.54		

Table 4. Comparison of European mink skull measurements and baculum length (mm) among different European populations. Eastern Europe I = Russia. Eastern Europe II = Finland, Poland, Leningrad region, Moscu region, Danube Delta and Caucase.

Tabla 4. Comparación de las medidas craneales y longitud del báculo (mm) de visón europeo entre diferentes poblaciones europeas. Europa del Este I = Rusia. Europa del Este II = Finlandia, Polania, región de Leningrado, región de Moscu, Delta del Danubio y Caúcaso.



2. Model of small female (Powell 1979, Moors, 1980). The females are smaller because of small size of preys dens (Erlinge 1979, Simms 1979, Moors 1980) advantages to reach the sexual maturity in early age (Erlinge 1979), capacity of small females to channel more power for reproduction (pregnancy and lactation), decreasing their own energy needs (Powell 1979, Moors 1980).

3. Model of big male (Ralls 1977). The males are positively selected to compete with other males for females. The size upper limit is conditional on abundance and size of preys. The size lower limit is conditional on intrasexual selection.

The overlap between skull measurements of males and females is very low, so the skulls of both sexes are easily distinguishable.

The lower size of Spanish European minks, in comparison with other European populations (higher latitude) is difficult to explain. The Bergman rule doesn't explain the variations of size in genus *Mustela* and carnivores (Ralls and Harvey 1985, Gittleman 1985) in Europe and Asia. On the contrary, the North American weasels play the Bergman rule (Ralls and Harvey 1985, King 1989).

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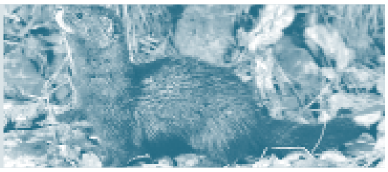


ACKNOWLEDGEMENTS

We want grateful to Spain Environment Ministry, Government of Navarra, Government of La Rioja, Government of Alava, Generalitat of Catalonia, especially to E. Castién, J. Ochoa, L. Lopo, J. Carreras, J.M. López Martín, O. Arribas, J. Palazón and to everybody that supplied data and dead minks.

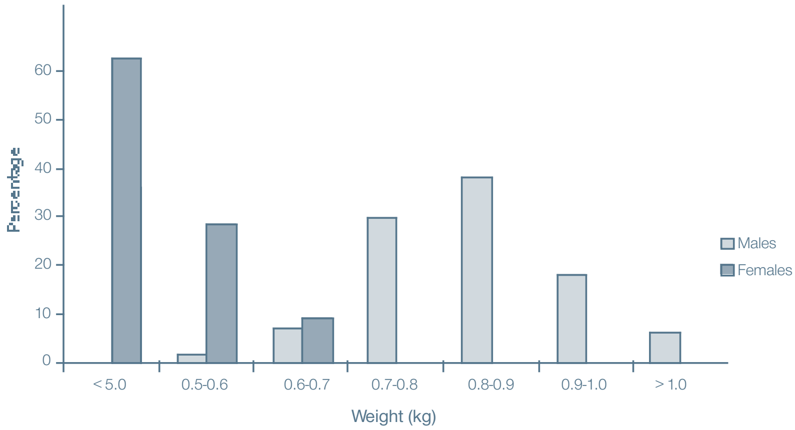


Figure 1. Range of males and females weight (kg) of European mink from northern Spain.

Figura 1 Rango del peso (kg) de los machos y hembras de visón europeo procedentes del norte de España.

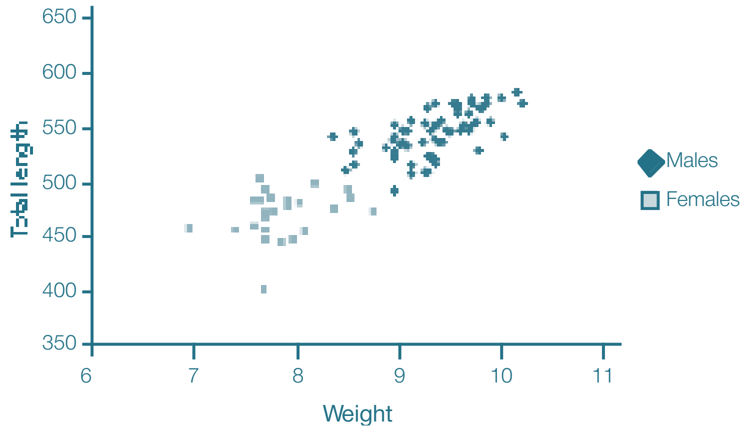


Figure 2. Functional relationship between Total length (TL) and cube root of Weight in European mink (males and females) from northern Spain.

Figura 2. Relación funcional entre la Longitud Total (TL) y la raiz cúbica del peso en los visones europeos (machos y hembras) procedentes del norte de España.

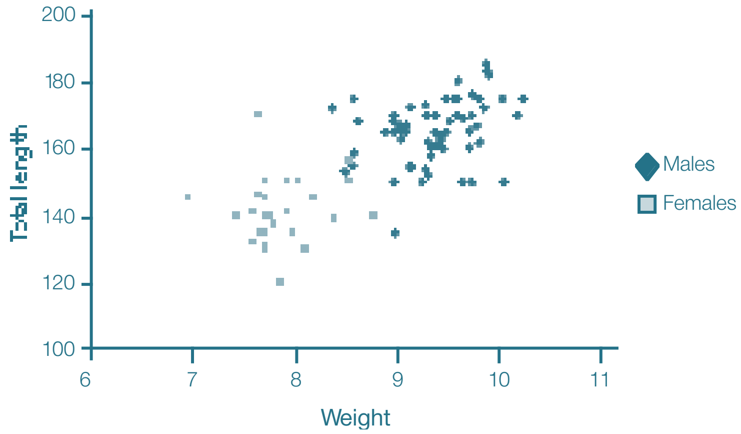


Figure 3. Functional relationship between Tail length and cube root of Weight in European mink (males and females) from northern Spain.

Figura 3. Relación funcional entre la longitud de la cola y la raiz cúbica del peso en los visones europeos (machos y hembras) procedentes del norte de España.

[How many European mink (*Mustela lutreola*) inhabits in the Navarre rivers, Northern Spain?]

¿CUÁNTOS VISONES EUROPEOS (*Mustela Lutreola*) HABITAN EN LOS RÍOS DE NAVARRA, NORTE DE ESPAÑA?

RESUMEN

Desde 1991 a 2001, el visón europeo ha sido trampeado a lo largo de los ríos de Navarra (norte de España). 95 visones (50 machos y 16 hembras) fueron capturados, utilizando el método estandar de estaciones de trampeo (diez trampas colocadas durante 10 días en las orillas de los ríos, cada estación de trampeo). Los trampeos fueron realizados en 1994-95 (71 estaciones) y en 2000-01 (45 estaciones). La presencia de visón europeo fue de 539 km de ríos en 1994-95 y de 1.014 km en 2000-01. Además, densidades diferentes de captura fueron estimadas para diferentes tramos de ríos de Navarra.

Dos estudios de captura/recaptura y radioseguimiento sobre 39,5 km del río Ega (1995-96) fueron realizados para estimar densidades teóricas de visón europeo. La densidad de captura (número de visones por longitude de estación de trampeo) de tres estaciones de trampeo y dos densidades teóricas (captura/recaptura y radioseguimiento) fueron correlacionados.

Aplicando ambos métodos, estimamos la densidad del visón europeo en los ríos de Navarra entre 0,17 y 1,08 visones/km de río, y una población de visón europeo de entre 205 y 240 visones durante 1994-95. En 2000-01,

Running title:
[European minks numbers in Navarre]

Santiago Palazón[1,2], Jordi Ruiz-Olmo[1] and Joaquim Gosálbez[2].

[1]Environment Department, Generalitat of Catalonia, Dr. Roux, 80, 08017 Barcelona, Spain.
[2]Animal Biology Department, Barcelona University, Avda Diagonal, 645, 08028 Barcelona, Spain.

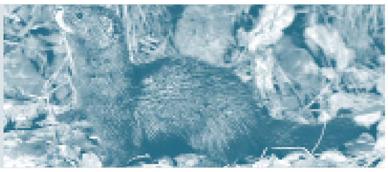
Santiago Palazón
Environment Department, Generalitat of Catalonia
Dr. Roux, 80 - 08017 Barcelona. Spain
E-mail: santiago.palazon@gencat.net

ABSTRACT

Since 1991 to 2001, European mink have been trapped along rivers of Navarra (Northern Spain). Ninety-five minks (50 males and 16 females) were captured, using the standard trapping station method (ten traps placed for ten days on riverbed of a river stream, each trapping station). Trapping was carried out in 1994-95 (71 stations) and in 2000-01 (45 stations). The European mink presence was stated along 539 km of river in 1994-95 and along 1,014 km in 2000-01. Besides, different densities of capture were estimated for different river streams of Navarre.

Two studies of capture/recapture and radiotracking on 39.5 km of Ega river (1995-96) were carried through to estimate European mink theoretical densities. The density of capture (number of European minks per trapping station length) of three trapping stations and two theoretical densities (capture/recapture and radiotracking) were correlated.

Applying such methods, we estimated a European mink density in rivers of Navarre between 0.17 and 1.08 minks/km of river, and a European mink population in Navarre ranging between 205 and



240 minks during 1994-95. In 2000-01, the European mink density was estimated between 0.05 and 1.02 mink/km of river, and the European mink population ranging between 250 and 294 adult individuals.

Between the first and the second study -6 years-, two important facts were detected: Firstly, a decrease of European mink density (minks estimated per kilometer of river) and secondly, a small increase of European mink distribution, mainly along Aragon and Alhama rivers. This increase can be the ending process of expansion to south-west and south-east of this species since its appearance in Iberian Peninsula during years 50s.

Key words: European mink, number, density, Navarre, Northen Spain.

la densidad de visón europeo fue estimada entre 0,05 y 1,02 visones/km de río, y una población de visón europeo de entre 250 y 294 individuos adultos.

Entre el primero y el segundo estudio -6 años-, dos importantes factores fueron detectados: Primero, un decrecimiento de la densidad del visón europeo (visones estimados por kilómetro de río) y segundo, un pequeño incremento de la distribución, principalmente a lo largo de los ríos Aragon y Alhama. Este incremento puede ser el fin del proceso de expansión en dirección sudoeste y sudeste de esta especie desde su aparición en la Península Ibérica en los años 50.

Palabras clave: visón europeo, número, densidad, Navarra, norte de España.

INTRODUCTION

The small and medium size carnivores, especially the semi-aquatic mustelids, are a zoological group difficult to take a census, due to nocturnal and avoided habits. Therefore, the studies about small and medium size and semi-aquatic mustelids are scarce (Weber 1989, Smal 1991). Some authors have based their studies by tracks on mud or snow, by the number of dens or resting sites, by animals captured, etc. Frequently, the density has been estimated by distance (kilometers of river) and surface (ha and km^2). European mink is the most endangered species of mustelid in Europe. The situation and status of their populations in Europe (Spain and France, Romania, and Russia) is little known. Only in Spain and Belarus the density of European mink and other mustelids were studied (Sidorovich and Macdonald 2001).

STUDY AREA

There are two study areas. First, the riparian ecosystems in Navarre and second, a stream of Ega river of 39.5 km (latitude: 42O 24’N 42O 39’N; longitude: 1O59’O), including three U.T.M. of 10 x 10 km squares (30TWN80, 30TWN81, 30TWM89). The second area was located in a Mediterranean hydrophilic geose-

ries of irrigated land. The average annual rainfall in the zone is between 400 mm and 600 mm and the altitude of the area ranges between 315 m and 395 m. The riparian forest was dominated by *Alnus glutinosa*, *Populus alba*, *Populus nigra*, *Salix alba*, *Fraxinus angustifolia* and *Ulmus minor*. During the 1980s and 90s, the south stream riverside has suffered significant deforestation on the banks, with the widening of the riverbed and the building of 45 degree sloped walls using large rocks. The study area is surrounded by non-irrigated arable (mainly cereal crops) land in the north and by irrigated land in the south.

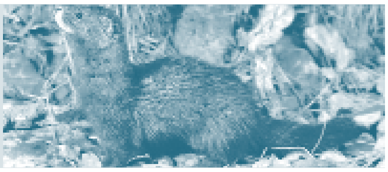
It is one of the areas in Navarre with the richest wildlife. Main fish species are the Cyprinids (*Chondrostoma toxostoma*, *Phoxinus phoxinus*, *Gobio gobio*, *Barbus graellsii*), the Cobitids (*Noemacheilus barbatulus*, *Cobitis calderoni*), Salmonids (*Salmo trutta*) and Anguilids (*Anguilla anguilla*). The American crayfish (*Procambarus clarkii*) is very common and toads (*Bufo bufo* and *Bufo calamita*) and green frogs (*Rana perezi*) are also abundant on the riverbanks. Anseriforms, Ralliforms and Ardeids are the most common aquatic birds, in addition to raptors, passeriforms, cuculiforms and coraciforms. Carnivore mammals, such as the stone marten (*Martes foina*), weasel (*Mustela nivalis*), badger (*Meles meles*), otter (*Lutra lutra*), genet (*Genetta genetta*) and fox (*Vulpes vulpes*), share the riparian habitat with *M.lutreola*. Other mammals such as the rabbit (*Oryctolagus cuniculus*), Iberian hare (*Lepus granatensis*) and wild boar (*Sus scrofa*) are also present; with small mammals such as mice (*Apodemus sylvaticus*, *Mus musculus* and *Mus spretus*), brown rat (*Rattus norvegicus*), water vole (*Arvicola sapidus*), voles (*Microtus agrestis*, *Microtus arvalis*, *Microtus duodecimcostatus*) and shrews (*Crocidura russula* and *Suncus etruscus*) which inhabit the riverside forest (Castién and Gosálbez 1992, Palomo and Gisbert 2002).

The river is polluted by a nearby industrial estate, several villages and a paper factory. They cause that the waters of the river containing high levels of PCBs (LópezMartín et al. 1994). However, the recent opening of several water-treatment plants has reduced the pollution levels. In addition, the self-cleansing of the river permits acceptable levels of water quality, but in the summer, when the level of water drops significantly, the level of dissolved oxygen is very low (Álvarez et al. 1990).

METHODOLOGY

First study area: two studies on the presence of European mink in riparian habitats (rivers), where the method of trapping station was used, were carried out during 1994-95 (n = 71) (Palazón et al. 1995) and 2000-01 (n = 45) (Palazón et al. 2001). In each study, the number of river streams (rivers and tributaries) and the kilometres with European mink presence was calculated. From the results of trapping, a density of capture ($D_i = n_i/L_i$), where ni was the number of minks captured and L_i was the distance (km) of trapping station, was estimated.

Second study area: on a stream of Ega river, three trapping stations (4.35 km length) were set to estimate the density of capture in this river (D_{EGA}). Two studies parallel on densities of minks



was carried out in the same river stream during 1995-96. These studies were realized by means of a system of capture/recapture (intense trapping for 5 months in six times) and by means of radio-tracking. From these studies, two theoretical densities ($D_{C\text{-}R}$ and D_{RT}) (number of minks/kilometre of river) were estimated.

Two correction factors were estimated, comparing the density of capture and both theoretical densities. The correction factor $X_{C\text{-}R}$ proceeds from the comparison between the density of capture (D_{EGA}) and the density of minks estimated by capture/recapture ($D_{C\text{-}R}$), using the Schannbel method (Sutherland, 1996). The correction factor X_{RT} proceeds from the comparison between the capture density (D_{EGA}) and the number of minks estimated by radio-tracking (D_{RT}). Both theoretical densities ($D_{C\text{-}R}$ and D_{RT}) were applied to every of rivers where trapping were carried out (First study area). In all those rivers with European mink presence, but where the trapping didn't allow estimate a density of capture, a theoretical densities ($D_{C\text{-}R}$ and D_{RT}) was assigned. It was estimated from other trapped rivers with similar habitat (width of river, width of riparian forest, etc.).

RESULTS

The number of kilometres of river with presence of European mink was 539 in 1994-95 (Fig. 1) and 1,014 in 2000-01 (Fig. 2). The density of capture in the three trapping station set on Ega river was D_{EGA} = 1.61 minks per kilometre of river. The theoretical densities of minks on Ega river were $D_{C\text{-}R}$ = 0.396 minks per kilometre of river and D_{RT} = 0.463 minks per kilometre of river. From these results, both correction factors, $X_{C\text{-}R}$ and X_{RT} were 0.246 and 0.288 respectively.

The number of minks ranged between 205 (C-R) and 240 (RT) in 1994-95 (Table 1). The average density was 0.38-0.44 minks per kilometre of river (range = 0.17-1.08). In 2000-2001, this number increased and ranged between 251 (C-R) and 294 (RT) (Table 2), but the average density was 0.25-0.29 minks per kilometre of river (range = 0.05-1.02).

DISCUSSION

When minks reach the three months of age, their size is similar to adult individuals (Maran & Robinson, 1996). So, the differentiation, in the field, between juvenile, subadult and adult minks is very difficult. We consider juveniles minks from May to August (0-4 months), subadults minks from September to December (5-8 months) and adults minks from January, in the next year (9 or more months), when they reach the sexual maturity. The trappings for these 10 years were always in autumn and winter, when the offspring aged more than 3-4 months.

Five years later, the distribution of European mink in Navarre increased from 539 (1994-95) to 1,014 km (76.7 %) (2000-01), but the density of minks decreased (mean = 32.4 %). The number total of minks was greater in 2000-01. The mink expanded, meanly by Aragon basin, but the stop to expansion downstream to river Ebro is strange.

The density and number of minks inhabiting on riparian ecosystems is subordinated to: availability of potential preys, availability of dens or resting sites, the width of riverbed and riparian forest, climatic factors, etc. The density changes year around: pre-reproductive time (January-March), reproductive time (March-June) and post-reproductive and dispersal time (July-December). During this last time is when the mortality rate of juvenile minks is higher. Sidorovich (1997) and Sidorovich and Kozholin (1994) estimated that the differences between the pre-reproductive and post-reproductive density was from 1.0 to 4.75, respectively. The number of minks inhabiting on rivers in winter (dispersal and mate season) is subordinated to: number of females, number of females participating in the reproduction process, number of minks per litter and survival of the new offspring before to arrive to the next reproductive period.

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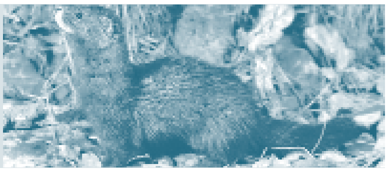

ACKNOWLEDGEMENTS

This research was funded by Spain Environment Ministry and Goverment of Navarra. We grateful to help of Enrique Castién, Javier Ochoa, José María López Martín, Oscar Arribas, Elena Rafart and Jordi Palazón.

Rivers	Km	D_i	D_{C-R}	D_{RT}	N_{C-R}	N_{RT}
Upper Ega	58	1.11	0.27	0.32	15.7	18.6
Tributaries Upper Ega	23	0.55	0.27	0.32	6,21	7.36
Lower Ega	55	1.61	0.40	0.46	22.0	25.3
Urederra	15	3.75	0.92	1.08	13.8	16.2
Upper Arga	25	1.29	0.32	0.37	8.0	9.2
Middle Arga	20	0.71	0.17	0.20	3.4	4.0
Lower Arga	10	1.11	0.27	0.32	2.7	3.2
Arakil	25	0.71	0.17	0.20	4.2	5.0
Ulzama basin	75	1.43	0.35	0.41	26.2	30.7
Ebro	122	1.29	0.32	0.37	39.0	45.0
Baztán	19	2.14	0.53	0.62	10.1	11.8
Tributaries of Baztán	36	0.91	0.22	0.26	7.9	9.4
Ezkurra	20	2.86	0.70	0.82	14.0	16.4
Bidasoa	35	2.00	0.49	0.58	17.1	20.3
Urumea	24	2.35	0.59	0.68	14.2	16.3
Total	539				204.6	239.8

Table 1. Density and numbers of European mink inhabiting on the rivers of Navarra in 1994-1995. Km = kilometres with presence of European mink. Ni = number of minks captured. Di = density of capture. D_{C-R} = theoretical density estimated by capture-recapture. D_{RT} = theoretical density estimated by radio-tracking. N_{C-R} = number of European minks estimated by capture-recapture. N_{RT} = number of European minks estimated by radio-tracking.

Tabla 1. Densidad y número de visones europeos que habitan en los ríos de Navarra durante 1994-1995. Km = kilómetros con presencia de visón europeo. Ni = número de visones capturados. Di = densidad de captura. D_{C-R} = densidad teórica estimada por captura-recaptura. D_{RT} = densidad teórica estimada por radioseguimiento. N_{C-R} = número estimado de visones europeos por captura-recaptura. N_{RT} = número estimado de visones europeos por radioseguimiento.

Rivers	Km	D_i	D_{C-R}	D_{RT}	N_{C-R}	N_{RT}
Ega-Urederra basin	151	1.01	0.25	0.29	37.7	43.8
Arga basin	100	0.755	0.19	0.22	18.6	22.0
Salado	25	0.38	0.09	0.11	2,2	2.7
Elorz	30	0.38	0.09	0.11	2.7	3.3
Arakil-Larraun	85	0.52	0.13	0.15	11.1	12.8
Ulzama basin	56	2.00	0.49	0.58	27.4	32.5
Aragon basin	146	0.88	0.22	0.25	32.0	36.5
Cidacos	48	0.44	0.11	0.13	5.3	6.2
Linares-Odrón	52	1.67	0.35	0.41	21.3	25.0
Alhama	28	3.53	0.87	1.02	24.4	28.6
Ebro	122	1.85	0.45	0.53	54.9	64.7
Urumea-Añarbe	44	0.52	0.13	0.15	5.7	6.6
Bidasoa-Baztán basin	110	0.215	0.05	0.05	5.3	6.2
Leizarán	7	0.52	0.13	0.15	0.9	1.1
Araxes	10	0.52	0.13	0.15	1.3	1.5
Total	**1,014**				**250.8**	**293.5**

Table 2. Density and numbers of European mink inhabiting on the rivers of Navarra in 2000-2001. Km = kilometres with presence of European mink. Ni = number of minks captured. Di = density of capture. D_{C-R} = theoretical density estimated by capture-recapture. D_{RT} = theoretical density estimated by radio-tracking. N_{C-R} = number of European minks estimated by capture-recapture. N_{RT} = number of European minks estimated by radio-tracking.

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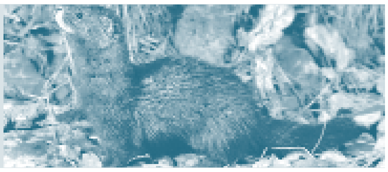


Figure 1. Distribution of European mink (*Mustela lutreola*) on rivers of Navarra in 1994-1995 and number of minks estimated.

Figura 1. Distribución del visón europeo (Mustela lutreola) en los ríos de Navarra durante 1994-1995 y número estimado de visones.

Figure 2. Distribution of European mink (*Mustela lutreola*) on rivers of Navarra in 2002-2001 and number of minks estimated.

Figura 2. Distribución del visón europeo (Mustela lutreola) en los ríos de Navarra durante 2000-2001 y número estimado de visones.

[Feeding ecology of released European mink in Hiiumaa island 2000-2003]

ECOLOGÍA ALIMENTICIA DE VISONES EUROPEOS (*Mustela Lutreola*) LIBERADOS EN LA ISLA DE HIIUMAA (2000-2003)

RESUMEN

Se ha estudiado la ecología de la alimentación de los visones europeos (Mustela lutreola) liberados en la Isla de Hiiumaa (Estonia). Se recogieron 564 muestrasscats entre 2000 y 2003, y se encontraron 22 especies presa en la dieta del visón europeo. Las principales presas fueroneran anfibios (49,6 % de la biomasa consumida como alimento). Peces, crustáceos y pequeños mamíferos fuerontenían menos importantescia. Los anfibios prevalecen en todos los tipos de hábitat estudiados, excepto en las desembocaduras de ríos cercanoas a lagos, donde dominaronban los peces. Los anfibios fueroneran significativamente más importantes como presas en la estación fría que en la estación templada. Anfibios y cangrejos prevalecieroían durante la estación templada.

De manera sorprendente, la alta proporción de cangrejos en la dieta del visón durante el verano se puede explicar por la sequía acaecida durante la recogida de datos. Esta presa es fácil de capturar cuando los niveles de agua son muy bajos o cuando el cauce va seco (como ocurrió desde la primavera de 2002 hasta el otoño de 2003). El porcentaje La tasa de cangrejos en la dieta aumentóaba significativamente con la sequía, en comparación

Running title:
[Feeding ecology of released European mink in Hiiumaa Island 2000-2003]

M. Põdra[1, 2], L. Kõlamets[2], I. Solovej[3], V. E. Sidorovich[3], T. Maran[4]

[1] Hiiumaa Protected Areas Administration. Vabrikuväljak 1, Kärdla 92411, Hiiumaa, Estonia.

[2] Tallinn University. Narva road 25, Tallinn 10120, Estonia.

[3] Institute of Zoology NAS of Belarus. Akademicheskaja street 27, Minsk-220072, Belarus.

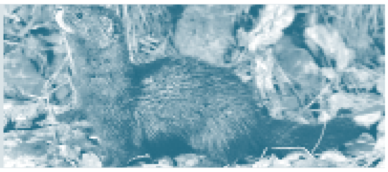
[4] Institute of Zoology NAS of Belarus. Akademicheskaja street 27, Minsk-220072, Belarus.

[5] Foundation "Lutreola". Paldiski road 145, Tallinn 13522, Estonia.

Madis Põdra
Hiiumaa Protected Areas Administration. Vabrikuväljak 1, Kärdla 92411, Hiiumaa, Estonia.
E-mail: madis.podra@hiiuloodus.ee

ABSTRACT

Feeding ecology of released European minks (*Mustela lutreola*) was studied in Hiiumaa Island (Estonia). 564 scats were collected in 2000-2003 and 22 prey species were found in the diet of European mink. Main prey items were amphibians (49.6 % of food biomass consumed). Fishes, crustaceans and small mammals were less important. Amphibians were prevailing in all types of habitats under study, except river mouth close to lake, where fish dominated. Amphibians were significantly more important prey in cold season then in warm season. Amphibians and crayfish were prevailing during warm season. Surprisingly high proportion of crayfish in mink's diet during summer can be explained by draught during the data collection. This prey was easy to catch in case very low water-level or dry bottom (as from spring 2002 to autumn in 2003). Crayfish share in the diet rose signifi-



cantly with draught in comparison to normal years (from 2000 to spring in 2002). The diet of seven individuals was investigated: three out of seven ate mostly amphibians (more than half of the biomass consumed), in the diet of two mink the crayfish was prevailing, one mink was mostly eating fishes and one - small mammals. In comparison to American mink (*Mustela vison*) eradicated in Hiiumaa Island in 1998 - 2000, the released mink consumed more amphibians and less small mammals in spring period. Possible causes of dynamics in diet of European mink are discussed.

Key Words: European mink, *Mustela lutreola*, diet, Hiiuma Island, feeding ecology, prey.

INTRODUCTION

The diet of European mink has been analysed in few studies. This study is specifically focuses to the analyses on feeding ecology of island-population in the course of its establishment. The release of captive-bred European minks was started in 2000, with final aim to create viable population in the second largest island in Estonia - Island Hiiumaa. It is believed that the habitats of the island are able to maintain only a minimum viable population of the European mink. Therefore, from conservation point of view it is of utmost importance to get an overview about characteristics of feeding of released mink in the island.

This study have the following aims: (1) to describe the diet of European mink in Hiiumaa Island; (2) to compare its diet in different habitats; (3) to analyse seasonal and (4) yearly differences (normal and draught years) in the same habitat; (5) to compare the feeding of the eradicated (in 1999 - 2000) American mink (*Mustela vison*) and the released European mink (*Mustela lutreola*).

STUDY AREA AND METHODS

Hiiumaa Island is situated in West-Estonian archipelago. The area of the island is 1019 km^2, distance from mainland equals 22 km. Almost 70 % of the island is covered by forests and ~7% by marshes. There are 326 km of watercourses and 13 lakes.

con años normales (desde el 2000 hasta la primavera de 2002). Se investigó la dieta de siete individuos: tres de los siete comieronían sobre todo anfibios (más de la mitad de la biomasa consumida); los cangrejos prevalecieroían en la dieta de dos visones; un visón comióía principalmentesobre todo peces y otros pequeños mamíferos. En comparación con el visón americano (Mustela vison), erradicado de la Isla de Hiiumaa en 1998 – 2000, los visones liberados consumieroían más anfibios y menos pequeños mamíferos en primavera. Se discuten las posibles causas de la dinámica en la dieta del visón europeo.

Palabras clave: visón europeo, Mustela lutreola, dieta, Isla de Hiiuma, ecología de la alimentación, presas.

10 rivers are longer than 10 km; the longest is Luguse River (21 km). Most of rivers and brooks have been canalized during intensive land-reclamation activities in 1950-1970. The length of natural water courses is ~57 km.

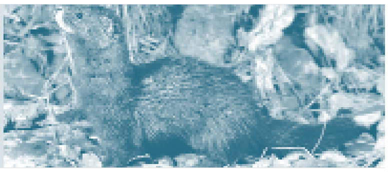
Water level of streams has high yearly fluctuation and may be quite low in summer, with the flow rate being less than <6.7 l/s. 15 species of fish have been recorded in the island; the most common are *Esox lucius*, *Rutilus rutilus*, *Lota lota*, in some rivers also *Salmo trutta*. The biomass of the fish is up to 438 g per 10 m of river stretch (normally < 100g), it depends on species, habitat and the rate of migration from sea. Crayfish, *Astacus astacus*, populations inhabit 4 rivers in 10 km of river stretch in total. Average number of individuals captured in these river-stretches per net-night was 5.7 ± 6.3 (mean ± SE) in 2002. The abundance of brown frogs (*Rana temporaria* and *Rana arvalis*) varies 0-7 ind./10m^2 and was the highest in swamped forest - 0.61 ± 0.34 (mean ± SE), and at stream banks 0.37 ± 0.10 ind./10 m^2 .

564 scats of European minks were collected at dens and from home ranges of radio-tagged animals, but also at snow-tracks and from live-traps in 2000 (June) - 2003 (January).

The main five habitat types for European mink were distinguished by means of radio-tracking and by tracking of field signs: canals, a canal between lakes, rivers, river-mouth and swamped forest. Usually the upper- or medium-stretches of rivers or brooks have been canalized, some of them are quite old and seemingly natural. The natural stretches of streams are divided to rivers (length >10 km) or brooks (< 10 km). River-mouth was defined as a stretch with length of ~0.5 km at the in-flow to coastal lake. The scats collected in three biotopes, canal between lakes, river-mouth and swamped forest, originated only from single specimen.

The scats of American minks were collected during the eradication of the species in 1998-2000. No American mink has been detected since then despite of intensive and regular monitoring of the European mink after the start of release in 2000. Only 26 scats of American mink were analyzed in total.

The scats were air-dried and stored for analyses. Before it they were washed with detergent. The remains of prey were identified to the level of species, whenever possible. Amphibians were identified by bones, fishes by scales or bones, mammals by hair or by teeth, reptiles by bones or skin and birds by feathers. Insects, crayfish and molluscs were distinguished by remains of their outer skeleton. Consumed biomass (%BC) of a prey category in the diet was calculated by coefficient of digestibility, occurrence of prey (%OC) category in the in the scats was calculated as well. χ^2-test was used to evaluate the significance of the difference in use of prey categories between scat samples. Due to small sample size only two seasons, April-October and November-March were compared. For comparison of the American and European mink diet, only scats collected in March and April (the most important period of American mink eradication in Hiiumaa Island) were included.



RESULT

Diet of European mink on Hiiumaa in 2000-2003

Total of 22 prey species were recorded in European mink diet (Tab. 1). The amphibians were forming the main prey category (49.6 %BC), other prey categories were consumed in lower rate: fish - 27.9 %BC, crayfish - 10.8 %BC and small mammals - 9.3 %BC. Occasionally birds, reptiles (*Natrix natrix*), insects and molluscs were found in scats (Fig. 1).

Diet in different habitats

In canals, the main food of the European mink were amphibians (38.8 %BC). Fish (21.9 %BC) and crayfish (26.1 %BC) were also consumed in remarkable extent. The other prey was eaten less: small mammals -10.2 %BC, birds - 2.2 %BC, insects and molluscs - 0.4 %BC.

In the canal between lakes the food of the European mink (in summer) consisted mostly of amphibians (79.2%). The other prey categories were less important: fish - 15.9 %BC, small mammals - 2.3 %BC, birds - 2.1 %BC, insects and reptiles - 0.5 %BC.

Also in small rivers/brooks the main prey of the European mink were amphibians (58.5 %BC). Fish (19.6 %BC), small mammals (15.6 %BC) and crayfish (5.4 %BC) were less important, and birds (0.6 %BC), insects, molluscs, reptiles (0.1%BC) were of minor importance.

At river-mouth, the fish (97.2 %BC) formed a substantial part of the diet (in summer). There was a minor part of amphibians (2.7 %BC). Share of small mammals (0.1 %BC) was insignificant.

In swamped forest, the amphibians (82.5 %BC) formed the major part of the diet. Reptiles (7.4 %BC), birds (5.8 %BC) and small mammals (4.1 %BC) were less important and the share of insects was insignificant (0.2 %BC).

Seasonal variation

Figure 2 and 3 show the proportion of main prey categories in the diet of European mink during two seasons.

The most important prey in **warm season** was as follows: amphibians - 43.4 %BC, fishes - 30.9 %BC, crayfish -12.5 %BC and small mammals - 10.4 %BC. Other food categories (2.8 %BC) such as birds, reptiles, insects and molluscs were less important.

Also in **cold season**, the most food consisted of amphibians (87.2 %BC), fishes (10 %BC), small mammals (2.4 %BC), crayfish (0.3 %BC). Other food categories (0.1 %BC) were of minor importance.

The proportion of amphibians was significantly higher in cold season than in warm season - 87.2 versus 38.3 %OC (χ^2 = 62.9; $P<0.0001$). Small mammals were eaten significantly less - 21.8 versus 10.3 %OC (χ^2 = 4.9; P = 0.0273). The same applies to crayfish - 37.9 versus 3.9 %OC

(χ^2 = 33.6; P<0.0001) and to all other food categories taken all together - 19.9 versus 2.6 %BC (χ^2 = 10.4; P = 0.0013). No significant difference was detected in consumption of fish between the seasons - 24.3 versus 29.5 %OC (χ^2 = 0.7; P = 0.3981).

Variation in diet during regular years (2000-2002, spring) and the draught period (2002-2003, autumn) in Luguse River

In the normal conditions, main prey of European mink in Luguse river were amphibians (47.8 %BC) and fish (40.1 %BC). Small mammals (9.0 %BC) and crayfish (2.9 %BC) were less important, the other categories (included birds, reptiles, insects and molluscs) were consumed rarely (0.2 %BC).

During the draught, crayfish formed the most important part of the diet (48.9 %BC). Amphibians (29.8 %BC), small mammals (16.3 %BC), other food (4.7 %BC) and fishes (0.5 %BC) were less important.

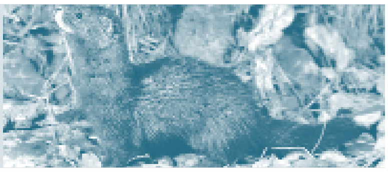
During the draught, the amphibians (50.0 versus 21.5 %OC) and fishes (26.1 versus 4.7 %OC) were consumed significantly less in comparison normal conditions (χ^2 = 12.7; P = 0.0004 and χ^2 = 15.9; P<0,0001, respectively). Crayfish was significantly more important prey - 15.2 versus 83.2 %OC (χ^2 = 70.7; P = 0.0001). Small mammals (19.6 versus 21.5 %OC) and other food categories (6.5 versus 6.0 %OC) were not significantly different in comparison to regular years (χ^2 = 0.005; P = 0.9433 and χ^2 = 0.01; P = 0.9054).

Individual variation

Figure 4 shows individual variation in the diet of seven European minks. Three individuals ate mainly amphibians (*Rana sp.*), two individuals mainly crayfish, last two remaining fish or small mammals, respectively.. The minks eating mainly crayfish (89.7 and 53.0 %BC) inhabited the river stretch with high abundance of crayfish. The individual, with high share of small mammals (56.7 %BC) in the diet, inhabited also the river stretch with high abundance crayfish, and the share of crayfish was relatively high in its diet (38.5 %BC) as well. Fish (97.2 %BC) was most important in the diet of the individual inhabiting river-mouth, with high abundance of fish. Amphibians were main food for individuals inhabiting canals (90.1 and 79.2 %BC), but also for the mink (82.5 %BC) staying in the forest Birds (5.8 %BC) and reptiles (7.4 %BC) were more frequent in the diet of the individual in the forest in the diet of other searched minks.

Diet of the released European mink and eradicated American mink in Hiiumaa in spring

Main food of European mink consisted of amphibians, other prey categories as fishes, crayfish, and small mammals were less consumed. Occasionally they ate small birds, reptiles, insects and molluscs (see the chapter "Diet of European mink on Hiiumaa in 2000-2003"). Main prey of American mink were amphibians (71.9%) by consumed biomass. Small mammals (19.9 %), fishes (7.3%), insects (0.8%) and crayfish (0.1%) were less important (Fig. 5).



In comparison to European mink, small mammals were significantly more important in the diet of American mink (March and April) - 65.4 versus 5 %OC (χ^2 = 14.9, P = 0.0001). Amphibians were significantly less important in the diet of American mink - 38.5 versus 95 %OC (χ^2 = 3.2, P = 0.0003). There was no significant differences in fish consumption - 23.1 %OC in American mink diet and 15 %OC in European mink diet (χ^2 = 0.1, P = 0.7568).

Discussion

The data on the diet of European mink in Hiiumaa is quite similar to the results in other studies in Russia, Estonia and Belarus. About half of the diet consists of amphibians; the other important food categories are fish, small mammals and crayfish. Aquatic prey forms a high proportion in the food of the species.

The results on diet in different habitats show, that share of amphibians in lower-quality habitats increases. At the river-mouth, where fish abundance is high, the main food items are pike (*Esox lucius*) and burbot (*Lota lota*). This result is similar to the study in North-Estonia (Maran et al. 1998), where minks ate mostly fish (trout's spawning river). In canals, with high abundance of crayfish and fish - these prey categories were important also along with amphibians. The canal between lakes (with swampy banks) was rich of fishes, but dried during summers and amphibians were more important food then fish. The diet of the mink inhabiting swamped forest far from water-bodies (unusual habitat for mink) was quite similar to the typical diet: amphibians dispersing from wintering sites were most important, birds and reptiles (*Natrix natrix*) were eaten less, but still more than in typical habitats.

In cold period, amphibians clearly dominated in the diet of European mink (87.2 %OC). That is very similar to the result in Belarus. The food was more diverse during warm period. The most important prey items were amphibians (38.3 %OC) and crayfish (37.9 %OC). High importance of crayfish may be due to the very dry summer in 2002 and 2003 when the canals dried partially making the crayfish an easy prey for predators. That suggestion is supported by the comparison of diet in regular year and during draught in Luguse canal - role of crayfish increased significantly with draught. The same was observed also in other canal with high abundance of crayfish - Vaemla. The surprisingly low proportion of fish in the diet during the draught remains unclear, as one could have expected that fish was an easy prey in remaining water pools in the bottom of river-bed during draught. One possible explanation is that dry spring with low water level prevented migration of fish and the fish abundance in rivers was very low. Despite of this our data clearly suggest that aquatic prey (fishes, crayfish, and brown frogs) is very important for the European mink.

Individual diet analyzes confirm that the diet of mink largely depends on prey species available in the biotopes. The scats collected from individuals inhabited places with high abundance of crayfish, contained lots of crayfish, especially during draught. Fish was main prey for the specimen inhabited river mouth rich in fish and amphibians were eaten the most often at canals

(except Luguse and Vaemla canals) or in forest. The result is similar to the studies of Belarus, where crayfishes were main food for individuals inhabiting rivers or lakes (with high abundance of crayfish), whereas frogs were most important in poorer habitats - at the brooks or fast-flowing rivers.

The comparison between American and European mink in spring period was analyzed on small sample of scats (n = 26 and n = 21), collected from different streams. Therefore the results do not provide good ground for strong conclusions. Yet, it seems that the American species tend to prefer more mammals than native mink, the European mink, in contrary, seem to feed more amphibians. This result is in accordance with diet comparison of two mink species in.

ACKNOWLEDGEMENTS

The main financial support was provided by the British Government Darwin Initiative Foundation in 2000-2001. The major financial support for this study was provided by European Union LIFE-program project “Recovery of *Mustela lutreola* in Estonia: captive and island populations” LIFE2000NAT/EE/7081 in 2001-2003. We are also grateful to Tallinn Zoo, Foundation “Lutreola”, Hiiumaa Protected Areas Administration and Tallinn Pedagogical University for support to this study.

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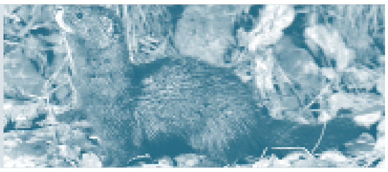

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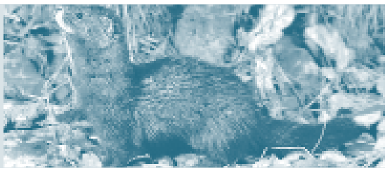
Prey item	n	%OC
Amphibia sp	98	17,3
Rana sp	127	22,5
Rana arvalis	26	4,6
Rana temporaria	7	1,2
Bufo bufo	4	0,7
Amphibia - total	**262**	**46,4**
Piscea sp	36	6,4
Cyprinidae sp	12	2,1
Salmo trutta	4	0,7
Lota lota	45	8
Esox lucius	44	7,8
Piscea - total	**140**	**24,8**
Mammalia sp	20	3,5
Small mammals sp	5	0,9
Insectivore sp	2	0,4
Microtus sp	10	1,8
Clethrionomus glareolus	2	0,4
Rattus norvegicus	20	3,5
Arvicola terrestris	26	4,6
Apodemus flavicollis	4	0,7
Sorex sp	8	1,4
Sorex araneus	1	0,2
Sorex minutus	1	0,2
Neomys fodiens	13	2,3
Mustela nivalis	3	0,5
Lepus europaeus (from garbage site)	1	0,2
Mammalia - total	**114**	**20,2**
Astacus astacus	187	33,1
Insecta sp	52	9,2
Gastropoda sp	6	1,1
Invertebrata - total	**245**	**43,4**
Natrix natrix	7	1,2
Reptilia - total	**7**	**1,2**
Aves sp	29	5,1
Aves - total	**29**	**5,1**

Table 1. Prey items, the number (n) and occurrence (%OC) of a food object in the diet of European mink (*Mustela lutreola*) on Hiiumaa in 2000-2003.

Tabla 1. Tipo de presas, número (n) y abundancia (%OC) en la dieta del visón europeo (Mustela lutreola) en Hiiumaa entre 2000 y 2003.



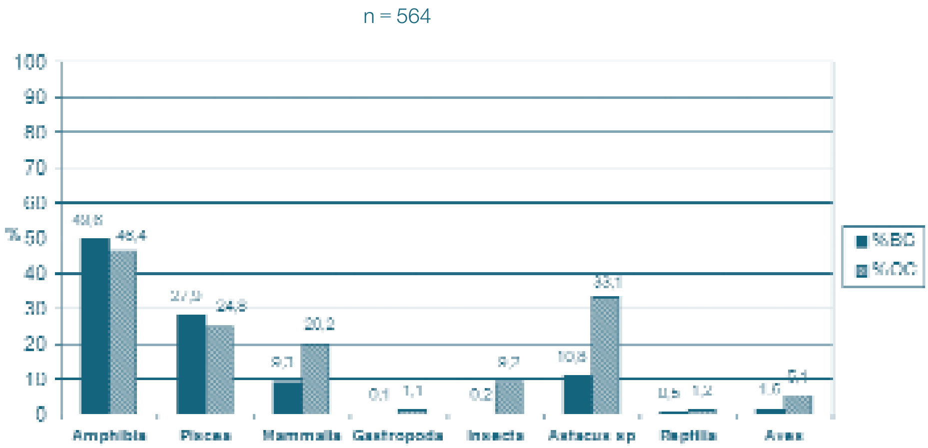


Figure 1. The diet of European mink (Mustela lutreola) on Hiiumaa in 2000-2003, presented as percentage of consumed biomass (%BC) and occurrence (%OC) of main food categories.
Figura 1. Dieta del visón europeo (Mustela lutreola) en Hiiumaa entre 2000 y 2003, presentada como porcentaje de biomasa consumida (%BC) y abundancia (%OC) de las principales categorías de comida.

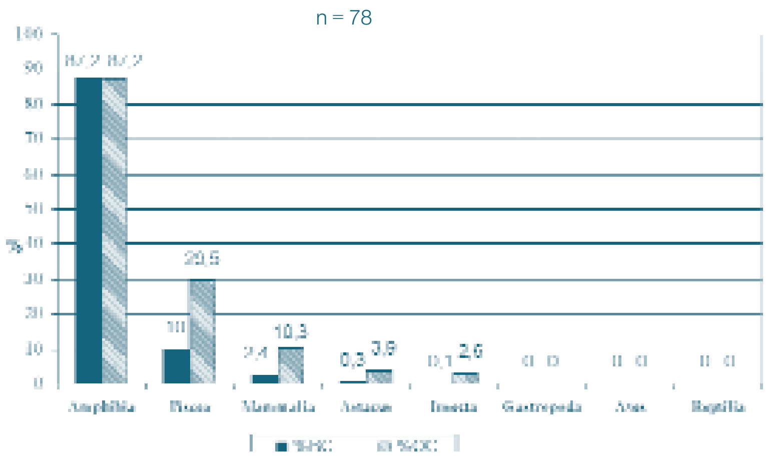


Figure 2. The diet of the European mink (*Mustela lutreola*) on Hiiumaa in warm season (April-October) presented as percentage of consumed biomass (%BC) and occurrence (%OC) of main food categories.
Figura 2. Dieta del visón europeo (Mustela lutreola) en Hiiumaa en la estación templada (abril-octubre) presentada como porcentaje de biomasa consumida (%BC) y abundancia (%OC) de las principales categorías de comida.

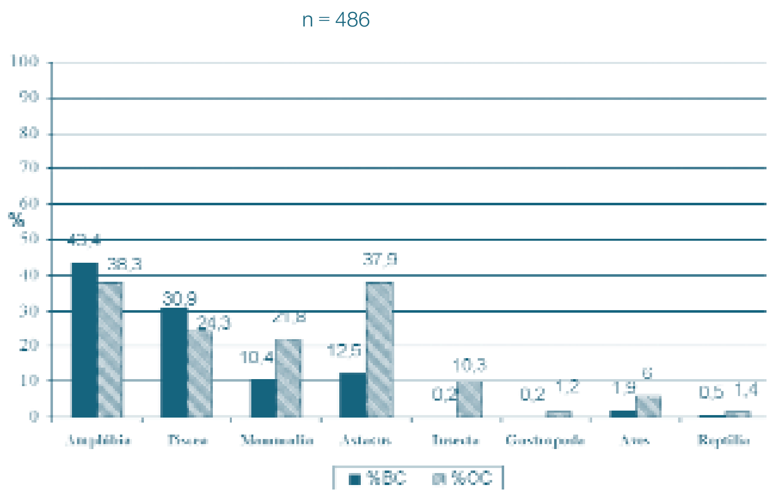


Figure 3. The diet of the European mink (*Mustela lutreola*) on Hiiumaa in cold season (November-March) presented as percentage of consumed biomass (%BC) and occurrence (%OC) of main food categories.
Figura 3. Dieta del visón europeo (Mustela lutreola) en Hiiumaa en la estación fría (noviembre-marzo) presentada como porcentaje de biomasa consumida (%BC) y abundancia (%OC) de las principales categorías de comida.

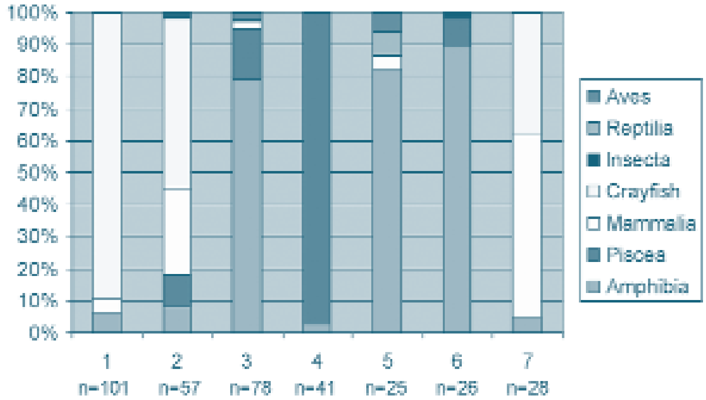
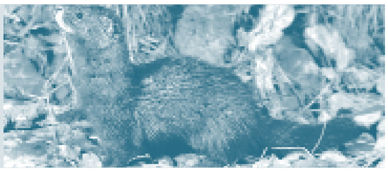


Figure 4. Individual differences in the food of seven European minks (*Mustela lutreola*) given by %BC.
Figura 4. Diferencias individuales en la comida de siete visones europeos (Mustela lutreola), presentada en %BC.



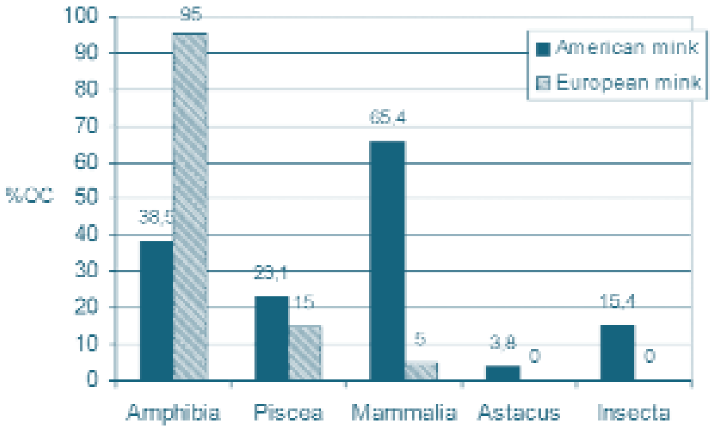


Figure 5. The diet of American mink (*Mustela vison*) and European mink (*Mustela lutreola*) in Hiiumaa in spring (March-April) between 1999 and 2001.

Figura 5. Dieta del visón americano (Mustela vison) y el visón europeo (Mustela lutreola) en Hiiumaa en primavera (marzo-abril) entre 1999 y 2001.

[Interspecific aggressiveness of European mink (*Mustela lutreola*) and American mink (*M. vison*): provisional results of experiments in captivity]

AGRESIVIDAD INTERESPECÍFICA DEL VISÓN EUROPEO (*Mustela Lutreola*) Y DEL VISÓN AMERICANO (*Mustela vison*): RESULTADOS PROVISIONALES DE EXPERIMENTOS EN CAUTIVIDAD

RESUMEN

La causa principal de extinción del visón europeo parece ser el impacto del introducido visón americano. Físicamente más fuerte y más agresivo, el visón americano puede expulsar a las especies nativas de sus hábitats óptimos.

Examinamos a los visones europeo y americano en cautividad y registramos sus reacciones ante diferentes oponentes (macho coespecífico, hembra coespecífica, macho cogenérico y hembra cogenérica). El visón oponente se capturaba en una jaula- trampa de mano hecha de alambre y se situaba en las cercanías del animal a examinar. Durante los 15 minutos del ensayo, registramos la duración del contacto cercano con el animal en la jaula de mano y si este contacto era agresivo (ataque) o cauteloso (curiosidad, olisqueo).

Encontramos que los machos se aproximaban y atacaban al oponente significativamente más que las hembras. Nuestros resultados muestran que machos y hembras de visón europeo atacaron con mayor frecuencia a sus oponentes de la misma especie y que tendían a evitar el contacto con visones americanos. Por el contrario, los machos de visón america-

Running title:
[Aggressiveness of European mink and American mink]

MERJE PÕLMA[1] AND TIIT MARAN[2]

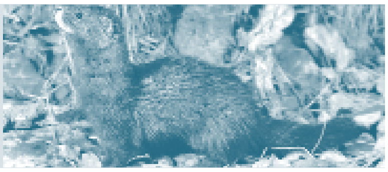
[1]Tallinn Zoological Gardens, Estonia
[2]Foundation "LUTREOLA"/Tallinn Zoological Gardens, Estonia

Merje Põlma
Tallinn Zoological Gardens, Estonia

ABSTRACT

The main cause of the European mink extinction seems to be the impact of introduced American mink. Physically stronger and more aggressive American mink may oust native species from optimal habitats.

We tested European and American minks in captivity and recorded their reaction to different opponents (conspecific male, conspecific female, congeneric male, and congeneric female). Opponent mink was captured into a wire mesh-handling cage and placed into the enclosure of the test animal. During 15 minute trials we recorded the duration of close contact with the animal in handling cage and whether this contact was aggressive (attacking) or cautious (staring, sniffing).



We found that males approached and attacked opponents significantly more than females. Our results show that male and female European minks attacked more frequently the opponents of their own species and tended to avoid contacts with American minks. To the contrary, male American minks tended to be more aggressive towards individuals of other species (European minks) than their own species.

Our experiments did not show that female American minks attacked more European minks than vice versa. Even if we did find that male American minks attacked more European minks than vice versa, this difference was not significant. It is obvious that for more conclusive results the sample size has to be increased. However, our data show that interspecific contacts are aggressive. American minks have clear preference in direct physical interspecific contacts anyway due to their bigger body size.

Interesting but not surprising was our discovery that captive born minks of both species have higher level of aggression than wild born individuals, regardless of the opponent.

Key Words: *Mustela lutreola*, *Mustela vison*, interspecific aggresiveness.

INTRODUCTION

The main cause of the European mink extinction seems to be the impact of introduced American mink. In Estonia, Belarus and some regions of Russia the decline of the European mink and the invasion of the American mink have coincided. The impact of the American mink has been explained in several non-exclusive ways including direct interspecific aggressiveness. Physically stronger and more aggressive American mink may oust native species from optimal habitats.

There are still very few researches made to compare the behaviour of two mink species. The aim of our study was to test in captivity (1) whether the reaction of minks to the congeneric opponent is as aggressive as their reaction to the conspecific opponent and (2) whether American minks are more aggressive towards European minks in the interspecific encounters or viceversa.

no tendieron a mostrar más agresividad hacia individuos de otras especies (visones europeos) que hacia los de su propia especie.

Nuestros experimentos no mostraron que las hembras de visón americano atacaran más al visón europeo que viceversa. Incluso en el caso de encontrar que los machos de visón americano atacaran más a visón europeo que viceversa, esta diferencia no es significativa. Es obvio que para obtener resultados más concluyentes se debe ampliar el tamaño de la muestra. De cualquier forma, nuestros datos muestran que los contactos interespecíficos son agresivos. El visón americano tiene clara preferencia por el contacto físico directo interespecífico en cualquier caso, debido a su mayor tamaño corporal.

Interesante, pero no sorprendente, fue nuestro descubrimiento de que los visones nacidos en cautividad de ambas especies tienen niveles más elevados de agresión que los individuos nacidos en libertad, sea cual fuere el oponente.

Palabras clave: Mustela lutreola, Mustela vison, agresividad interespecífica.

METHOD

The study was carried out from early September to late December in 1997, 2002 and 2003 at Tallinn Zoo. Observations were conducted in the evenings during 16.00-19.30. The behaviour of 24 male and 14 female European minks, 6 male and 4 female American minks, both of wild and captive origin, were studied. All minks were adult. Wild born minks had been in captivity 1-3 years before test. Each animal was housed in an individual outdoor naturally furnished enclosure (app. 2 x 4 x 2 m).

Minks were tested 4 times and their reaction to different opponents (conspecific male, conspecific female, congeneric male, and congeneric female) was recorded. Every mink took part in only one trial per day. The order of trials was randomised. Pairs (test animal versus opponent) were selected randomly as well. Opponent mink was captured into a wire mesh-handling cage (30 x 20 x 25 cm) and placed into the enclosure of the test animal.

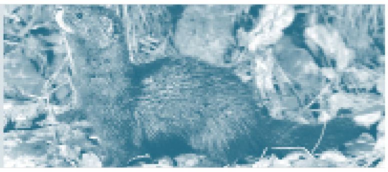
During 15-minute trials we recorded the duration of close contact with the animal in handling cage and whether this contact was aggressive (attacking) or cautious (staring, sniffing). To avoid any harm to the animals, minks were not provided any opportunity for direct physical contact. Close contacts together with attacks to the opponents were considered as aggression. A fixed interval sampling method was used. During 15 minutes trial the behaviour of minks was recorded in every 5 seconds (giving a total of 180 sample points). All statistical analyses were performed using STATISTICA software (Stat Soft, Inc. 2001). The trials were analysed first with ANOVA-test. For further detailed analyses Friedman ANOVA by ranks, Wilcoxon signed-rank test and Mann-Whitney U-test were used.

RESULTS AND DISCUSSION

Males approached and attacked opponents significantly more than females (Table 1.1). Captive born minks of both species approached and attacked opponents significantly more than wild born minks (Table 1.2).

Male European minks

Significant difference was apparent in reaction of male European minks towards different opponents (Fig. 1.1, 1.2). They had significantly more close contacts with male European minks than with male American minks ($n = 24$, $z = 3.01$, $p < 0.0026$) or with female American minks ($n = 24$, $z = 2.95$, $p < 0.0031$). European males also attacked significantly more male European minks than male American minks ($n = 24$, $z = 2.82$, $p < 0.0048$) or female American minks ($n = 24$, $z = 2.59$, $p < 0.0095$). They had significantly more contacts with female European minks than with male American minks ($n = 24$, $z = 2.37$, $p < 0.0176$). There were also more contacts and attacks to female European minks than to female American minks, though the differences were insignificant. Wild caught male European minks approached also more their conspecifics (Fig 1.3).



They more often approached male European minks than male American minks ($n = 6$, $z = 2.02$, $p < 0.0431$) or female American minks ($n = 6$, $z = 2.02$, $p < 0.0431$). Aggressiveness was highest towards other male European minks, male American minks were not attacked at all (Fig. 1.4).

Female European minks

We did not find difference in the reaction of female European minks towards opponents (Fig. 1.9, 1.10). Wild born female European minks did not attack any opponent and as a rule they even did not approach the opponent (Fig.1.11).

Male American minks

No significant difference was revealed in the reaction of male American minks towards opponents (Fig.1.5), though they tended to attack more often the European minks of both sex than the conspecifics (Fig.1.6). The same result was observed when wild caught male American minks were analysed separately (Fig.1.7, 1.8).

Female American minks

No significant difference was found in the reaction of female American minks towards opponents (Fig.1.12, 1.13). Wild caught specimen did not attack any opponent and only one approached the other female American mink (Fig.1.14).

Interactions between species

Male American minks were in longer contact and attacked male European minks more than vice versa but differences were insignificant (E $n = 24$, A $n = 6$, contacts: $z = -0.88$, $p = 0.3781$, attacks: $z = -0.52$, $p = 0.6041$). The same tendencies were observed when we separately analysed wild born male minks (E $n = 6$, A $n = 4$, contacts: $z = -1.71$, $p = 0.0881$, attacks: $z = -1.28$, $p = 0.2008$).

Male American minks also approached and attacked more female European minks than vice versa but the results were not statistically significant (E $n = 14$, A $n = 6$, contacts: $z = -1.48$, $p = 0.1376$; attacks: $z = -0.62$, $p = 0.5362$). Male European minks approached and attacked more female American minks than vice versa but these differences were insignificant as well (E $n = 24$, A $n = 4$, contacts: $z = 1.54$, $p = 0.1229$; attacks: $z = 1.28$, $p = 0.2005$). Wild caught American and European females were very shy and did not attack anyone. They even avoided approach to their opponent.

Clearly, the sample size gained so far has been too small for any far-reaching conclusion. Yet, our results show that male and female European minks attacked more frequently the opponents of their own species and tended to avoid contacts with American minks. To the contrary, male American minks tended to be more aggressive towards individuals of other species (European minks) than their own species.

In previous experiments in captivity it was found that male and female American minks dominated male and female European minks. Our experiments did not show that female American minks attacked more European minks than vice versa. Even if we did find that male American

minks attacked more European minks than vice versa, this difference was not significant. It is obvious that for more conclusive results the sample size has to be increased. However, our data show that interspecific contacts are aggressive. American minks have clear preference in direct physical interspecific contacts anyway due to their bigger body size.

Interesting but not surprising was our discovery that captive born minks of both species have higher level of aggression than wild born individuals, regardless of the opponent. Wild born individuals are usually very timid in captivity at the beginning. They avoid people and move mainly in darkness. Females remain shy and hidden longer than males. So the reaction of wild born specimens to a strange object may be influenced by their adaptation to captive condition. At the same time, captive born individuals, especially males, tended to be hyperaggressive. Males often attack females during breeding season even if the females are in oestrus, and they may attack also keepers.

Boldness (the degree of hesitancy when confronted with danger) is a fundamental psychological characteristic of animals that has been connected with various life history tradeoffs concerning foraging, predation, and social interactions. In captivity, the mean level of boldness may be altered with generations. Siberian polecats (Mustela eversmanni) in their fourth generation of captivity were significantly bolder than first generation of polecats. The high level of hyperaggression of captive-born male European minks may also have something to do with increase of boldness of captive animals as shown on polecats.

We did not find that the sequence of trials influenced results. However, there was one case in which the first opponent for a male European mink was a male American mink. The European male approached the American mink, sniffed him and quickly escaped into a nest box where he screamed for about one minute. This male European mink refused to come out of the nest box during next trials and only took a glance at the opponent from his nest box at the beginning of the tests.

There were two tests in which different male European minks moved for the most time stereotypically, which is good indicator of stress situation. In one trial the opponent was a male and in other trial a female American mink.

ACKNOWLEDGEMENTS

This study was supported by the Tallinn Zoo (Estonia) and the Darwin Initiative Foundation (Great Britain).

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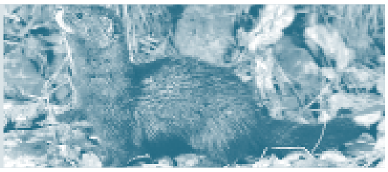


(1) Species activity	Males Mean ± SE (n/specimens)	Females Mean ± SE (n/specimens)	F	P
European mink Contacts	81.6 ± 7.3 (96/24)	49.6 ± 9.6 (56/14)	F = 7.10	p = 0.0085
European mink Aggressive contacts	74.4 ± 7.1 (96/24)	40.1 ± 9.2 (56/14)	F = 8.67	p = 0.0038
American mink Contacts	74.7 ± 11.7 (24/6)	20.1 ± 14.4 (16/4)	F = 8.62	p = 0.0056
American mink Aggressive contacts	47.3 ± 10.4 (24/6)	14.8 ± 12.7 (16/4)	F = 3.93	p = 0.0546

(2) Species activity	Wild caught Mean ± SE (n/specimens)	Captive born Mean ± SE (n/specimens)	F	P
European mink Contacts	16.0 ± 9.7 (44/11)	91.7 ± 6.2 (108/27)	F = 42.95	p = 0.0000
European mink Aggressive contacts	8.7 ± 9.4 (44/11)	83.4 ± 6.0 (108/27)	F = 44.88	p = 0.0000
American. mink Contacts	19.3 ± 6.8 (28/7)	131.3 ± 10.4 (12/3)	F = 81.68	p = 0.0000
American mink Aggressive contacts	6.3 ± 5.7 (28/7)	99.7 ± 8.8 (12/3)	F = 79.28	p = 0.0000

Table 1. The reaction of males and females (1), wild caught and captive born (2) European and American minks towards opponents. Contacts – all sample points on which a mink was in close contact with opponent, aggressive contacts - all sample points on which a mink attacked opponent (ANOVA).

Tabla 1. Reacción de los machos y hembras (1), capturados de la naturaleza y nacidos en cautividad (2) de visón europeo y visón americano hacia sus oponentes. Contactos – todos los puntos de muestra sobre los cuales un visón encerrado contacta con su oponente, contacto agresivo – todos los puntos de muestra sobre los cuales un visón ataca a su oponente (ANOVA).

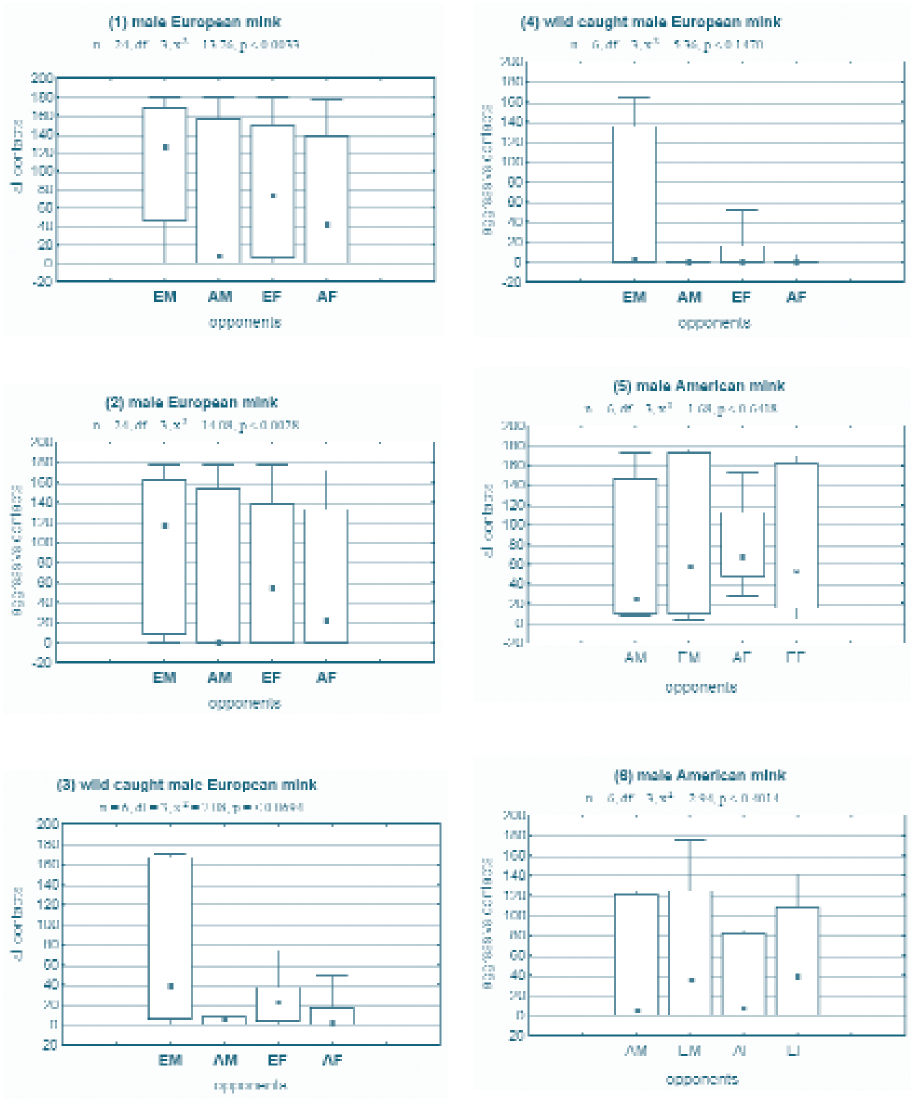
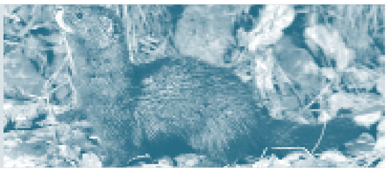
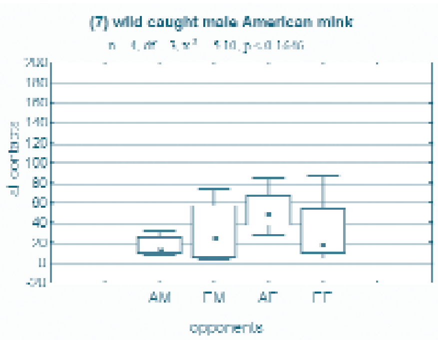


Figure 1.1. - 1.14. The reaction of minks towards different opponents. EM – Male European mink, AM – male American mink, EF – female European mink, AF- female American mink, contacts – all sample points on which a mink was in close contact with opponent, aggressive contacts - all sample points on which a mink attacked opponent. (Friedman ANOVA by ranks, Median, 25%-75%, Min-Max)

Figura 1.1. - 1.14. Reacción de los visones hacia sus oponentes. EM – macho de visón europeo, AM – macho de visón americano, EF – hembra de visón europeo, AF- hembras de visón americano, contactos – todos los puntos de muestra en los cuales un visón estuvo en contacto cercano con su oponente, contactos agresivos – todos los puntos de muestra sobre los cuales un visón atacó a su oponente. (Friedman ANOVA por rangos, Medio, 25%-75%, Mín-Máx).




(7) wild caught male American mink
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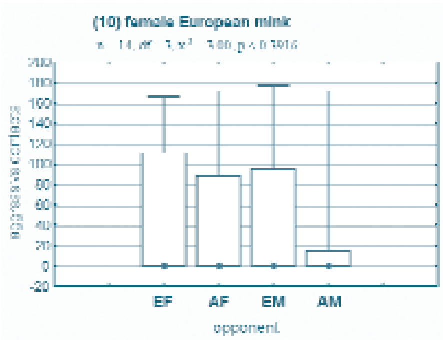
AM
EM
AF
EF
opponents


(10) female European mink
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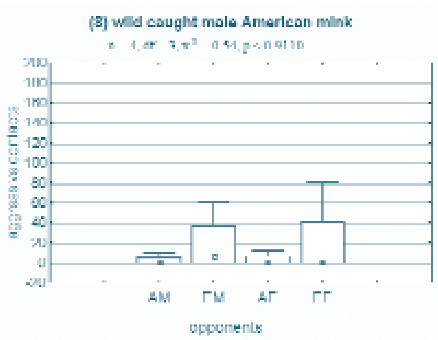
(8) wild caught male American mink
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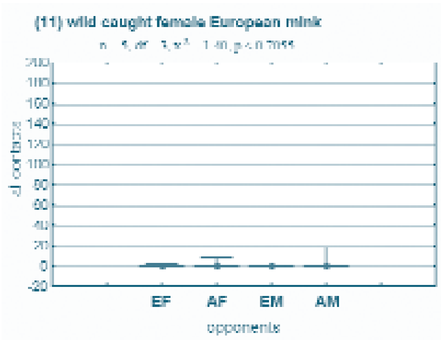
(11) wild caught female European mink
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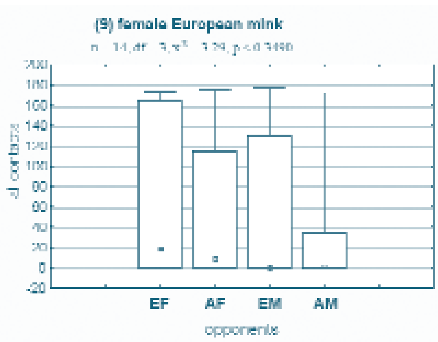
(9) female European mink
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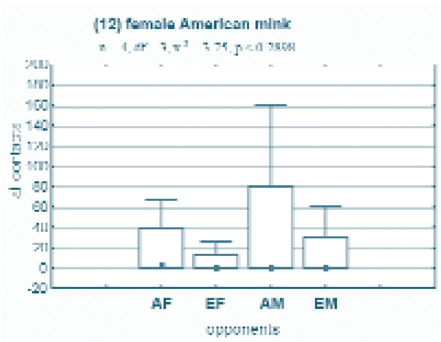
opponents


(12) female American mink
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100
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20
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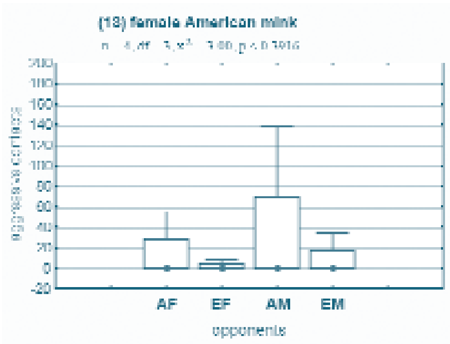
AF
EF
AM
EM
opponents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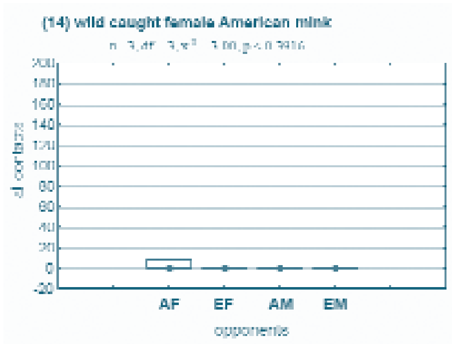
(14) wild caught female American mink
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[New hypothesis on the reasons of disappearance of European mink based on the study of behavioural interactions]

NUEVAS HIPÓTESIS ACERCA DE LAS CAUSAS DE DESAPARICIÓN DEL VISÓN EUROPEO BASADAS EN EL ESTUDIO DE LAS INTERACCIONES DE COMPORTAMIENTO

RESUMEN

Las relaciones interespecíficas entre el visón europeo(Mustela lutreola Linnaeus, 1761) y las especies emparentadas, como el visón americano (Neovison vison Schreber, 1777) y el turón (M. putorius Linnaeus, 1758), fueron estudiadas en la Estación Biológica "Tchernogolovka" del Instituto de Ecología y Evolución A.N. Severtsov, de la Academia Rusa de Ciencias, en diferentes periodos del ciclo del animal, para comprobar algunas hipótesis sobre el descenso de la densidad de población y la reducción del área de distribución del visón europeo. Se llevaron a cabo diferentes tipos de experimentos:

Encuentros de parejas interespecíficas en territorio neutral;

Introducción de un macho o una hembra de una especie en las instalaciones de un individuo o una pareja (macho y hembra) de otra especie.

Introducción de una hembra de turón en estro junto a un macho de visón europeo.

Observaciones a largo plazo de grupos mixtos, con las dos especies (visón europeo y americano) del mismo o distinto sexo.

Las hipótesis sobre las relaciones de competencia entre visón europeo y americano, y de la hibridación entre visón europeo y turón, como

Running title:
[Disappearance of European mink and study of behavioural interactions]

Rozhnov V.V., Petrin A.A.

A.N. Severtsov Institute of Ecology and Evolution, Russian Academy of Sciences, Leninsky prospect, 33, Moscow, 119071, Russia.

Rozhnov V.V.
A.N. Severtsov Institute of Ecology and Evolution, Russian Academy of Sciences, Leninsky prospect, 33, Moscow, 119071, Russia
E-mail: rozhnov@sevin.ru

ABSTRACT

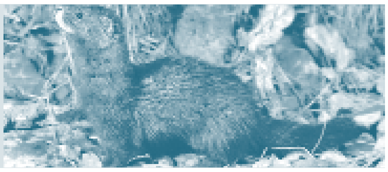
The interspecific interactions between European mink (*Mustela lutreola* Linnaeus, 1761) and close-related species, American mink (*Neovison vison* Schreber, 1777) and European polecat (*M. putorius* Linnaeus, 1758), were studied in Biological Station "Tchernogolovka" of the A.N. Severtsov Institute of Ecology and Evolution, Russian Academy of Sciences, in the different periods of animal annual cycle for testing some hypotheses about decreasing of population density and area reduction of European mink. Different types of experiments were carried out:

1. The pair interspecific encounters on neutral territory;

2. Male or female one species introduction to the single or pair (male and female) of the other species;

3. Introduction of the European polecat female in oestrus to the European mink male;

4. Long-term observations of mixed groups consisted of two species (European mink and American mink or European polecat) of the same or different sexes.



The hypotheses about competitive relationships between European and American minks, and hybridisation between the European mink and the European polecat as the reasons of disappearance of European mink were not supported.

The results of experiments show the unsteadiness of the European mink to the stressful influence, which is characterised by the unbalanced nervous system and can be manifested in behaviour:

i) Great number of interspecific defensive contacts;

ii) Significant part of non-realised aggressive contacts;

iii) Locomotion's inactivity in the major part of pair interspecific encounters.

The obtained results permit to propose a new hypothesis about the reasons of disappearance of European mink (Rozhnov and Petrin 2002). According to this hypothesis the presence of close-related species animals and their interspecies interactions induce stressful influence to the European mink and can suppress their normal reproductive functions. This disturbance of reproductive function induces the reduction of the M. lutreola population density and area. Its habitats are occupied by animals of close-related species, and, as result, the stressful influence is increased.

Proposed hypothesis orients to study (i) the genetic variation in the European mink populations by the molecular-genetic methods, (ii) unsteadiness of the European mink to the stressful influence by physiological methods, (iii) reproductive biology (estimation of reproductive function by ability of males to take part in reproduction, number of newborns in litter, number of fertilized females). These studies are necessary for the adequate strategy of conservation of this endangered species.

Key words: American mink, close-related species, European mink, European polecat, interspecific interactions

razón de la desaparición del visón europeo no quedaron confirmadas.

Los resultados de los experimentos muestran una alteración en el comportamiento del visón europeo bajo influencias estresantes, que se caracteriza por desequilibrios en el sistema nervioso y se pueden manifestar mediante:

Gran número de contactos defensivos interespecíficos.

Parte significativa de contactos agresivos no realizados.

Falta de actividad locomotora en la mayoría de los encuentros interespecíficos de parejas.

Los resultados obtenidos permiten proponer una nueva hipótesis sobre las razones de desaparición del visón europeo (Rozhnov and Petrin 2002). Según esta hipótesis, la presencia de especies animales emparentadas y sus interacciones interespecíficas inducen influencias estresantes en el visón europeo y pueden causar supresión de sus funciones reproductoras normales. Esta perturbación en su función reproductora induce la reducción de la densidad poblacional y del área de M. lutreola. Sus hábitats son ocupados por ejemplares de especies próximos y, como resultado, la influencia estresante se ve aumentada.

La hipótesis propuesta orienta el estudio hacia (i) la variación genética en las poblaciones de visón europeo por métodos de genética molecular, (ii) la falta de seguridad del visón europeo bajo influencias estresantes, por métodos psicológicos, (iii) biología reproductora (estima de las funciones reproductoras por la habilidad de los machos de participar en la reproducción, el número de nuevos nacimientos por camada, el número de hembras fertilizadas). Estos estudios son necesarios para establecer una adecuada estrategia de conservación de esta especie amenazada.

Palabras clave: visón americano, especies emparentadas, visón europeo, turón, relaciones interespecíficas.

INTRODUCTION

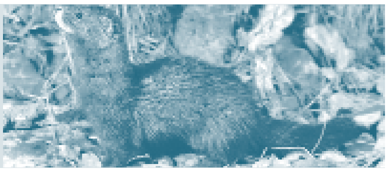
Decreasing of the European mink (*Mustela lutreola* Linnaeus, 1761) numbers takes part all over its range. In most places it totally disappeared. Special study is necessary to investigate the reasons of this process for development of the adequate strategy of species' conservation.

There are a lot of different hypotheses trying to provide an explanation for these reasons, but all of them are subjected to a sound criticism (Rozhnov, 1993, 2000).

The hypothesis about competitive exclusion of European mink by the acclimatised American mink (*Neovison vison* Schreber, 1777) is widely spread (about taxonomic status of the American mink and generic name *Neovison* see Abramov 2000). According to this hypothesis, the larger American mink physically drives out the European mink, as soon as both species use the same habitats and close diets. However, analyses of the process of disappearance of the European mink showed that it had begun before the appearance of the American species on the continent. In some places, where the European mink disappeared, the American mink did not appear since now (Tumanov and Zverev 1985, 1986, Schröpfer and Paliocha 1989, Sidorovich 1991).

Ternovsky (1977) set up a hypothesis about special reproductive exclusion of the European mink by the American mink. In his experiments on the interspecific hybridisation he managed to match American mink male with European mink females. The last became pregnant but embryos were reabsorbed. On the base of few experiments he supposed that in nature American mink males being more strong in comparison with the European mink males copulate with females of their own species as well as with the European mink females. Due to reabsorption of embryos in the last species it does not fill the disappeared part of population and decrease its numbers. However, anomalies in embryogenesis of European mink in places of its coexistence with the American mink were not confirmed yet, and posterior attempts of mating of these two species in captivity failed (Tumanov and Zverev 1986).

Another hypotheses connected disappearance of European mink with its hybridization with European polecat (*M. putorius* Linnaeus, 1758). The natural hybrids of these two species ("tumaki") are known for a long time (Ognev 1931, Heptner et al. 1967). This fact allowed presuming that European mink is absorbed by European polecat genetically (Granqvist 1981). However, according to analyses of fur purchases there was no registered increase of the hybrid animals although it should be in this case (Tumanov and Zverev 1986). When the shrub-tree vegetation is disturbed the competition for refuges between European mink and European polecat may occur. It may be resulted in exclusion and death of the smaller and weaker European mink (Schröpfer and Paliocha 1989). However, in places of coexistence of these species in flood-lands of rivers and springs the amount of food and shelters is so large that completely excludes their competition, and in this case it is beyond reason to consider the European mink weaker and smaller than European polecat (Tumanov 1996).



Many hypotheses are based on behaviour relationships of European mink with other species. That is why investigation of such direct contacts of European mink with American mink or European polecat is necessary for confirmation or refutation of existing hypotheses.

MATERIALS AND METHODS

The interspecific interactions between European mink and close-related species, American mink and European polecat, were studied in Biological Station "Tchernogolovka" (60 km from Moscow) of the A.N. Severtsov Institute of Ecology and Evolution, Russian Academy of Sciences, in different periods of animal sexual cycle for testing some hypotheses on decreasing of population density and area reduction of European mink. The following different types of experiments were carried out:

1. The pair interspecific encounters on neutral territory;

2. One species male or female introduction to the single or pair (male and female) of the other species;

3. Introduction of the European polecat female in oestrus to the European mink male;

4. Long-term observations of mixed groups consisted of two species (European mink and American mink or European polecat) of the same or different sexes.

Observations were carried out in large experimental enclosures 40 m^2 in area. The enclosure was free of any elements of interior and shelters during conducting the pair interspecific encounters. During carrying out of three other types of experiments in enclosures a complicated interior close to natural type was constructed, and there were enough of shelters there.

All interactions between animals were registered by direct visual observations. These interations were divided into four functional groups: agonistic during attack (aggressive contacts), agonistic during defence (defensive contacts), peaceful and recognizing (olfactory) contacts. Agonistic interactions of both groups were divided, according to the rate of emotional manifestation, on rough (attack from side stand, lunge from defence stand, keeping for the back of the neck, fight) and soft (approaching to the partner, pursuit, retreat and escaping) contacts. We included to the peaceful contacts: playing jumps, jumps on the partner, playing lunges, and synchronous movements. Recognizing (olfactory) contacts were presented by animals' sniffing one another of following body parts: nose, area around ear, back of the neck, waist, belly, ano-genital region, tail. Avoiding of one another by animals was also registered. The detailed description of behaviour elements of American mink and European polecat was done earlier (Sokolov and Rozhnov 1982, Rozhnov 1998).

The pair interspecific encounters on neutral territory (Table 1). Animals of two species were placed to the experimental enclosure simultaneously. Observations were carried out for 1 hour. Experiments were conducted out in breeding and non-breeding seasons.

Introduction of one species male or female to the pair (male and female) of the other species (Table 2). A pair of animals of the same species (male and female) were placed in the experimental enclosure, and they mastered the territory of the enclosure for 4-5 days. After that a male or female of another species was placed there too. Observations were carried out for 6 hours. After finishing of the experiment this new animal, was extracted from the experimental enclosure.

The introduction of the European polecat female in oestrus to the European mink male (Table 3). The European mink male was placed in the experimental enclosure, and he mastered the area of the enclosure for 4-5 days. After that the European polecat female in oestrus was placed to the same enclosure. Oestrus was determined by means of the vaginal smears. Observations were carried out for 4 hours. The European polecat female was extracted from the enclosure after finishing of the experiment.

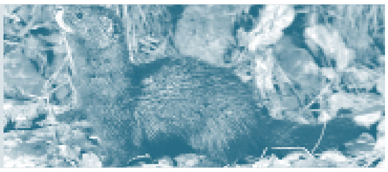
The long-term observations of mixed groups consisted of two species (European mink and American mink or European polecat) of the same or different sexes (Table 4). Two European mink females and two females of other species (American mink or European polecat) were kept in separate experimental enclosures for 4-5 days. After stabilisation of social relationships in these pairs of females they were united in a mixed two-species group, in which all contacts of animals were registered for 4-8 days. Than, in this group a male of one of two species taking part in the experiment was placed. After 4-8 days of observations this male was replaced by a male of the second species and observations were continued for 4-8 days more.

RESULTS

The results of our experiments allowed us (i) to characterize the structure of interspecific behaviour of European and American minks, and European polecat, (ii) to elucidate the features of interspecific aggressive and sexual behaviour, and (iii) to clear up locomotion's inactivity and search behaviour in the new territory. The results of these experiments were discussed in our previous publications (Rozhnov and Petrin 1998, 1999a, 1999b, 2001a, 2001b, 2003a, 2003b, Petrin 2000a, 2000b, 2002). In this article only general conclusions of our experiments are discussed.

The structure of interspecific behaviour (Fig. 1 and 2), may be demonstrated on the pair interspecific encounters (on neutral territory) as an example.

During non-breeding season aggressive contacts dominated at European mink in interactions between both species of minks, and defensive contacts – at American mink. In breeding season European mink had more defensive contacts, whereas American mink had equal portion of both – aggressive and defensive contacts. The European mink usually demonstrated rough type of aggressive and defensive contacts in both seasons, and the American mink – the soft one. The European mink had less olfactory contacts in both seasons. American mink had noticeably more



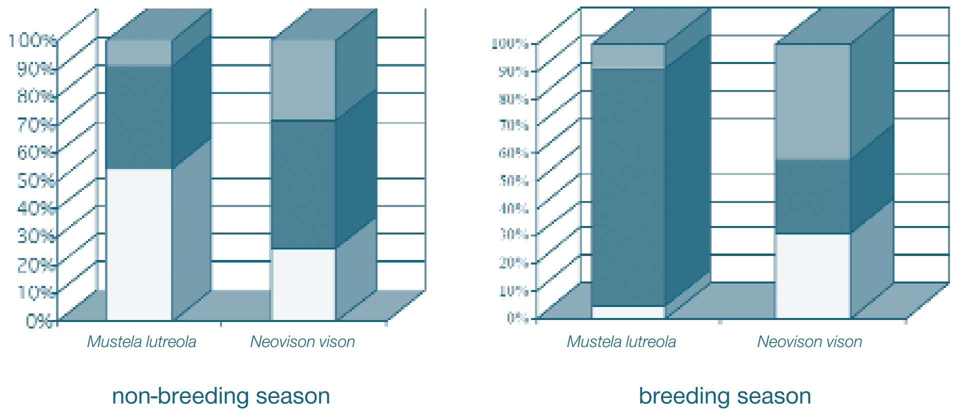


Figure 1. The structure of the interspecific contacts in pair encounters on neutral territory between European mink and American mink (independently of sex). Contacts: lower part of the column – aggressive, middle – defensive, upper – olfactory.

Figura 1. Estructura de los contactos interespecíficos en encuentros de parejas entre visón europeo y visón americano (independientemente del sexo) en territorio neutral. Contactos: parte inferior de la columna - agresivos; parte media - defensivos; parte superior - olfatorios.

olfactory contacts: during the non-breeding season there was about one third of all contacts, and in the breeding period about one half.

In interactions of the European mink and European polecat defensive contacts dominated in both species (in the European mink rough type, in the European polecat soft type). Portion of the aggressive contacts was somewhat higher in the European polecat in comparison with European mink, and defensive – in European mink. Interspecific recognizing (olfactory) contacts in the European mink were rare; in the European polecat their portion was visually higher. Interspecific peaceful (playing) contacts we observed in solitary cases in the European polecat only and only during the breeding season. In structure of behaviour directional on animals of other species in the European mink and in the European polecat during the breeding and non-breeding periods no differences were detected.

The properties of interspecific agonistic behaviour were determined in the European mink. Both in aggressive and defensive contacts in this species dominated rough contacts, in the American mink and European polecat – soft. In the European mink was detected and for the first time described non-realised aggression during attack: although animals of this species are often act as initiators of agonistic interactions with animals of other species and even began fight with them, practically always these interactions finished by defensive contacts – by escaping of the European mink. When the American mink or European polecat approached the European mink without paying any attention to it, the last in most cases demonstrated rough defensivebehaviour

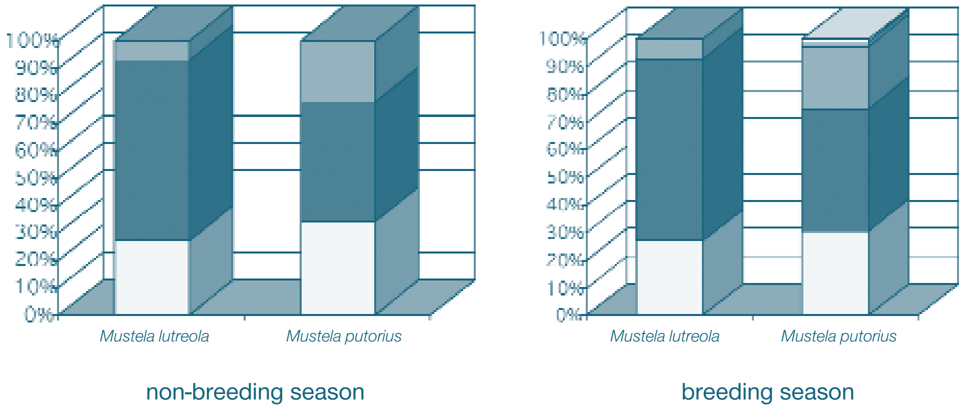


Figure 2. The structure of the interspecific contacts in pair encounters on neutral territory between European mink and European polecat (independently of sex). Contacts: lower part of the column - aggressive, middle - defensive, upper - olfactory; in polecat in the upper part of column during the breeding period - peaceful and sexual.

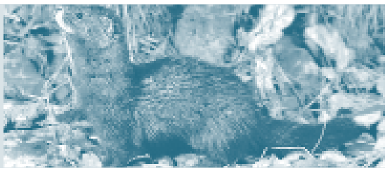
Figura 2. Estructura de los contactos interespecíficos en encuentros de parejas entre visón europeo y turón (independientemente del sexo) en territorio neutral. Contactos: parte inferior de la columna - agresivos; parte media - defensivos; parte superior - olfatorios; en turón, en la parte superior de la columna durante el periodo de cría - pacífico y sexual.

(lunge from defence stand), after which American mink or European polecat run away. One more peculiarity: during uniting of European mink and animals of the other species in one two-specific group in European mink the numbers of intraspecific aggressive contacts increased.

We did not registered **interspecific sexual behaviour** of the European mink to American mink or European polecat, as well as of that species to the European mink in our experiments. There were only two exceptions (of 56) in pair interspecific encounters on neutral territory, when European polecat males demonstrated some elements of sexual behaviour. European mink females in its answer demonstrated aggressive behaviour in spite they were in oestrus. European mink males aggressively reacted to European polecat females in oestrus, and European polecat females demonstrated defensive behaviour to European mink males.

Locomotion's activity of European mink in experiments was lower than of American mink and European polecat. Animals of this species were often inactive during pair interspecific encounters on neutral territory; and American mink and European polecat were active during the whole experiment. We found differences in the speed of animal's movement also. European mink was faster than European polecat and could run away from it easy, but European mink had no such advantage over the American mink.

The results of our experiments and found out features of behaviour allow us to verify unbalanced character of the European mink nervous system. It is revealed in: (i) a large number of interspecific defensive contacts in an answer not only to the aggressive contacts of American mink or



European polecat but also to the presence of indifferent animals nearby; (ii) non-realised aggressive behaviour during attack; (iii) inactivity during the most part of experiment. Besides, the European mink demonstrates more rough aggressive and defensive contacts both inter- and intraspecific relationships. All this can characterize the European mink as a species easily undergoing to stress influences. The presence of closely related species, American mink or European polecat, may be a representatives of such stress factors.

It is necessary to mention one more important circumstance. For intraspecific relationships of investigated species it is typical that during breeding season male follows conspecific female regardless her condition. It doesn't matter if she is in oestrus or not. At the same time female's behaviour depends on her state: if she is not ready for copulation she plays with male or demonstrates aggressive behaviour in the case of very pressing male's pursuit. Copulation takes part when female is ready for it. In considered experiments we practically did not observe any interest of other species males to European mink females, and in those rare cases when European polecat males demonstrated elements of sexual behaviour, European mink females demonstrated aggressive behaviour in spite of their oestrus state. The aggressive reaction of males of European mink was registered not only on other species females but also on females of the same species, as well as their low potency (Tikhomirov, pers. comm.). Mentioned materials are evidence of complicity of disturbance of isolate barriers and of low probability of European mink and European polecat hybridisation.

Thus, the results of our experiments does not support existing hypotheses of cause of European mink disappearance – not on physical exclusion by two other species, not on possibility of free interspecific hybridization with European polecat.

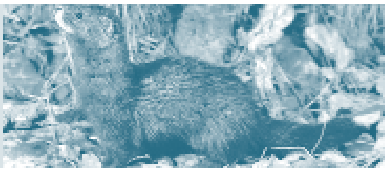
The obtained results permit to propose a new hypothesis about the reasons of disappearance of European mink (Rozhnov and Petrin 2003a). It consists in following: by virtue of instability of the European mink for stress effect caused by presence of animals of other species, its normal reproductive function gets broken. It is especially applied to males who become unable to insemination. As a result population numbers of the European mink decreases, and its habitats are occupied by other animal species, and this, in its turn, causes more high stress influence on the European mink males. The reason of instability of the European mink to stress influence may be reduction of the genetic polymorphism of its populations, negative consequences of which are well known for other species (Wayne et al., 1991): the liability to infections and stress increases, and this is reflected on the reproductive function.

In the background of our hypothesis there are two well know population genetics conceptions: (i) conception of the genetic polymorphism of populations (Ford, 1940), and (ii) conception of "adaptive norm" of population, based on Chetverikov's (1926) data on a huge source of invisible inherited variability, and developed by Altukhov (1989, 2003) in his conception of optimal gene diversity of population. Decrease of genetic diversity of populations is known to a different species decreasing of their numbers (O'Brien et al. 1983, 1985, Avise 1994, Baranov et al. 1997).

There is a prediction that Aleut disease of American mink was carried to European mink populations. Invasions of parasitic nematodes significantly influence on the European mink populations. These diseases can lead both to elimination of animals and to reduction of their breeding function (Henttonen 1992, Tyutyunik 2000, Tumanov 2002).

The point of view about participation of stress reactions in general complex of mechanisms of population dynamics is widely spread. Depression of reproduction by stress factors is known for females of different mammals. Connection of reproduction with such factors is discussed in a number of reviews (Wasser and Barash 1983, Labov et al. 1985). It was also demonstrated in many special works, mainly for rodents. This connection was experimentally proved for bank voles populations *Clethrionomys rutilus* and *C. rufocanus* (Ims 1985). For sympatric bank voles it was proved experimentally. In a mixed population of different house mice forms – *Mus musculus domesticus* and *M. spretus* females of the last species do not become pregnant because of psycho-physiological stress (Cassaing 1984). In mixed populations of black and Norway rats just the presence of the latter species is regarded as a mechanism of pregnancy inhibition in black rat (Kalinin 1995).

Proposed hypothesis allows to lay down the main lines of current investigation of the European mink. First of all it is an evaluation of the genetic variability of European mink populations by means of molecular-genetic methods. As we have shown, higher susceptibility to stress of European mink in comparison with other species (American mink, European polecat) is seen in a great number of interspecific defence aggression acts, in non-realised aggressive behaviour during attack, and also in its behaviour during the "open field" test (a number of different behaviour parameters such as locomotion, urination and defecation frequency and other) (Rozhnov, prepared for publication). Therefore it is necessary to carry out physiological experiments, which can proof the higher susceptibility to stress of the European mink. The third line, which needs forthcoming research is the reproductive biology of European mink and determination of its reproductive function which can be evaluated according following parameters: ability of males to take part in reproduction (on their sexual potency), number of newborns in litter, number of fertilized females. Without these investigations it is impossible to develop adequate strategy of conservation of this vanishing species. These investigations are carried out at the Centre for European mink conservation, especially created at the Biological Station "Tchernogolovka" of the A.N. Severtsov Institute of Ecology and Evolution, Russian Academy of Sciences (Rozhnov and Petrin 2001b, 2003b).



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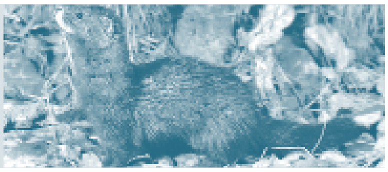

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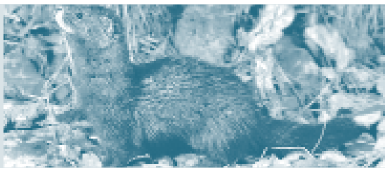


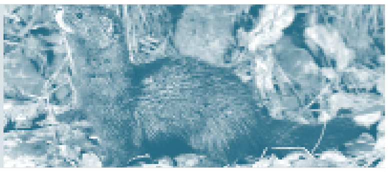
			Non-breeding season	Breeding season
Number of experimental animals	*M. lutreola*	males	2	3
		females	3	3
		total	5	6
	N. vison	males	5	4
		females	5	5
		total	10	9
	M. putorius	males	5	7
		females	4	8
		total	9	15
Number of encounters	*M. lutreola* male – *M. putorius* male		8	13
	M. lutreola female – *M. putorius* female		8	17
	M. lutreola male – *M. putorius* female		7	12
	M. lutreola female – *M. putorius* male		9	14
	M. lutreola male – *N. vison* male		6	-
	M. lutreola female – *N. vison* female		9	13
	M. lutreola male – *N. vison* female		9	-
	M. lutreola female – *N. vison* male		13	11

Table 1. The characteristics of the experiments on the pair interspecific encounters on neutral territory
Tabla 1. Características de los experimentos de encuentros de parejas interespecíficas en territorio neutral.

Number of experimental animals	*M. lutreola*	males	3
		females	3
		total	6
	M. putorius	males	7
		females	11
		total	18
	N. vison	males	3
		females	3
		total	6
The duration of the single experiment (h)			6
Total time of observation (h)			366
Number of introductions to the pair of M. lutreola	*M. putorius* males		10
	M. putorius females		13
	Total		23
	N. vison males		6
	N. vison females		7
	Total		13
Number of introductions to the pair of N. vison	*M. lutreola* males		4
	M. lutreola females		6
	Total		10
Number of introductions to the pair of M. putorius	*M. lutreola* males		6
	M. lutreola females		9
	Total		15

Table 2. The characteristics of the experiments with one species male or female introduction to the single or pair (male and female) of the other species.

Tabla 2. Características de los experimentos de introducción de un macho o una hembra de una especie con un ejemplar o una pareja (macho y hembra) de otra especie.



Number of used animals	*Mustela lutreola* (males)	3
	Mustela putorius (females)	5
The duration of the single experiment (h)		4
Total time of observation (h)		40
Number of experiments		10

Table 3. The characteristic of experiments with introduction of the European polecat female in oestrus to the European mink male.

Tabla 3. Características de los experimentos de introducción de hembras de turón en periodo de estro junto a un macho de visón europeo.

The species			*M. lutreola -N. vison*	*M. lutreola–M. putorius* Non- breeding season	*M. lutreola–M. putorius* Breeding season
Number of experimental animals	*M. lutreola*	males	3	1	1
		females	2	2	2
		total	4	3	3
	N. vison	males	1	-	-
		females	2	-	-
		total	3	-	-
	M. putorius	males	-	2	2
		females	-	4	3
		total	-	6	5
Number of experiments			2	2	2
Total time of observation (h)			450	282	455

Table 4. The characteristics of the long-term observations of mixed groups consisted of two species (European mink and American mink or European polecat) of the same or different sexes.

Tabla 4. Características de las observaciones a largo plazo de grupos mixtos, formados por las dos especies (visón europeo y visón americano o turón) del mismo o distinto sexo.

[The helminthes as a cause of negative effect on the European mink (*Mustela lutreola* Linaeus, 1758) in Belarus]

LA HELMINTOSIS COMO CAUSA DEL EFECTO NEGATIVO DEL VISÓN EUROPEO (*Mustela Lutreola*) EN BIELORRUSIA

RESUMEN

Se presenta el resultado de muchos años (1960-1995) de examen helmintológico del visón europeo en Bielorrusia. La prevalencia de infección de los visones por helmintos fue del 88,0 % (conforme a examen helmintológico completo). Estos animales actúan como hospedadores de 18 especies de helmintos. Se presta atención a los helmintos como causantes de un efecto negativo en las poblaciones de visón europeo en Bielorrusia.

Palabras clave: Bielorrusia, enfermedades, helmintos, infección por helmintos, visón europeo

Running title:
[Helminthes and European mink in Belarus]

V.T. Shimalov and V.V. Shimalov

Brest State University, Boulevard of Cosmonauts 21, 224665 Brest, Belarus

V.T. Shimalov
Brest State University, Boulevard of Cosmonauts 21, 224665 Brest, Belarus
E-mail: shimalov@brsu.brest.by

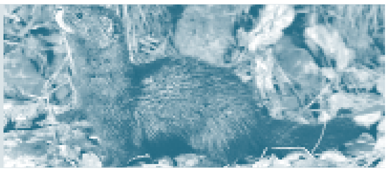
ABSTRACT

The results of many years (1960-1995) of helminthological examinations of the European mink in Belarus are presented. The prevalence of mink infection by helminthes was 88.0 % (assessed by complete helminthological examination). These animals acted as hosts for 18 species of helminthes. Pay attention to the helminthes as a cause of negative effect on the European mink populations in Belarus.

Key words: Belarus, diseases, European mink, helminthes, helminth infection.

INTRODUCTION

The European mink is an aboriginal mustelid species in Belorussian fauna that was widespread nearly throughout the territory of Belarus. These animals lives in riverside ecosystems and adapt to near-water way of life. European minks accumulate of helminths common for other mustelids (Shimalov et al. 1993, Sidorovich et al. 1997) and are now registered in northern and southern parts of Belarus (Sidorovich 1995, Mikhalchuk et al. 1997). The state of these populations requires new studies in Belarus in the 2000s.



MATERIAL AND METHODS

This report is the result of many years (1960-1995) of helminthological examinations of European minks in Belarus. The animals were killed by hunters in the upper reaches of the rivers in basins of the West Dvina (the northern Belarus, Vitebsk and Minsk regions), the Pripyat and the Dniepr (the southern Belarus, Brest and Gomel regions). Fifty animals (28 males and 22 females) were investigated by complete helminthological examination after Skrjabin (1928) as well carried out partial helminthological examination (examined by helminths only skulls, livers, lungs, intestines, urinary bladders and muscle tissues) of 20 animals (in tens males and females). Identification of European mink helminths was carried out with the aid of Kontrimavichus (1969) and Kozlov (1977), taking into consideration the synonyms of nematode capillariid species (Moravec 1982, Moravec et al. 1987).

RESULTS AND DISCUSSION

The total rate of infection of European minks by helminths was 88.0% (assessed by complete helminthological examination). These animals were host to 18 species of helminths: six Trematoda, two Cestoda, nine Nematoda and one Acanthocephala (Table 1).

Only five species of helminths (trematode *Isthmiophora melis* (Schrank 1788), nematodes *Molineus patens* (Dujardin 1845), *Pearsonema mucronata* (Molin 1858) and *Skrjabingylus nasicola* (Leuckart 1842), acanthocephalan *Corynosoma strumosum* (Rudolphi 1802) were registered in European minks in the 1960s. Fifteen species of helminths these animals accumulated in 1980s, and another three species of helminths (trematode *Opisthorchis felineus* (Rivolta 1884), nematodes *Crenosoma taiga* (Skrjabin and Petrow 1928) and *Trichinella* sp.) were extended the list of helminths of the European mink in the 1990s.

A hundred per cent of infections by trematode *I. melis*, larvae of cestode *Spirometra erinacei europaei* (Rudolphi 1819), nematode *P. mucronata* were established in European minks in the period 1985-1995. The number of parasites varied from 1 to 200 specimens of *I. melis*, from 1 to 60 larval stages of *S. erinacei europaei* and from 1 to 10 specimens of *P. mucronata* in infective animals. These species of helminths usually were found in the result of partial helminthological examination of 20 animals (Table 2).

Helminths were localized in the muscle tissue (larvae of *Alaria alata* (Goeze 1782), *S. erinacei europaei* and *Trichinella sp.*), in the frontal sinuses (*S. nasicola*), in the liver (*Metorchis bilis* (Braun 1890), *O. felineus*, *Pseudamphistomum truncatum* (Rudolphi 1819), in the lungs and the lymph nodes close to bronchial tubes (*C. taiga, Filaroides martis* (Werner 1782), in the urinary bladder (*P. mucronata*), in the stomach (*Aonchoteca putorii* (Rudolphi 1819) and in the intestine (all other species of helminths including *A. putorii*).

Some helminths of European minks occurs when they eats water animals. This mustelid species live near water, eat water animals and can be infected by eight species of helminths: *Apophallus donicus* (Skrjabin and Lindtrop 1919), *C. strumosum*, *M. bilis*, *O. felineus*, *P. truncatum* (from fishes and *C. strumosum* also from amphipod crustaceans), *I. melis* and larvae of *A. alata* and *S. erinacei europaei* (from amphibians and *S. erinacei* europaei larvae also from copepod crustaceans).

Helminths may be a cause of serious diseases of European minks. For example, *M. bilis*, *O. felineus* and *P. truncatum* is a cause of liver diseases, *C. taiga* and *F. martis* – cause of affect of pulmonary tissue, *S. nasicola* – cause of fineness and perforation of skull bones, intestinal helminths – cause of indigestion. We saw these negative influences by trematodes and nematodes on liver, lungs and skulls infective animals.

The infection with 2-7 species of helminths were found in 80.0 % of European minks examined and we observe that they with more than 500 specimens of helminths diminish total weigh of hosts by 30-50%. According to Lubashenko and Petrov (1962) minks with helminth infections had became lower productivity, delay of change the hair cover, deterioration of hair structure, predisposition to infectious diseases, reduction of the litter and death of animals.

Helminth infections may have a negative effect on European minks (diseases, exhaustion and even death of sick animals; these were confirmed by us and other helminthologist) and be one of the reasons for number decrease of the populations of these animals in Belarus.

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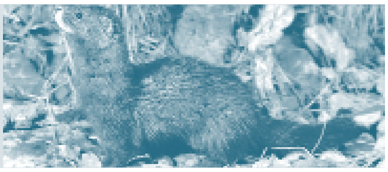

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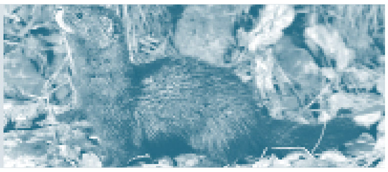
Species of helminth	Prevalence %	Number of helminths (min-max)
Trematoda		
Alaria alata (Goeze 1782), larvae	22,0	1,000- more than 1,000
Apophallus donicus (Skrjabin et Lindtrop 1919)	24,0	1-100
Isthmiophora melis (Schrank 1788)	52,0	1-200
Metorchis bilis (Braun 1890)	20,0	1-60
Opisthorchis felineus (Rivolta 1884)	8,0	1-50
Pseudamphistomum truncatum (Rudolphi 1819)	16,0	1-40
Cestoda		
Spirometra erinacei europaei (Rudolphi 1819), larvae	44,0	1-60
Taenia mustelae (Gmelin 1790)	14,0	1-20
Nematoda		
Aonchoteca putorii (Rudolphi 1819)	54,0	1-20
Baylisascaris devosi (Sprent 1952)	26,0	3-30
Crenosoma taiga (Skrjabin and Petrow 1928)	24,0	2-20
Filaroides martis (Werner 1782)	30,0	2-20
Molineus patens (Dujardin 1845)	32,0	3-30
Pearsonema mucronata (Molin 1858)	64,0	1-10
Skrjabingylus nasicola (Leuckart 1842)	50,0	1-40
Strongyloides martis (Petrow 1940)	30,0	5-18
Trichinella sp., larvae	20,0	2-5 in compressorium
Acanthocephala		
Corynosoma strumosum (Rudolphi, 1802)	14,0	10-40

Table 1. Results of complete helminthological examination of European mink (n = 50)
Tabla 1. Resultados del examen helmintológico completo del visón europeo (n = 50)



Species of helminth	Prevalence %	Number of helminths (min-max)
Trematoda		
I. melis	100	2-150
O. felineus	25,0	3-60
Cestoda		
S. erinacei europaei, larvae	100	1-48
Nematoda		
P. mucronata	50,0	2-8
S. nasicola	40,0	4-20
Trichinella sp., larvae	35,0	3-4 in compressorium

Table 2. Results of partial helminthological examination of European mink (n = 20)
Tabla 2. Resultado de los exámenes helmintológicos parciales del visón europeo (n = 20)

[The European mink (*Mustela lutreola)* in Belarus: past and present, the population decline, urgent questions, conservation initiatives and problems]

EL VISÓN EUROPEO (*Mustela Lutreola*) EN BIELORRUSIA: PASADO Y PRESENTE, EL DESCENSO POBLACIONAL, ASPECTOS URGENTES, INICIATIVAS DE CONSERVACIÓN Y PROBLEMAS

RESUMEN

Algunos informes sobre el status del visón europeo en Bielorrusia publicados en los años 20 y 50, ponían en evidencia que la especie era bastante común en muchos distritos, mientras que la población estaba siendo aparentemente sobreexplotada en otros, caracterizados por una mayor presión de la caza. Durante los años 80 y 90, encontramos e investigamos tres densas poblaciones de visón europeo, sin presencia de visón americano en el hábitat. Desde 1986, concentramos nuestro estudio en esta especie amenazada del Noreste de Bielorrusia. Durante el declive de la población de visón europeo, se ha detectado influencia de varios factores desfavorables, que incluyen competencia por los recursos e interferencias (encuentros agresivos, principalmente) con otros mustélidos acuáticos(como el visón americano, la nutria o el turón), pérdida de hábitat, invasión y contaminación por helmintos. Además, se estudiaron cambios en su condición corporal, utilización del hábitat, patrón de actividad, dieta, tasa reproductora y densidad de las poblaciones en declive de visón europeo y las poblaciones en expansión de visón americano. Los datos obtenidos sugieren las siguien-

Running title:
[The European mink in Belarus].

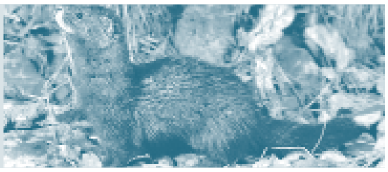
V. E. Sidorovich

Vertebrate Predation Research Group, Institute of Zoology, National Academy of Sciences of Belarus, Akademicheskaya str., 27, Minsk-220072, Belarus

Vertebrate Predation Research Group, Institute of Zoology, National Academy of Sciences of Belarus, Akademicheskaya str., 27, Minsk-220072, Belarus
E-mail: vadimsid@mustbel.open.by

ABSTRACT

Some information published on the European mink status in Belarus in 1920s and 1950s evidenced that the species was rather common in many districts, while the population was seemingly overexploited in other districts characterized by the stronger hunting pressure. During 1980s and 1990s we found and investigated three dense populations of the European without presence of the American mink in the habitats. Since 1986, we concentrated our study on the endangered species in north-eastern Belarus. During the European mink population decline, an influence of various unfavourable factors including a resource competition and interference (aggressive encounters, first of all) with the other riparian mustelids (i.e. the American mink, the otter, the polecat), habitat loss, helminth invasion and contamination have been tested. Also, the changes in body condition, habitat use, home range, activity pattern, diet, reproductive rate and density of the declining populations of the European mink and the expanding populations of the American mink were investigated. The obtained data suggest the following conclusions. The main factors of the current decline in the European mink in



Belarus are an aggressive attitude from the American mink towards the European mink and the high reproductive increase in expanding populations of the American mink. Some resource competition affected the European mink population could be possible, but it seems to be not the main factor conducting the fast decline of the native mink populations.

Key words: the European mink, population decline, competition, endangered species, Belarus

tes conclusiones. Los principales factores del actual declive del visón europeo en Bielorrusia son la actitud agresiva del visón americano hacia el europeo y la gran aumento reproductor de la población en expansión de visón americano. Podría ser posible que una cierta competencia por los recursos afectara a la población de visón europeo, pero éste no parece ser el principal factor causante del rápido declive de las poblaciones de visón nativo.

Palabras clave: visón europeo, declive poblacional, competencia, especie amenazada, Bielorrusia.

INTRODUCTION

At the beginning of the 1980s in Belarus, the majority of the local zoologists, who was involved in study on either riparian ecosystems or mammals, assumed the European mink *Mustela lutreola* had disappeared in the country. There was almost nothing published about the current distribution and cause of the decline of this endangered species. At the same time, any reliable proof of presence or complete disappearance of the European mink in Belarus was not gained.

Only in 1985-1986 during the several special expeditions to northern Belarus, proves (photos, skins, carcasses, live captured individuals) of the European mink presence were obtained. The first findings of the species has been in the Lovat river head, Gorodok district, Vitebsk region, NE Belarus. Since then, an intensive study on this critically endangered European mustelid species has started in Belarus.

The stated initial hypothesis which could explain the European mink vanishing in Belarus originated from general features of the situation with the species in Europe. Since 1950-1970 in many countries of Eastern Europe such as Russia, Belarus, Ukraine, Latvia, Lithuania and Estonia, numbers of the European mink have decreased rapidly (Tumanov and Zverev 1986, Maran et al. 1998). Many hypotheses were applied to explain the decline in the native mink populations (Ternovsky and Ternovskaja 1994, Schröpfer and Paliocha 1989, Tumanov 1996, Sidorovich 1997,

Maran and Henntonen 1995, Maran et al. 1998). At the same time, the naturalised American mink grew in number very quickly (Gerell 1967a, Tumanov and Zverev 1986, Sidorovich and Kozulin 1994, Sidorovich et al. 1995). So, the both processes of the European mink population decline and the American mink naturalization were simultaneously going on. Therefore, it was noteworthy to assume, that the expansion of the American may be the cause of the European mink demise. It has been the initial hypothesis which was like a framework of the established research design.

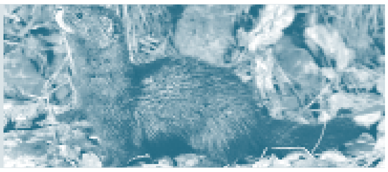
The follows actually have been done to study on the European mink populations in Belarus and their decline cause. A lot of efforts were spent to reveal the current distribution of the endangered species in Belarus and neighbouring regions of Russia (Sidorovich and Kozulin 1994, Sidorovich et al. 1995, Sidorovich 2001). Since 1986 we concentrated our study on the endangered species in the Lovat upper reaches, north-eastern Belarus, and since 1991 we did much study on the species in the Loknja medium-sized river basin, Pskov region, Russia. The main research goals were to get more knowledge on the European mink ecology and reveal the causes of the current decline of its populations. The two mentioned populations were investigated through their declining from the stage of a fairly stable dense population to nearly extinction of the species. During the population decline, an influence of various unfavourable factors including a resource competition and interference (aggressive encounters, first of all) with the other riparian mustelids (i.e. the American mink, the otter, the polecat), habitat loss, helminth invasion and contamination have been investigated. Also, the changes in body condition, habitat use, home range, activity pattern, diet, reproductive rate and density of the declining populations of the European mink and the expanding populations of the American mink were studied. In 1995-1997 being sponsored by the Darwin Initiative Foundation (UK) and in collaboration with Prof.Dr. David Macdonald (WildCRU, Zoology Department, University of Oxford), we fulfilled particularly much studies. At that time, we did particularly much studies: radiotracking; snowtracking and census; scat analysis; estimation of prey abundance and availability; demography analysis, morphology and helminthology studies, pollution control.

REVIEW OF THE RESULTS

Past and present distribution of the European mink in Belarus

Unpublished data from hunting statistics relating the European mink and some information published on the species status in Belarus in 1920s (Fedushin 1929), 1940s and 1950s (Serzhanin 1961) evidenced that the species was rather common in many districts, while the population was seemingly overexploited in other districts characterized by the stronger hunting pressure.

To reveal the current distribution of the European mink in Belarus, mink skins kept in many local hunting organisations and taken from local trappers were looked through; a questionnaire to hunters was applied; live box-trappings, track survey (Sidorovich 1999), and census (Sidorovich



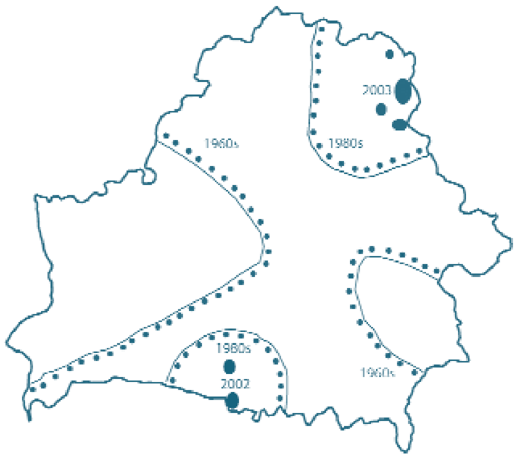


Figure 1. The change in the European mink distribution in Belarus in 1960-2003.

Figura 1. Cambios en la distribución del visón europeo en Bielorrusia entre 1960 y 2003.

and Macdonald 2001) were carried out. We combined getting of a simple information relating the European mink presence in the whole Belarus and detailed study on its population dynamics in the Lovat river head, NE Belarus. Figure 1 shows approximate changes in the European mink distribution in Belarus during 1960-2003. It is a dramatical decrease in the range. Currently, as far as we know, still there are small two fragments of the former European mink populations in the Luchosa and Orshitsa upper reaches, NE Belarus as well as the last survivors in the Lovat river head, NE Belarus and in the Stviga river catchment, central south of Belarus. In August 2003 in the Luchosa and Orshitsa upper reaches, an approximate ratio between the European mink and the American mink was as one to one. I assume that still there are between one and two hundreds European minks in the area of the Luchosa and Orshitsa upper reaches.

Figure 2 shows the monitored multiannual (1986-2003) changes in European mink density in the Lovat river head, NE Belarus. There, the first American mink was trapped in autumn of 1988, and in 1992-1993 (only in 5 years) the naturalised species got high population density, while the European minks appeared to be rare. The last European minks survived along brooks characterized by the lowest carrying capacity for a semia-

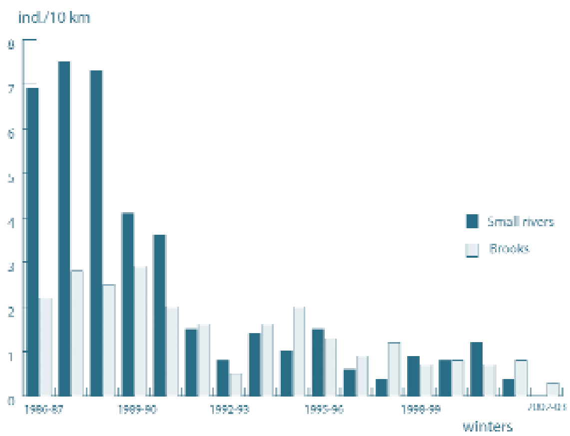


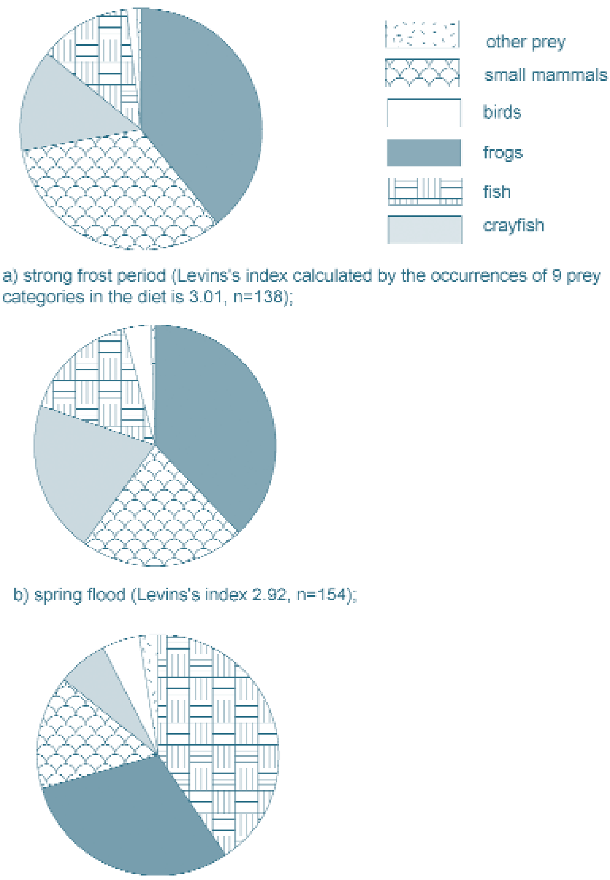
Figure 2. Dynamics of the European mink density (individuals per 10 km of stream stretch) in the Lovat river head by the winters of 1986-2003, Gorodok district, Vitebsk region, NE Belarus.

Figura 2. Dinámica de la densidad de visón europeo (individuos por 10 km de curso fluvial) en la cabecera del río Lovat durante los inviernos de 1986-2003, distrito de Gorodok, región de Vitebsk, NE de Bielorrusia.

quatic predator habitat. In those years, by assuming that an aggressive behaviour of the American mink or another its impact on the native mink leads to the latter´s decline, we decided to protect the European mink population by a partial eradication of the naturalized minks. This drastic measure was quite effective to last the European mink´s presence in the Lovat river head (Figure 2). Otherwise, so we assumed, the native mink would have disappeared there until the winter of 1995-1996. Such quicker rate of the European mink extinction was recorded in the other river catchments of the northern Belarus.

It is easy to notice, that disappearing of the European mink ran rather fast, when a population has began to decline. Usually, basic decline in the European mink population proceeded 5 years (Figure 2). So, the quick rate of decrease in numbers was one of the main specific features of the European mink decline even in favourable environmental conditions which are still common in Belarus.

In the Lovat river head and everywhere in Belarus, the decline in European minks was tightly correlated with the American mink expansion. Due to a high reproduction rate, the expansion of the American mink population ran fairly fast (Sidorovich 1993, 1997). All females bred every year with a high fertility - about 7,4 embryos per a pregnant female on average. In the adjacent area drained by the Drissa river, after the American mink population had stabilized at a fairly high density, only 88% of fema-



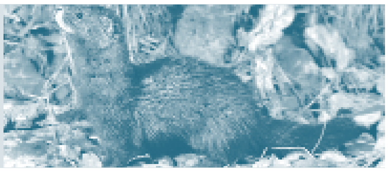
a) strong frost period (Levins's index calculated by the occurrences of 9 prey categories in the diet is 3.01, n=138);

b) spring flood (Levins's index 2.92, n=154);

c) summer drought (Levins's index 3.71, n=402)

Figure 3. Dietary composition (biomass consumed in %) of the European mink in the harshest and changeable seasonal periods in the Lovat river head, 1986-1995, Gorodok district, Vitebsk region, NE Belarus.

Figura 3. Composición de la dieta (% de biomasa consumida) del visón europeo en los periodos más severos y cambiantes de la cabecera del río Lovat, 1986-1995, distrito de Gorodok, región de Vitebsk, NE de Bielorrusia.



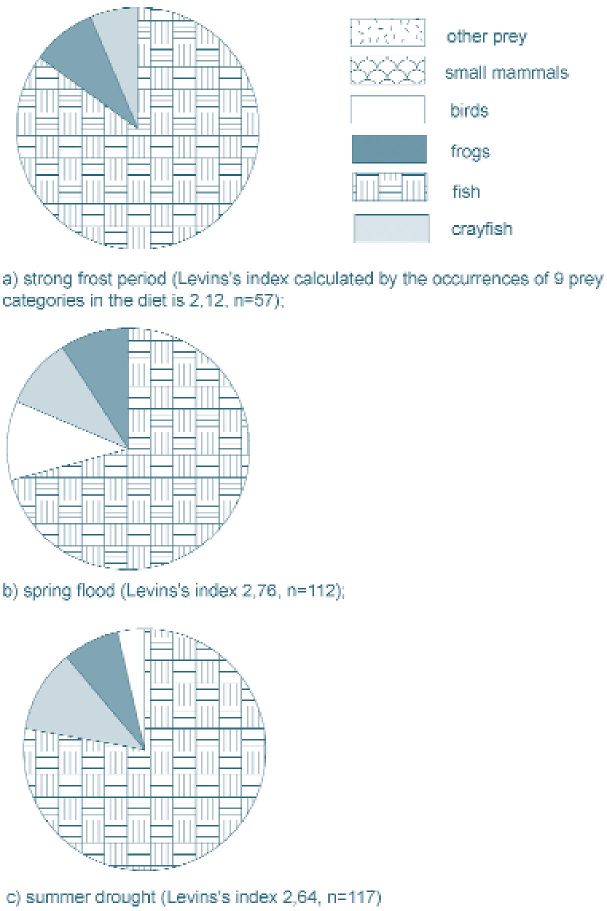


Figure 4. Dietary composition (biomass consumed in %) of the otter in the harshest and changeable seasonal periods in the Lovat river head, 1986-1995, Gorodok district, Vitebsk region, NE Belarus.

Figura 4. Composición de la dieta (% de biomasa consumida) de la nutria en los periodos más severos y cambiantes de la cabecera del río Lovat, 1986-1995, distrito de Gorodok, región de Vitebsk, NE de Bielorrusia.

les took part in reproduction and their fertility was much lower - about 3,9 embryos per a pregnant female on average. The high reproduction rate led to the fast occupation of the suitable habitats by the American mink.

Testing of different hypotheses on the European mink population decline

In the Lovat river head, NE Belarus, where the European mink population was monitored from the stage of fairly high density until almost disappearing (Figure 2), different hypotheses relating the species demise stated by colleagues (Schröpfer and Paliocha 1989, Ternovsky and Ternovskaja, 1994, Tumanov 1996, Sidorovich 1997, Maran and Henntonen 1995, Maran et al. 1998) were tested.

Human impacts. In the Lovat upper reaches during the period of the European mink population decline, the trapping pressure was not heavier than that before, when the species densely populated the area. According to our rough estimates, in 1986-1989 an annual mink harvesting was approximately 20-40% there. Then in 1990s the catching rate did not exceed 60% and on average it was about 20-30%. Well-known hunting experience obtained in Belarus suggests that such hunting pressure, when even each second European mink was captured is not too hard for the species population to survive in numbers. Since 1994 furbearing began to decline in the area as well as in the whole Belarus due to decreasing interest in fur and increasing costs of trapping. So, this factor could not be the decline cause.

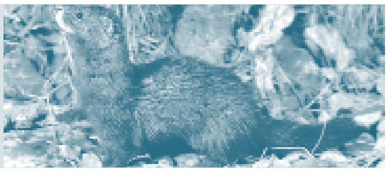
By late 1980s and early 1990s in the Lovat upper reaches, when the European mink numbers decreased rapidly, all types of aqua-

tic ecosystems in the area looked fairly pristine, and this indicates that changes in environment were not responsible for the decline. There in different localities the portion of agricultural landscape comprises 12-31% only. Any other effects of human activities (including pollution) which could lead to a substantial deterioration in the natural ecosystems were also unimportant. In concern of the pollution in the Lovat upper reaches and Belarus on the whole (Sidorovich 1997), no contaminants (heavy metals, organochlorine pesticides and radionuclides) were found in dangerous concentrations in the habitats as well as in the semiaquatic mustelids themselves with the exception of the Minsk city area and the Chernobyl radionuclide contaminated zone. PCBs were not discovered in tissue samples of the European mink, its prey and the habitats. The detection limit was 0,01 mg/kg of wet weight. As to an acid deposition, only small portion of glacial lakes was characterized by natural, somewhat acid water, whereas a substantial acid contamination was still uncommon in Belarus (Jakushko et al. 1995). So, there is no support that either habitat deterioration or pollution could be the cause of the decline in European minks in the Lovat upper reaches and Belarus on the whole. Conversely, the riverine habitats in the Lovat river head as in any other river catchments were densely populated by beavers which construction activity lead to a marked habitat improvement (Sidorovich 1997).

Prey abundance and availability. The prey of the European mink such as amphibians, crayfish, fish, aquatic beetles and voles were seemingly common enough for this semiaquatic predator to survive in numbers in the Lovat river head (Sidorovich et al. 2001a, b, 2003). To prove that, much study has been done by the specially elaborated net equipment in June-September 2001.

The total biomass of aquatic prey (fish, crayfish, edible frogs and big aquatic beetles) found in 100 m stretches of the Lovat river varied widely from 114 g to 4046 g, and with an average of 1699 g. Fish made up the main part (67-89%) of the aquatic prey biomass. In the small river we caught twenty fish species, but in the individual stretches surveyed only 4 to 11 fish species were recorded. Crayfish is well-known as one of very important prey of the European mink (Maran and Henttonen 1995). Doing the census of aquatic prey in June-September 2001 in the Lovat river head by the mentioned net equipment, the crayfish (*Astacus astacus*) biomass varied up to 1721 g, and with an average of 31-526 g in 100 m stretch depending on the river parameters (Sidorovich et al. 2003). More extensive crayfish census conducted in the area with a standard double section crayfish net in 1995-2003 gave the following results. From 0-27 crayfish were captured per net-night, with an average of 2,1 at particular places of small rivers, glacial lakes and brooks. No crayfish was captured in 58% of net-nights in small rivers (n=129), in 33% of those in glacial lakes (n=81) and 96% of those in brooks (n=89). Despite of the fluctuations in crayfish abundance nearly each year there were aquatic habitats densely populated by this prey species in the Lovat upper reaches. At the same time, during period of crayfish temporary decline other prey were sufficiently available for European minks.

As it has been revealed, frogs (in particular the common frog *Rana temporaria*) were a very important prey of this predator (Sidorovich 1997, 2000, Sidorovich et al. 2001a), and just this prey category was plentiful there. In the warm season in the valley of the Lovat river up to 18, on



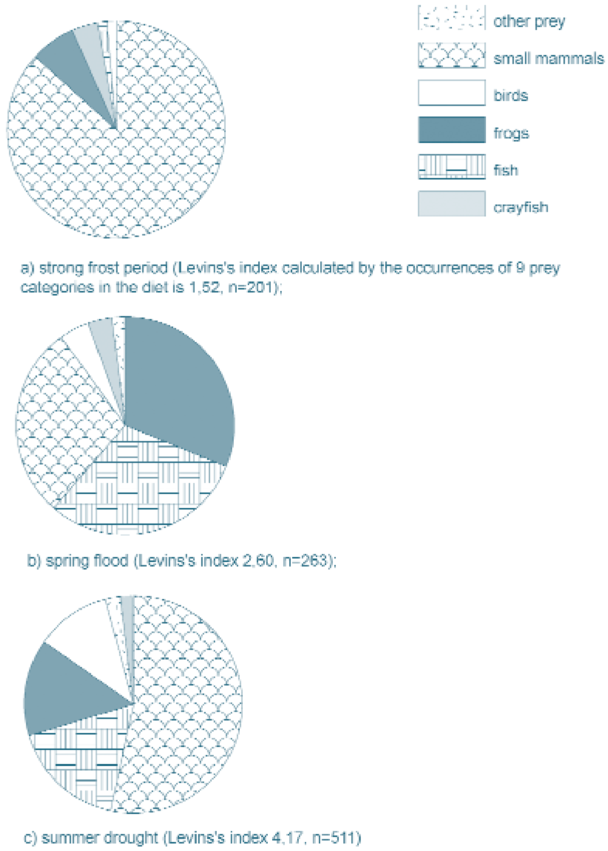


Figure 5. Dietary composition (biomass consumed in %) of the polecat in the harshest and changeable seasonal periods in the Lovat river head, 1986-1995, Gorodok district, Vitebsk region, NE Belarus.

Figura 5. Composición de la dieta (% de biomasa consumida) del turón en los periodos más severos y cambiantes de la cabecera del río Lovat, 1986-1995, distrito de Gorodok, región de Vitebsk, NE de Bielorrusia.

average 0,41 frogs per 10 m^2 were censused (n=3567 plots of 10 m^2). Common frogs prevailed in the habitats (97%, n=1461). Due to wintering concentrations of common frogs the total biomass of water-dwelling prey in the Lovat river head in the cold season was much higher than that in the warm season. The detailed census of overwintering common frogs done by nets in December 1995 along a 200m section of the Lovat small river (flow rate - about 0,6 m/sec, mean depth – 0,6 m, and mean width - 5 m) revealed 79 kg of them, i.e. about 395 kg common frogs per km of the river stretch. In late October and November 2000 we did a census of water dwelling-prey in three brooks flowing into the Lovat, which were fairly densely dammed by beavers (Sidorovich et al. 2001b). On average about 60 kg of common frogs per km of the brook stretch were captured.

A very essential factor providing a sufficient food supply for European minks and other semiaquatic predators at small watercourses is damming by beavers. In the Lovat river head the number of beaver ponds varied in small rivers from 0,3 to 3,3, on average it was about 1,5 per 1 km stretch. The mean area of beaver ponds per 1 km of stream stretch constituted from 106 to 120635 m^2/km and with an average of 24684 m^2/km. In the cold season, the aquatic prey biomass in the beaver ponds was up to 13 (mean 3,6) kg per 100 m^2, in the warm season - up to 3,1 (mean 0,8) kg per 100 m^2. On average it is higher than the biomass of aquatic prey censused in the in 100 m^2 of the small watercourses: in the cold season - 8 fold (n = 11 ponds investigated); in the warm season - 19 fold (n=17).

The total biomass of aquatic prey in beaver pond, however, was much higher than that in the comparable length of a neighbouring non-flooded section of the stream: in the cold season - up to 180, on average 58 fold; in the warm season - up to 1403, on average 281 fold.

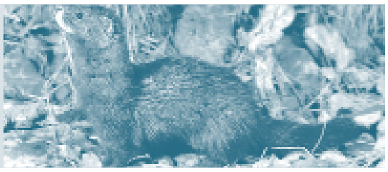
Thus, the obtained data suggest that food shortage might not be a cause of the European mink demise in the Lovat upper reaches.

Influence of the American mink expansion, but which kind of its impact is the most detrimental? So as in the Lovat upper reaches human impacts and prey shortage could not be responsible for the fast decline of the European mink population, the question arises. What has changed in the ecosystem that could affect the European mink? A possible answer was: naturalized populations of the American mink. This alien predatory species introduced in the adjacent areas and expanded to the area has similar diet and preference for riparian habitats as the native mink. Moreover, this bigger mink species is characterized by high population density and well developed feeding plasticity resulting in a wide food spectrum with the use of the most common and available prey (Gerell 1967b, Eberhardt and Sargeant 1975, Jenkins and Harper 1980, Kyne et al. 1989, Dunstone 1993, Sidorovich 1997, 2000, Jedrzejewska and Jedrzejewski 1998, Sidorovich et al. 2001a). So, a competition in form of either an interference while using the same habitats or an exploitation of the same food resources with this extra numerous predator could have affected the native mink. Another idea is a disease (virus, parasite etc) which might be brought by the American mink and to which the native mink appeared to be too vulnerable (Maran and Henntonen 1995). The fourth hypothesis connecting with the American mink which could explain the fast decline in the European minks was proposed by Ternovsky and Ternovskaja (1994). He assumed that an altered reproduction happened in European minks coexisting with arrived American minks as a result of interbreeding of American mink males and European mink females, leading to an abnormal development of the embryos.

Taking into an account the observed pronounced correlation between declining of the European mink populations and expansion of American minks, it is noteworthy to suppose that impact of the American mink is the cause of the European mink demise, but which kind of its impact is the most detrimental?

Diseases and parasites. There was no special study carried out in Belarus to test the disease idea directly. Nevertheless, indirect data showing no support to the disease hypothesis were obtained. During 1996-2001 in the Lovat river head we fixed radiocollars on 38 European minks, and 18 of them were radiotracked longer than 6 months. American minks were common in the habitats. If the disease hypothesis is right, many individuals of the radiotagged European minks might be died from the disease, and we could find the carcasses postulating unknown cause of the deaths. Actually, we had no any such a finding.

Concerning the infestation with helminths, we found only a slight increase in the level of infestation of the declining European mink population. Though, this observation should be related to the total increase of the semiaquatic mustelid density due to the American mink expansion



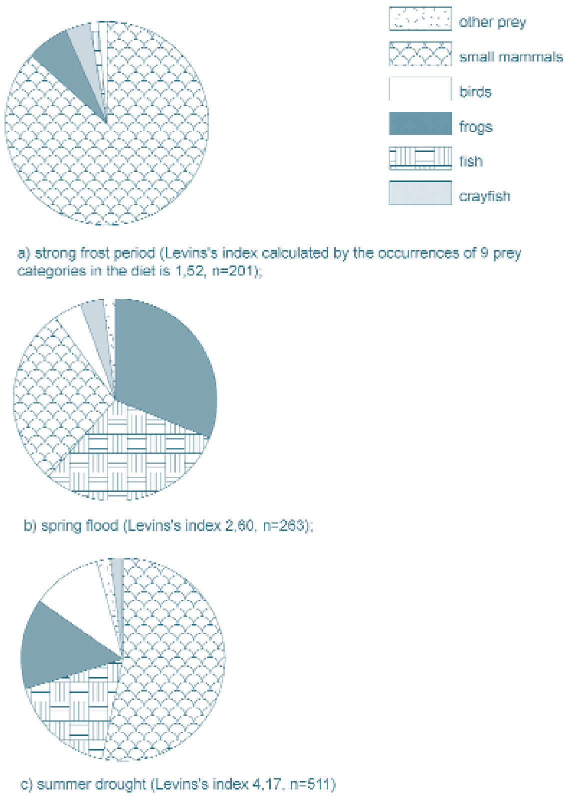


Figure 6. Dietary composition (biomass consumed in %) of the American mink in the harshest and changeable seasonal periods in the Lovat river head, 1986-1995, Gorodok district, Vitebsk region, NE Belarus.

Figura 6. Composición de la dieta (% de biomasa consumida) del visón americano en los periodos más severos y cambiantes de la cabecera del río Lovat, 1986-1995, distrito de Gorodok, región de Vitebsk, NE de Bielorrusia.

(Sidorovich and Bychkova 1993, Sidorovich 1997).

So, there is no any evidence that diseases and helminth invasions were important factors conducted the fast decline in the native mink in the upper reaches of the Lovat river.

Altered reproduction in the European mink population affected by an interbreeding with American minks. Ternovsky and Ternovskaja (1994) traced the decline in the European minks to an altered reproduction as a result of interbreeding of American mink males and European mink females, leading to an abnormal development of the embryos. These abnormal hybrid embryos were recorded in captivity (Ternovsky and Ternovskaja 1994), yet it may be unusual in a wild population of the European mink as we found the high proportion of normal developed embryos.

Nine females were caught in May, 1990-1995 in NE Belarus in conditions of rather high naturalised mink density. All of them were pregnant and fertility ranged between 3-6 embryos/female (mean = 4,0). Although one embryo was resorbing, the others (n=36) were well developed. All pregnant females inhabited small rivers densely populated by American mink, and the density of European mink was very low (0,5-2,0 inds./10 km).

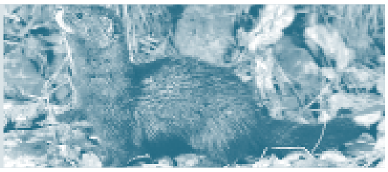
So, the idea of an altered reproduction in European minks due to an interbreeding with American minks is seemingly not true.

Aggressive encounters between American mink and European mink. Our prediction in relation to an aggressive interference from the American mink towards the European mink was mainly based on the substantially bigger size of the American mink. These differences were recorded on a statistically significant level during the first two years of the American mink expansion (Table 1; Sidorovich et al. 1999). In the course of several years after the American mink arrival, we recorded some striking changes in the weight of European minks (Sidorovich et al. 1999). In subsequent years, both sexes of the native mink became larger and larger. The trends were statistically significant. When the European mink has been near to extinction in the area, its body weight was almost the same as that of the American mink. It was quite the opposite of what we expected: if there had been competition for food, the body weights should have diverged from each other after the American mink naturalization. So, it seemed the most likely explanation is aggression - direct attacks by the American mink on the European mink.

During the intensive radio-tracking study conducted in 1995-1997 and a further less intensive study in 1998-1999 on the head of the Lovat river, it has been revealed that aggressive encounters between naturalised mink and native mink were common, and the data obtained suggest that just attacks by naturalised mink could lead to the quick European mink disappearance (Sidorovich et al. 2000). These data are presented in Table 2. These aggressive encounters were mostly (12 out of 14 encounters recorded) initiated by American mink males, and were directed towards European mink of either sex. Only once an aggressive attack from a female American mink towards a female native mink was recorded. Following such attacks the European mink left the river area and sheltered for up to 22 hours in unusual habitats such as forest or fields at a random site, e.g. under a fallen spruce. Usually, the European mink attempted to return to the river, sometimes already within 15 minutes, in which case they were normally subjected to repeated attacks. Most often they returned within 30 minutes to 2 hours. The data suggest that if a male American mink came within a distance 200 m of a European mink, the naturalised mink male would drive away and chase the European mink. Moreover, according to the obtained observations (Sidorovich et al. 2000) within European mink territories American mink tended to use fresh tracks to search for European mink, and then drove them away. In effect of the aggressive behaviour of American minks the majority of European minks ranged or staied at brooks as habitats of the poorest quality.

Considering these results it becomes clear why the European mink population declined so quickly from a dense population to near extinction. Some resource competition affecting the European mink population might be possible, but it seems not important enough to conduct the fast decline of the native mink populations, because resource competition takes time, whereas frequent aggressive encounters with the physically stronger American mink impact the European mink directly and heavier.

Competition for prey. Nevertheless, study on the sharing of food resources in the semiaquatic mustelid guild (including the European mink, the otter, the polecat and the American mink) was conducted to test for a resource competition between these species (Sidorovich 1997, 2000,



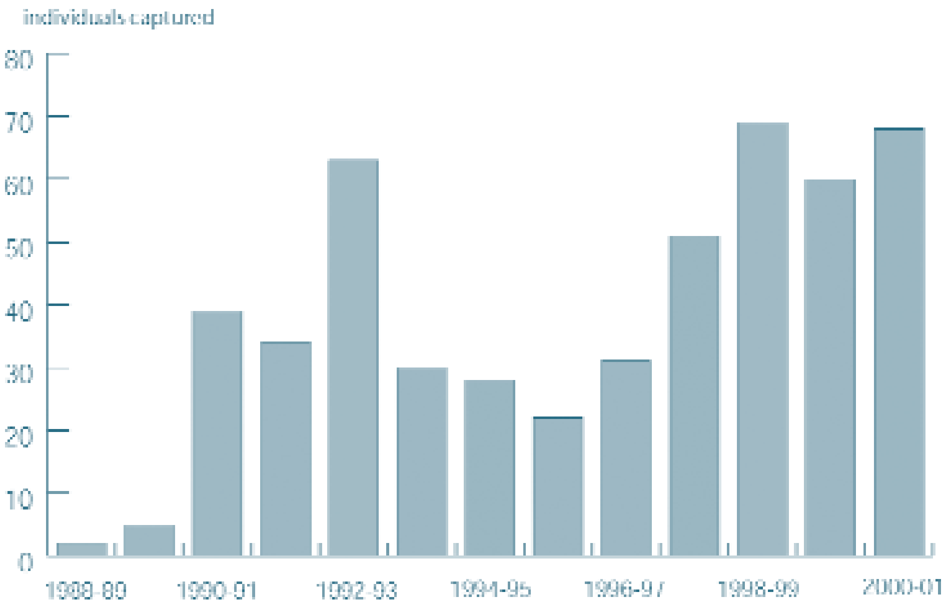


Figure 7. Pooled number of the American minks removed (hunting bag of locals plus our eradication efforts) from the Lovat river head, Gorodok district, Vitebsk region, NE Belarus, 1988-2001.

Figura 7. Número total de visones americanos recogidos (de cazadores locales y nuestros esfuerzos de erradicación) de la cabecera del río Lovat, 1986-1995, distrito de Gorodok, región de Vitebsk, NE de Bielorrusia, 1988-2001.

Sidorovich et al. 2001). Detailed data on the diets of these riparian mustelids on a seasonal basis were gained (Figures 3-6; Sidorovich, 2000). These dietary studies were concentrated on the changing and harshest seasonal habitat conditions such as spring flood, summer drought, and strong frost periods, when a resource competition between the species should be more pronounced.

The data obtained suggest that the native semiaquatic predators, i.e. the otter and the European mink, inhabited streams as their main habitats, and they have become evolutionarily separated in terms of prey consumption (Figures 3 and 4, Sidorovich 1997, 2000). Therefore, the native semiaquatic predators currently do not compete significantly for food. Mostly inhabiting fairly large aquatic ecosystems having sufficient fish abundance, otters specialised in feeding on fish, whereas the European mink was a generalist predator at land-water ecotones such as the banks of streams and the shores of glacial lakes. Nevertheless, the European mink had rather specialised feeding upon frogs (Sidorovich et al. 2001), and generally, it might be characterized by generalistic feeding habits of a frog specialist. The study of the feeding habits of the nine radio-

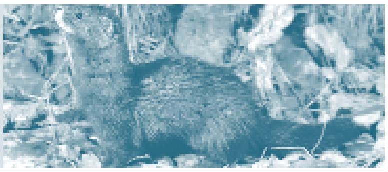
tagged European minks on an individual level evidenced that three of them (2 males and 1 female) were complete specialists on amphibians, mainly on common frogs: 77-97% of their scats (n=102-200 scats analysed) contained frog remains. Moreover, 197 of in total 204 prey remains (97%) collected from the female, and 54 of in total 60 prey remains (90%) collected from one of these males were common frogs. The males mainly lived at brooks, whereas the female was more frequently located at a fast flowing, small river. The specialization of these European mink individuals was maintaining throughout the whole year. Another European mink individual was a specialist on crayfish (*Astacus astacus*; 62%, n=85 scats analysed). The remaining five individuals basically had a diversified diet and only seasonally specialized on frogs. The individual dietary specificity of the European minks was correlated with prey abundance in the habitats (concerning crayfish: r_s=0,90, P=0,001; frogs: r_s=0,88, P=0,001). So, probably the diet is determined by the particular habitat conditions and may be defined as an opportunistic feeding habit.

Crayfish was an important prey item for both native semiaquatic mustelids. So as in the study areas of northern Belarus, crayfish abundance varied a lot from year to year and from one aquatic ecosystem to another one, these fluctuations affect the diets of semiaquatic mustelids. In years of outbreak in crayfish population or in habitats where crayfish survived during a crash in the most of its population, both European mink and otter fed on crayfish a lot (Kolbin 1958, Zharkov et al. 1977, Sidorovich 1997, Sidorovich et al. 2001). On the contrary, when crayfish abundance was low, European mink consumed many more frogs, whereas otter mostly fed on fish. A shortage of both fish and crayfish forced the otters to supplement their diets with frogs (Sidorovich 1997, 2000). Probably, because frogs as substituting prey were plenty in the study area in the Lovat upper reaches as well as in the whole Belarus and adjacent regions of Russia (Pikulik 1985; Sidorovich et al. 2001), in our studies we did not find any influence of a decrease in crayfish density on the populations of both otters and European minks.

The above-mentioned dietary differences between European minks and otters partly separate these semiaquatic predators. In addition, the differences in habitat use (otters mainly populate water-abundant rivers, whereas European mink mostly lived at smaller streams) increase an extent of food niche sharing between the native semiaquatic mustelids and should maintain the stable co-existence of these species.

The polecat was characterized by a diversified diet and fed basically on small mammals, amphibians and birds (Figure 5, Sidorovich 1997, 2000). So, this terrestrial predator basically seems not to compete with the native semiaquatic mustelids. Only frogs were an important joint prey category of all the riparian mustelids. But due to the above-mentioned high density of frogs this could not limit the densities of their main consumers such as European mink and polecat.

In Belarus, in comparison with the native riparian mustelid species, the American mink has many competitive features as a predator along land-water ecotones (Sidorovich 1997, 2000, Sidorovich et al 2001). In seasonally changing conditions, the feeding habits of naturalised mink were characterised by well-developed opportunism. This has been found for the American mink



in many areas in North America (Eberhardt and Sargeant 1975, Arnold and Fritzell 1987) and in its naturalised populations in Europe (Gerell 1967b, Jenkins and Harper 1980, Kyne et al. 1989, Dunstone 1993, Sidorovich 1997, 2000, Jedrzejewska and Jedrzejewski 1998, Sidorovich et al. 2001a). Highly adaptive feeding habits allow a semiaquatic predator to survive in unfavourable or changeable habitat conditions (Figure 6, Sidorovich 1997, 2000). Therefore, the American mink seems to be a more competitive semiaquatic predator when compared to the native mink in the seasonally changing conditions in riparian habitats. The European mink was less opportunistic, and maintained the diversified diet based on water-living prey even if the abundance and the availability of prey in aquatic ecosystems decreased (Figure 3, Sidorovich 1997, 2000). For instance, in dry and hot summers, fish and crayfish are quickly extirpated by various predators. After that, the most abundant and easily available prey categories for a riparian mustelid became frogs, small mammals and birds. Nevertheless, the European mink maintained its typical diet, whereas American mink switched to feed upon the small mammals which concentrated in riparian habitats (Figure 3 and 6, Sidorovich 1997, 2000). By winter in the conditions of strong frost, when aquatic ecosystems were almost completely ice bound, access to catch water-living prey was very limited, and, moreover, foraging in aquatic ecosystems exacerbated by low air and water temperatures, the American mink changed from its typical diet and specialised in feeding on small mammals. At the same time, despite of the unfavourable conditions to catch water-living prey, this trend was much less pronounced in the native mink (Figure 3 and 6, Sidorovich, 1997, 2000).

Also, the American mink more frequently used marshes both within valleys of rivers and glacial lakes and isolated ones. Fairly often they fed and stayed in forest habitats, whereas all 12 radiotracked European minks mainly inhabited stream banks and shores and never fed in forest habitats.

Study on the feeding habits of ten radiotagged American minks on an individual level revealed three specialists (2 females and 1 male) in feeding on rodents, mainly riparian species such as water vole (*Arvicola terrestris*) and root vole (*Microtus oeconomus*). The majority (86-92%) of their scats contained small mammal remains (rodent remains were found in 79-82% of the scats analyzed, n=84-184). In the warm period, these micromammalian specialists mainly inhabited marshes and black alder swamps. The remaining seven American mink individuals had a diversified diet, although three of them were also characterized by some specialization in feeding on small mammals. Despite the predominance of small mammals in the diets of American minks, no correlation was found between proportion of small mammals in the diets and their abundance in the habitats. In contrast, the proportions of alternative prey in the diets of American minks was positively correlated with their abundance in the habitats (crayfish: r_s=0,82, P=0,004; frogs: r_s=0,96, P<0,001). So, the revealed specialization of the radiotagged American minks in feeding on small mammals was an individual specificity.

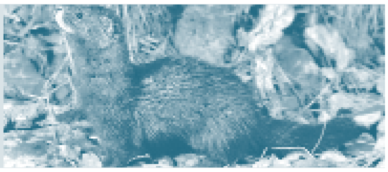
Concerning the diel activity rhythm, the radiotracked American minks were active more frequent by night and twilight with a low around midday. They only spent about 39% of the time for

feeding and other types of activities. The radiotracked European minks were less effective as a predator. They spent about 60% of the time for feeding and other types of activities and were active almost equably throughout the 24 hours.

Taking into account the above commented results, the revealed food niche overlaps (Sidorovich 2000) suggest that a resource competition with the naturalized mink possibly slightly affected the European mink population. But it was not a strong impact and mainly related to a part of the population. In our opinion, the competition for prey may happen between individuals living in fairly poor habitats conditions very similar food spectra. The obtained data suggest that such habitat types are brook and rather fast flowing small river. Even so, again it should be emphasized that a resource competition takes time in contrast to the consequences of frequent aggressive encounters with the physically stronger intruder.

Demographic results. Demographic studies on the European mink gave several interesting results connected with the different aspects of the decline in the species populations (Sidorovich 1997). One of the important results is tightly connected with habitat selection by native minks. Before the American mink expansion, female European minks preferred to inhabit small rivers or larger aquatic ecosystems, whereas males did not show a preference for either habitat type. The reduction in European mink density (Figure 2) was greatest on small rivers ($t = 11,3$, $P < 0,001$), whereas such change in the population part distributed at brooks was less, although still statistically significant ($t=4,9$, $P=0,001$). By radiotracking it was revealed that in the conditions of high American mink density, European minks very often used brooks (<2 km long for 20% of all radiolocations done; 2-10km long in 19.8%), and it was more frequently than the naturalised mink did (1,7 and 7,0%, respectively; $G \geq 6,4$, $P \geq 0,03$). One notable difference between male and female European mink lay in their use of rivers and brooks: male European minks were located at brooks for 60% of the radiolocations done, while females used this type of habitat less frequently (22% of the radiolocations; $G=18,3$, $P<0,01$); 1 female and 27 males were caught at brooks in 1986-1991 (before and during the American mink's expansion), 2 females and 49 males were captured in this habitat type in 1992-1997 (in the presence of a dense American mink population). Furthermore, we never found a European mink litter at a brook, whereas 33 litters were found along small rivers and glacial lakes. It is possible that females are not able to inhabit such small streams continuously as there are insufficient resources available to allow them to raise a litter in so poor quality habitats. So as in the conditions of a high density of American minks, brooks appeared the last habitats available for European minks, the occupation of more favourable habitats as small rivers by American minks perhaps negatively affect the reproduction in European minks.

Also, in the declining population of the European mink in NE Belarus, we found that males substantially predominated females. On the Lovat upper reaches during the American mink expansion in 1991-1997, 13 of 19 kits inspected in nests (68%), 8 of 14 juveniles trapped (57%), 24 of 35 trapped adults (69%) and 56 of 67 live-trapped individuals (84%) were males. The last



ratio differs significantly from 1:1 (χ^2=17,3, P <0.01), whereas the sex ratios of European mink populations prior to the arrival of the American mink approximated 1:1 (Sidorovich 1997).

The proportion of juveniles was very low (28,6%, n=50). As a result, the average age in the population was fairly high (males = 2,2 years, females = 1,6 years), and the juvenile-adult ratio was 0.4. In contrast in the expanding population of the American mink, the proportion of juveniles and the juvenile-adult ratio was significantly higher: 83,0% (G=27,1, P <0,01) and 4.0, respectively.

Despite of the low proportion of juveniles in the declining population of the European mink, probably all females bred every year. As it was mentioned, nine females caught in May, 1990-1995 in NE Belarus in conditions of rather high naturalised mink density were normally pregnant.

As to the litter size in the declining population of the European mink, five nests had an average of 3,8 kits (range 2 to 6) aged up to two weeks. Seven other litters, aged over one month, consisted of an average of 2,4 kits (range 1 to 5). Substantially higher litter size was found in the rather stable population of the European mink in Russia (Danilov and Tumanov 1976) and in the expanding American mink population on the Lovat upper reaches (Sidorovich 1993).

Thus, the declining European mink population is characterized by an altered population structure, low reproduction rate and high mortality. A possible explanation is an interference from the American mink. Females seem to be more vulnerable than males. In effect, the native mink is eliminated from favourable habitats which are occupied by expanding American mink population. The situation is accentuated by the female's apparent inability to raise a litter in poor quality habitat. Such habitat loss, and particularly its effect on females, may offer an explanation for the decrease in reproduction rate and the increase in mortality observed in European minks.

Further questions

So, from the reviewed results the main question for further studies arises. How to rescue the European mink? Certainly, first of all, this have to be done by captive breeding and genetic work like it is conducted in Tallinn zoo (Estonia) and at the University of Osnabrück (Germany). Then, this have to be done by eradication of the American minks, first of all, in islands with a sufficient habitat carrying capacity for the European mink like it has been done at the Hiiumaa island in Baltic sea (Estonia). Nevertheless, the reviewed studies evidently show a great demand of further scientific research. There are still too many questions which might be very important to renew the European mink population in the wild. Looking at the research priorities, the most pressing questions might be as follows. First of all, taking into account the revealed ecological specificity of each mink species, it is very important to learn, could the European mink population survive, if fairly low density of the American mink is maintained by an intensive box-trapping?

So, an intensive box trapping method should be elaborated, too. Secondly, it is important to learn why males considerably predominate in the declining populations of the European mink. Thirdly, why is the reproduction rate in the declining population so low? The next important questions are the following. Do all females breed every year and what factors affect this? What are the critical level of food supply for a female European mink to raise a litter in poor quality habitat, e.g. brooks? What is the survival rate of young individuals and which factors affect it? The next priority is the detailed study on the ecology of European minks inhabiting small streams with length up to 10 km which are the last habitats of this critically endangered species, when the American mink population got high density. There, it is especially important to investigate interspecific relationships of the European mink with other predators and habitat quality in relation to beaver construction activity.

Conservation initiatives and problems

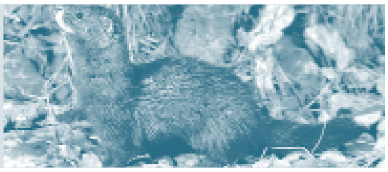
One of the conservation initiatives undertaken in Belarus was an intensive box trapping of minks and removal of captured American minks in the Lovat river head in order to maintain the declining population of the European mink (Sidorovich and Polozov 2002).

The first eradication had been done in 1993. Later in 1998-2001, partial eradication of American minks was done again. In the Figure 7, the pooled number of American minks captured by locals (mainly by hunters) and exterminated by us during the whole period of our study (1986-2001) in the area of about 241 km2 at the Lovat river head is given. It varied from 2 (in the beginning of the expansion) to 69 individuals. If we consider only the period of 1991-2001, when the American mink attained a high population density, the annual number captured American minks was 22-69 (normally 22-39, but 51-69 in years when we undertook the deliberate removal of American minks). Taking into an account that by early winter the normal level of the American mink number in the Lovat river head comprises 70-80 individuals, it is plausible that about 40% of them were exterminated during a normal hunting per the cold season and about 80% of them were killed in the years, when we tried to eradicate the alien species. The heavy removal was enough to limit density of American minks at a low level which was approximately 1-2 inds/10 km of small river stretch.

This drastic measure was quite effective to last the European mink´s presence in the Lovat river head (Figure 2). But the experiment was stopped because we faced the shortage of financial support for the work.

ACKNOWLEDGEMENTS

This review is based on both my own and joint studies, and those undertaken with many colleagues, notably Prof. Dr. David Macdonald (Wildlife Conservation Research Unit, Oxford University, UK), Dr. Hans Kruuk (Institute for Terrestrial Ecology, Banchory, Scotland), Dr. Tiit



Maran (Tallinn Zoo, Estonia), Prof. Dr. Michael Pikulik, Dr. Elizaveta Bychkova, Dmitry Krasko, and Alexey Polozov (Institute of Zoology, National Academy of Sciences of Belarus), Dr.Vladimir Savchenko (Institute for Problem of Natural Resources Usage and Ecology, National Academy of Sciences of Belarus). Also, Sergei Saluk, Vjacheslav Budnyi, and Igor Kochanovsky helped. The studies were financially supported by several bodies. The Institute of Zoology of the National Academy of Sciences of Belarus supported the study in its entirety between 1986-1993, and in part between 1994-1999. In addition, partial support (1994-1996) was provided by the Soros Foundation, and special acknowledgement is made of the substantial financial support (1995-1997) provided by the British Government's Darwin Initiative Foundation. I would like to say thanks to all sponsors and contributors for the fruitful joint studies on the European mink in Belarus.

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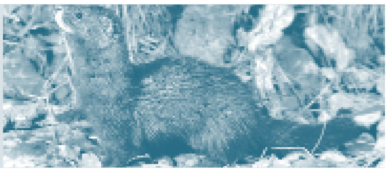

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Species	Sex	Weight (g) before	Weight (g) after after	Length (cm) before	Length (cm) after
M.vison	male	-	1325±36,9 (42)	-	42,9±0,3 (42)
M.vison	female	-	781±21,0 (23)	-	37,0±0,2 (23)
M.lutreola	male	851±24,2 (16)	990±20,5 (22)	39,2±0,3 (16)	40,7±0,3 (22)
M.lutreola	female	534±12,7 (8)	646±64,9 (6)	35,1±0,3 (8)	36,5±0,1 (6)

Table 1. Mean weights and body lengths of the European mink and the American mink in the Lovat Upper reaches, NE Belarus. Measurements of European minks are from before and after the arrival of American minks in number (July 1990), with weights in g, snout-vent lengths in cm, standard errors, number of observations in brackets.

Tabla 1. Medias del peso y la longitud corporal de visón americano y europeo en el curso alto del río Lovat, NE Bielorrusia. Las medidas de visón europeo están tomadas antes y después de la llegada de visón americano (julio de 1990), con el peso en g, longitud del hocico a la cloaca en cm, error estándar y número de observaciones entre paréntesis.

Species, sex	Distance between the radio-tagged mustelids, m			Pattern of behaviour at small distances		
	200 -1000	<200	very close	Aggressive encounter	Avoidance	Nothing happend probably a peaceful contact
M.l. m-m	14	4	2	1	4	1
M.l. f-f	2	1	0	0	1	0
M.l. m-f	17	7	5	0	1	5
M.l. f – M.v. m	16	6	6	5	5	1?
*M.l.*m – M.v. m	25	8	8	8	7	0
M.l. f – M.v. f	7	1	1	1	1	0
M.l. m – M.v. f	8	1	1	0	0	1?
M.v. m-m	22	4	2	0	0	2
M.v. f-f	4	0	0	0	0	0
M.v. m-f	47	12	9	0	0	9

Denotation: *M.l.* - European mink, *M.v.*- American mink; m - male, f - female.

Table 2. Registered contacts between the radiotagged American minks and European minks (total of radiolocations was 19,217), the Lovat upper reaches, NE Belarus, 1995-1999.

Tabla 2. Registro de los contactos entre visones americanos y europeos radiocontrolados (las radiolocalizaciones totales fueron 19.217), en el curso alto del río Lovat, NE Bielorrusia, 1995-1999.

[The distribution of European mink in Russia and the estimation of trapping impact]

LA DISTRIBUCIÓN DEL VISÓN EUROPEO EN RUSIA Y LA ESTIMACIÓN DEL IMPACTO DE LA COLOCACIÓN DE TRAMPAS

RESUMEN

En el presente, el área del visón europeo consiste en hábitats de diferentes tamaños, distantes y aislados. Se hallan dispersos por el territorio que forma la parte europea de Rusia, los montes Urales y el norte del Caúcaso. No existe un descenso aparente del visón europeo. Los cambios en los límites de su área no son tan significativos como las reducciones en el interior del área. El descenso de visón europeo en las regiones del Norte tiene lugar bajo condiciones de descenso general del interés económico de pieles trampeadas de Mustela sp., sin cambios visibles en las condiciones naturales.

Hoy en día, el trampeo de visón europeo no es ilegal en Rusia, debido a que la recolecta de "visón salvaje" está permitida en la zona de la taiga. El visón europeo no es un importante objeto de trampeo porque la baja densidad de sus poblaciones hace poco rentable en términos económicos dicho trampeo. El papel del trampeo en la conservación de especies aborígenes no sólo tiene un significado negativo. La prohibición del trampeo de todos los mamíferos semi-acuáticos parece ser ineficaz en la conservación del visón europeo. Más bien parece que favorecerá la expansión del visón americano y el rápido desplazamiento

Running title:
[Distribution of European mink in Russia and trapping]

D.V. Skumatov and A.P. Saveljev

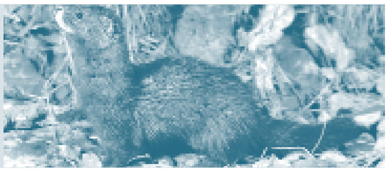
Russian Research Institute of Game Management and Fur Farming (VNIIOZ) of RAAS
Engels str., 79. Kirov 610000 Russia.

Dmitry Valentinovich Skumatov
Russian Research Institute of Game Management and Fur Farming (VNIIOZ) of RAAS
Engels str., 79. Kirov 610000 Russia
E-mail: mink@mink.kirov.ru

ABSTRACT

At present European mink's area consists of isolated distant habitats different in size. They are dispersed over the territory of the European part of Russia, the Ural and the Northern Caucasus. There is no front of European mink decrease. The changes of its area's borders are not so significant, as the reductions inside the area. Declining of European mink in northern regions took place under the conditions of the general decrease of trappers' economic interest to Mustela sp. fur, and without visible changes of other natural conditions.

Today European mink trapping is not illegal in Russia, because «wild mink» harvesting is permitted in a taiga zone. European mink is not an important object of trapping, because a low density of its populations makes their trapping economically unprofitable. The role of trapping in preserving aboriginal species does not have only a negative meaning. The ban on trapping of all semi-aquatic furbearers seems to be ineffective for European mink conservation. Most likely, it will favor the American mink expansion and rapid European mink displacement. Trapping should not be considered a major factor of decreasing European mink populations.



The patterns of territorial distribution of the two mink species in the Russian North, being the result of our trap barriers experiment, may be practically used for management of the American mink resources and for conservation of European mink. A considerable decrease of population density of American mink gives a vital space to European mink and, therefore, increases its survival chances.

Key words: European mink, American mink, distribution, Russia, trapping.

INTRODUCTION

Today European mink (*Mustela lutreola* L., 1761) trapping is not illegal in Russia, because «wild mink» harvesting is permitted in a taiga zone. Under that name both American mink (*Mustela vison* Schreber, 1877), and European mink are meant. Formally European mink is entered in the lists of endangered species of many regions of European Russia, the Northern Caucasus, and the Ural, but it does not have any impact on the improvement of a bad situation concerning that species. The ban on mink trapping (for both species or for European mink only) in some single regions of Central and South Russia does not give positive results too. Local populations of European mink for a long time have been living in the taiga zone of the European part of Russia under conditions of progressive expansion of American mink and intensive trapping of the last species (Saveljev and Skumatov 2001). That expansion is the basic cause of the accident with aboriginal species in the opinion of a number of zoologists (Popov 1949, Ternovski and Ternovskaya 1994, Sidorovich 2000). Introductions of European mink into isolated habitats outside of the historical area were not supported by all scientists (Shvartz and Vaisfeld 1993). That suggests that it is necessary to study the efficiency of "trap barriers" for restraining the American mink migration to the biotopes that are inhabited by aboriginal species now, and to estimate the importance of trapping in population dynamics of two mink species in the aboriginal mink's area.

del visón europeo. El trampeo no debería ser considerado un factor importante de descenso de las poblaciones de visón europeo.

Los patrones de distribución territorial de ambas especies de visón en el norte de Rusia, como resultado de nuestro experimento de "barreras trampa", pueden ser utilizados de manera práctica para el manejo del visón americano como recurso y para la conservación del visón europeo. Un considerable descenso en la densidad de población de visón americano proporciona un espacio vital al visón europeo, incrementando así sus oportunidades de supervivencia.

Palabras clave: visón europeo, visón americano, distribución, Rusia, trampeo.

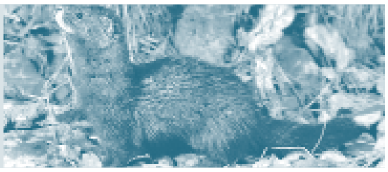
MATERIAL AND METHODS

The data on the distribution and harvesting of two species of mink were collected in 1995-1998 from 11 regions of the North-East of the European part of Russian Federation, and in 1998-2003 from other regions on the whole former area of aboriginal species. Field observations, census and capturing of animals were carried out in Kirov, Nizhni Novgorod regions and Komi Republik. The 353 questionnaires of regular respondents of VNIIOZ trappers were used. The specific identification of wild mink skins from trappers and in fur trade companies was carried out. The origin of 94 European mink skins was analyzed.

Figure 1. One of the authors with young European mink in nursery. Kirov 2000. (Photo by A. Saveljev).

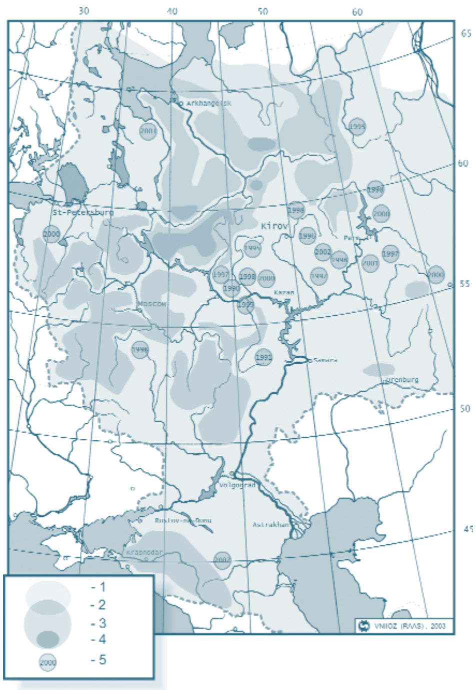
Figura 1. Uno de los autores con un joven ejemplar de visón europeo en la guardería. Kirov 2000. (Photo by A. Saveljev).

An artificial population of European mink was created to estimate the opportunity of American mink selective trapping with the purpose to preserve local populations of aboriginal species under the conditions of two species sympatry. The experiment was carried out in 1999-2000 at one hundred kilometers' distance to the east of Kirov on the Lugovka river, the Cheptsa river basin (58º 35' N, 50º 57' E – 58º 31' N, 50º 54' E). The Lugovka basin area is 40 km^2. During the first stage (winter-spring of 1999/2000) American mink was completely exterminated by killing and leghold traps. In the Lugovka river basin two releases of European mink with 11 and 16 adult and young animals from VNIIOZ nursery (Fig. 1) were carried out in August 2000 and



September 2001, correspondingly. In the nursery the animals were trained to eat live food (frogs, mice). All the animals for the first release were cryomarked. The individual features of animals (form and size of white spots on animals' fur) for the second release were enough for their reliable identification and so their marking was not made. European mink and their migrations were registered visually, by tracks, and by trapping. Wire box traps and wooden box traps were used for the control of appear of American mink too. At the remote sites (in the mouth of the Lugovka river and within its neighbouring river basins) leghold traps were used. The capture was carried out in two periods: August-November and February-March.

RECENT DISTRIBUTION OF TWO MINK SPECIES IN FORMER EUROPEAN MINK AREA



Currently European mink area consists of isolated distant habitats different in size. They are distributed over the territory of the European part of Russia, the Ural and the Northern Caucasus (Fig. 2). The parts of the area marked in the figure as territories, where European mink is rare and found sporadically, represent zones where such habitats existed at the turn of the XXth and XXIth centuries. American mink spread throughout those territories as well. In northern regions (where only European mink lives) its population density is very low. Dots in the figure indicating the year of the last encounter (trapping) of European mink give a hope that it may live there at present, but most likely it has vanished by now. The places marked in the figure, where European mink is still a common species, are certain parts of its area where it has a comparatively high population density, and American mink is not observed or is encountered rarely.

Figure 2. Present distribution of two mink species in European part of Russia (original).
1 - American mink area; 2 - Zone of sympatry of two species; 3 - Territories where European mink is rare and is encountered sporadically; 4 - Regions where European mink is still a common species; 5 - Sites and years of the latest registrations of European mink.

Figura 2. Distribución actual de las dos especies de visón en el área europea de Rusia (original).
1 – área de visón americano; 2 – zona de simpatría de las dos especies; 3 – territorios en los que el visón europeo es raro y es encontrado esporádicamente; 4 – regiones en las que el visón europeo es aún una especie común; 5 – Sitios y años de los últimos registros de visón europeo.

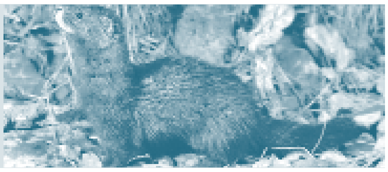
Underlying data are submitted in the table 1. From other regions of European Russia, Ural and Northern Caucasus we obtained information from trappers, zoologists, fur agents and from releasable data.

During the last 20 years there were no available reliable data on the fact that European mink lives to the east of the Ural and in West Siberia. Concerning all cases we examined, the information about observing European mink to the east of the Ural in its natural habitat was incorrect due to mistakes in identifying the species of mink. It was confirmed that European mink lived on Kunashir Island (Far East) in the population artificially created in the 1980s (Ternovski and Ternovskaya 1994). Probably, such population exists on Iturup Island, too.

On the western slope of the South Ural Mountains aboriginal mink still inhabits the territory of Chelyabinsk region on watershed sites in the upper parts of the following rivers: the Sim, the Ay, the Yuryuzan (Kiseleva and Potapkin 2003). In Orenburg region it is observed along the tributaries of the Sakmara river and may be encountered in other parts of the region (Rudi, 2003). At present there are no reliable data on the living of European mink in the territory of Bashkortostan, but according to the data on its distribution in the South Ural the species probably lives in the south-eastern part of Bashkortostan.

In the Middle Ural Mountains European mink is found on the watershed of the Ufa river and the Sylva river in Sverdlovsk region. In the north-east of Perm region in the river basins of the Kolva, the Vishera, the Yaz'va and the Yayva the cases of European mink trapping are very rare. It lives in the right-bank territory of the Upper Kama: along the streams in such upper rivers as the Siva, the Obva, the Chermos, the In'va and the Kosa. During the recent years, alone individuals were caught along the rivers flowing from the east into the Kama reservoir, and along the tributaries of the Iren' river (the Sylva river basin).

In the North and Forearctic Urals in the basin of the Pechora river European mink has most likely vanished already. In the left-bank territory of the Pechora and in the upper Izhma aboriginal mink still lives, but American mink has been already found there, too. In the lower Izhma, the Cil'ma river and their tributaries there is no European mink, apparently, because modern trappers either never encountered mink there, or captured American minks are spotted very seldom. In the upper Vychegda and along tributaries of its left bank European mink is already a rare vanishing species. It inhabits the right-bank tributaries of the Vychegda in the territory of Komi Republic and in Arkhangelsk region, and at certain sites it is common. But American mink begins to settle there, though it does not live everywhere. Only European mink lives in the basin of the Mezen. In the nearest future American mink may appear there from the basin of the Pinega. European mink lives in the territories located on the right bank of the Severnaja Dvina and in the upper Pinega, but American mink has already appeared there, and it is not rare in those places at present. The same situation is observed in the territory between the Severnaja Dvina and the Onega and between the Severnaja Dvina and the Sukhona. To the west of the Onega within the territory of Arkhangelsk region European mink has vanished, as it was not found in the bag of trappers. It is not encountered in Karelia and in Kaliningrad region as well.



Within the former area of European mink the situation is the following. At the end of the 1990s singular individuals of European mink were harvested within the territory between the Vyatka and the Kama rivers, in the territory of Udmurtia Republic and Kirov region, specifically in the river basin of the Izh, in the upper Kilmez' and on the left-bank tributaries of the Cheptsa. In Kirov region European mink lives on the watershed of the Yug and the Moloma, single individuals are caught by trappers when taking other species of animals in the basin of the Luza and on the right-hand tributaries of the upper Kama. It is highly possible that European mink still lives along the small tributaries of the Kobra.

European mink is widely spread everywhere on the watershed of the Sukhona and the Volga (i.e. on the tributaries of those rivers), in the Kostroma and the Unzha basins, in the territory located between the Rybinsk reservoir in the west and the Yug river basin and the upper Vetluga in the east. But American mink lives there, too, now predominating in numbers, especially in Kostroma region. The latter species does not live only on the tributaries of the Sogozha and the Uhra in Yaroslavl region and in certain small rivers in Vologda region.

In the territory of Leningrad region European mink is the endangered species. But the species inhabits, as it is known, the basin of the Chagodoshcha river. In Novgorod and Pskov regions that species has the same status: European mink is occasionally encountered on watershed sites throughout the territory, predominantly in the south and in the east of those regions.

In Central Russia European mink is still present as an element of fauna in all federal regions of the country. The areas of its distribution are along small rivers on watershed sites of the Volga left-bank territory, and also in the river basin of the Western Dvina (Kachanovsky, 2001), in the territories between the Dnieper and the Western Dvina, the Dnieper and the Desna, the Desna and the Oka.

The last data on the living of European mink in the south of Nizhni Novgorod region, in Mordoviya, Ulyanovsk and Penza regions dated back to the first half of the 1990s. By present in a greater part of the regions along the lower Volga European mink has already vanished, but small populations are observed in the right-bank areas of the Moksha and the Sura, and also in the left-bank areas of the Don: between the Khoper and the Medveditsa (Phylypechev and Belyachenko, 2003), the Khoper and the Vorona.

In the left-bank territories of the Volga from Nizhni Novgorod region and further towards the south all water basins have been already occupied by American mink, but European mink probably lives in the Mary lowland, on the watershed places along the border of Samara and Orenburg regions.

In the regions of the South of Russia, along the tributaries of the Don, the Seim, the Psel, the Oskol and the upper Nothern Donets the presence of European mink is quite probable, but we have no recent data.

In the North Caucasus European mink is found at present, but it is locally distributed only in certain places. It lives in the delta of the Kuban (Gineev and Krivenko, 1998), along its left-bank tributaries in Karachaevo-Cherkesiya and it is still found throughout the Kuban lowland. In the Stavropol

Territory it is encountered in the basin of the Kuma. Aboriginal mink may live on the mountain tributaries of the Terek, but at present there is no reliable information on that part of area.

TRAPPING OF MINK IN FOREST ZONE

In a greater part of the territory studied the main objects of trapping are beaver (*Castor fiber* L., 1758), pine marten, muskrat (*Ondatra zibethica* L., 1766) and American mink (Figs. 3 and 4), otter (*Lutra lutra* L., 1758), polecat, stoat (*Mustela erminea* L., 1758), and European mink are trapped in passing or accidentally. In northern regions, where there is no American mink in flood land biotopes, European mink is not an important object of trapping, because low density of its populations makes their trapping economically unprofitable. For example, in the upper Mezen river basin (Komi Republic) the maximum bag of trappers was about thirty European mink per year within the territory of 10,000 km^2 in the early 1990s. Now the trappers catch accidentally only singular individuals of that species (Fig. 5).

The cost of the European mink fur was 1-7 euros per skin in 1997-2003 (Table 2). The cost of American mink skins was higher (3-10 euro). A certain rise in prices is explained by the inflation (Table 2). Real prices have decreased. In Kirov, from 1998 till 2003 the number of fur companies buying the skins of “wild mink” decreased from seven to one.

Many skins examined were of a low quality, because of the early terms of trapping. Fur-trade agents confirmed that the majority of European mink were trapped with fish traps. It is known that in certain cases those animals were found in beaver traps, and also in traps for muskrat and even for marten.

The role of trapping in preserving aboriginal species does not have only a negative meaning. The trapping of two species of mink takes place, where there is a high and growing density of American mink population. When special mink trapping is carried out, it is directed usually to American mink. European mink has nowhere economically profitable densities. Small forest brooks are a basic refuge for aboriginal species, and it is not frequently involved in trapping of semi-aquatic animals.

Trapping of mink was banned in the early 1980s in Novgorod region. Before the ban the resident trapper caught 3-4 European mink per each season of trapping, and American mink was trapped rarely. After the ban 6-8 American minks per year were trapped and no European mink.

Figure 3. Successful trapper from Kirov region with bunch of American mink skins, closed in ondatra coat and marten fur-cap (Photo by D. Polenov). *Figura 3. Trampero con éxito de la región de Kirov con manojos de pieles de visón americano, cubierto con un abrigo de rata almizclera y un gorro de piel de marta (Photo by D. Polenov).*

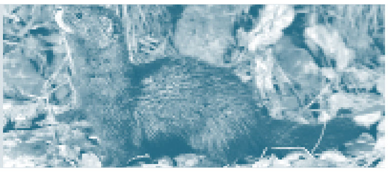


Figure 4. Hunters from Kirov clothed in otter fur-cap (Photo by A. Saveljev). *Figura 4. Cazadores de Kirov vestidos con gorros de piel de nutria (Photo by A. Saveljev).*

"TRAP BARRIERS": EXPERIMENTAL ESTIMATION OF THE EUROPEAN MINK LOCAL POPULATIONS CONSERVATION EFFICIENCY

By the beginning of that experiment aboriginal species did not inhabit that river for more than 10 years, and American mink lived along all rivers at a density of 2-5 individuals per 10 km of a river-bank. Nine individuals of American mink (5 adult males and 4 adult females) were caught with 20 killing traps, 10 leg-hold traps and with dogs, and five individuals were caught in adjacent rivers.

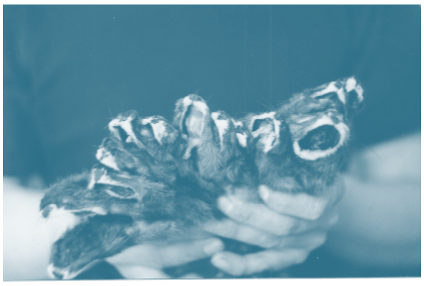


Figure 5. Some European mink skins received by the fur trade company (Photo by A. Saveljev). *Figura 5. Pieles de visón europeo recibidas por la compañía de comercio peletera (Photo by A. Saveljev).*

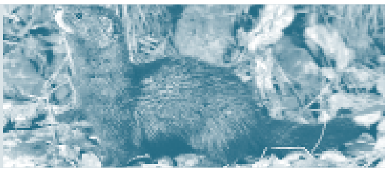
In our experiment before the first release of European mink, full capturing of American mink was carried out with traps in January-April and by catching with dogs in May for 8 days. The effectiveness of killing traps was about 190 trap-days per one mink. The majority of traps were set under ice. The trapping with killing traps in autumn was 2-3 times more efficient, but in autumn it was impossible to catch all the animals. As a result of complete capturing for the end of winter, the density of the American mink population was 0.6 individuals per 1 km of a stream. The ratio of sexes was equal, and the portion of young mink was only 22%.

In the Lugovka river and in the adjacent rivers 26 American mink, two polecats (*Mustela putorius* L., 1758), one weasel (*Mustela nivalis* L., 1766), one pine marten (*Martes martes* L., 1758), and one European mink were caught with killing and life traps.

Releases were carried out at three sites along the Lugovka. In August 2000, 3 or 4 animals of different age and sex and from different litters for one site were released. In September 2001, 5 or 6 animals predominantly from one litter for one site were released on idem sites. After the release a certain number of animals migrated to the adjacent river basins during the first month and early in spring (6 km, 8 km, and 10 km from the place of release). One male of European mink was trapped in 6 months after release in the neighbouring river. The distance of its movement along a straight line made up 10 km. The fatness of the animal was normal. Within the basin of the Lugovka during the period of 7 months the immigration of 2 American mink was detected. At the same time the majority of European mink individuals left the mainstream, and moved to small tributaries and adjacent waterlogged sites. The trapping of American mink in the Lugovka in 2000-2003 resulted in 9 animals. Among them males (56%) and juveniles (64%) were prevailed. After the releases of European mink in 2000-2003 maximal numbers of American mink (in autumn) was not more than 2-4 individuals (0.15 - 0.25 ind./1 km) on the Lugovka river basin. Such density of American mink gave probably an opportunity to preserve some European mink in places of release and on the adjacent brooks till winter 2003/2004. But we don't have data about litters of European mink in place of releases. In spring 2000 after a flood the activities were carried out to increase the survival of frog's spawn. In autumn 2000-2001 to improve habitats beavers were supported, and dams were built for water rapid streaming and preventing its full freezing (Sidorovich, 1995). A high density of frogs' populations (mainly *Rana temporaria* L., 1758) in 2000-2001 and six beavers' settlements along the Lugovka favoured the European mink survival. The capture of American mink in autumn with life traps made up about 300 trap-days per mink. The efficiency of life traps considerably decreased in winter, because of a deep snow cover (in winter of 2000/2001 it was almost one meter and along the river-bed - even deeper), and a long period of freezing-over of rivers (over 6 months). In winter the most part of migrations of semi-aquatic mustelids take place under snow and ice. Low temperatures of air make food baits in traps inefficient.

DISCUSSION

Today in Russia American mink is not found only in the Mezen river basin (Arkhangelsk and Komi), and European mink lives there at a density of 0.5 – 2.0 ind./10 km of a river bank (Turnin 1998, Pleshak 2002). American mink is observed in all other large river basins, and the aboriginal species is met less often than acclimatized species, or the aborigine has already vanished. There is no front of European mink decrease. The changes of its area's borders are not so significant, as the changes inside the natural area. There is fragmentation and localization of populations and their vanishing, and in a greater part of historical area in Russia European mink is not met any more. According to experts' estimation, contemporary numbers of European mink in Russia makes up about 20,000 individuals (Tumanov 2003), but it is difficult to give its real numbers, as there are no extensive present-day data on census, and, besides, it is impossible



to estimate an actual species ratio that changes with time greatly. In Vologda and Kostroma regions during 5-7 last years the portion of the European mink skins in the harvest from two mink species decreased from 50-70% to 1-10 %. For the whole area there is mostly information about catching single individuals and about local populations consisting of some tens of individuals. While in 1996-98 in Vologda region only European mink inhabited certain territories and small rivers, nowadays American mink lived already in all districts of that region. In 1996-1998 in the eastern part of Kostroma region European mink was common along small rivers, and American mink was met mainly along large and middle streams. But now a latter species became a major bag of trappers, while European mink is rare or vanished. The above mentioned phenomenon took place under the conditions of the general decrease of trappers' economic interest to *Mustela* sp. fur, and without visible changes of other natural conditions.

The influence of new diseases, over-trapping and the worsening of climatic conditions cause the decrease of numbers and population density of the species. Animals tend to disappear in suboptimal habitats. The decrease of this kind is temporary as usual. Unlikely the general changes of the species' area would occur under the pressure of the above mentioned reasons. After adaptation to diseases, or the decrease of a trapping pressure, or the improvement of natural conditions populations usually restore themselves. But the greater part of European mink area is characterized by the linear distribution of populations along the rivers with a high density in small rivers. Small rivers are the subject of strong negative man-made changes in places densely populated by humans (Lodé et al. 2001, Tumanov 1996). Under such conditions the above mentioned causes of the European mink decrease are resulted in the isolation of local populations and their conservation only in the remained optimal habitats. The isolation of local European mink populations in small rivers has increased after American mink spreading, because high densities of acclimatized populations exist in large and middle rivers (Sidorovich 1995). A long-term isolation of local populations of European mink at their low numbers results in negative consequences: inbreeding and genetic monomorphism (Michaux et al. 2003), impossibility to adapt to diseases and decrease of immunity, disturbances in behavior and reproduction (Rozhnov and Petrin 2003), and interspecific outbreeding. Those are the causes of local populations disappearing for a time.

Exchange of animals between different regions (local populations) should be carried out for "renewing of blood" of isolated local populations of European mink. That was recommended also by J. Michaux et al. (2003). When the unbroken habitats occur in throughout vast territory, and there is a rather numerous population of European mink with a high density and with an opportunity of high level of combination of mating among individual animals, such population can support its own existence for a long time and resist external unfavourable impact. For example, European mink is present at the swampy wood watersheds, or in large rivers' deltas (e.g., Kuban delta, see Gineev and Krivenko 1998; or Danube delta, see Kranz et al. 2003). However, it is necessary to carry out a strict planning and a veterinarian control of the above mentioned exchange (translocations).

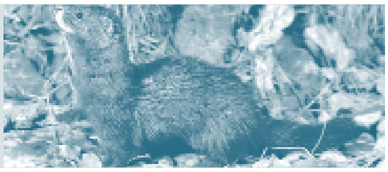
Complete and fast vanishing of European mink over a big territory occurs after the reduction and sufficient deterioration of optimal habitats, or (in valid habitats) after the increasing of the American mink numbers and its spreading over all suitable habitats. Now such process takes place in the taiga zone of European Russia. Seemingly, the like situation is on Ukraine too (Volokh 2001).

The trapping of mustelids in Russia only reflects the above mentioned processes, but does not change their significantly. Pessimistic predictions for European mink vanishing by the beginning of the XXIst century in the territory of Kirov region did not come true. In our opinion, it took place largely due to a great demand for wild mink furs and American mink active trapping in the late 1980s - first half of the 1990s. In Russia not only zoologists, but also officials and trappers realized the problem of European mink conservation. But common people see no problem for themselves, because mink is abundant, and it is of little importance for them what species of mink they trap. Traditionally a great significance of trapping for people in our country and its climatic peculiarities complicate the solving of the problem of European mink conservation. Trapping should not be considered a major factor of decreasing European mink populations. The ban on trapping of all semi-aquatic furbearers seems to be ineffective for European mink conservation. Most likely, it will favor the American mink expansion and rapid European mink displacement. But selective trapping of American mink could prevent its rapid expansion.

The patterns of territorial distribution of the two mink species in the Russian North, being the result of the trap barriers experiment, may be practically used for management of the American mink resources and for conservation of European mink. We consider that «trap barriers» could be highly efficient in medium rivers and in the mouths of small streams. The data obtained showed a rather high ability of introduced European mink to adapt to new habitats and new foods that they never met before in the nurseries. A high efficiency of killing traps and the opportunity of using them in any season resulted in a considerable impact on the American mink population. The efficiency of life traps is low in our conditions. The purposeful trapping of American mink is possible when two species of mink live alongside. For that purpose the traps should be placed in water and without baits. And the capturing should be carried out in the best habitats where American mink is present. A considerable decrease of its population density gives a vital space to European mink and, therefore, increases its survival chances. Certainly, if only European mink is present, the ban of its trapping should be strongly recommended. In many sites such management certainly will be palliative and temporary without the support of European mink populations by translocations or by introductions of aboriginal species.

ACKNOWLEDGEMENTS

We are grateful to Mrs. Tatiana Vasenina (VNIIOZ, Kirov, Russia) and Dr. Nikolay Bogatyrev (Univ. of Bath, UK) for the translation of manuscript into English. We would like to express our gratitude to all the people who gave assistance to us in the course of collecting information about distribution of European mink and its trapping.



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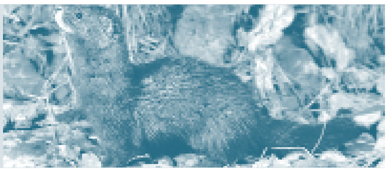


Administrative Region of Russia	Source	Number of animals (skins)	Year
Arkhangelsk	Trappers and fur agents	7	1999-2003
Ivanovo	Trappers and fur agents	4	2003
Kaluga	Fur agent	1	2001
Kirov	Trappers and biologist-hanter, our study	3	1998-2001
Komi republic	Trappers and fur agents	14	1999-2003
Kostroma	Trappers and fur agents	38	1999-2003
Moscow	Trapper	1	2000
Nizhni-Novgorod	Our study	1	1996
Tver'	Trappers	3	1999-2003
Udmurtia	Trappers	2	1999-2003
Volgograd	Trappers	2	1995
Vologda	Trappers and fur agents	17	1999-2003
Yaroslavl'	Trappers	3	2003

Table 1. Factual data on distribution of European mink in Russia (1995-2003)
Tabla 1. Datos objetivos sobre la distribución de visón europeo en Rusia (1995-2003)

Species	1998/99	1999/2000	2000/01	2001/02	2002/03
Beaver	250	-	490	640	740
Otter	500	-	1000	1200	2500
Polecat	40	-	60	100	100
Muskrat	40	50	60	80	110
American mink	150	200	270	280	350
European mink	50	150	150	280	280

Table 2. Maximum price (in RUR) per furbearer skin in Kirov
Tabla 2. Precio máximo (en RUR) por piel de mamífero semiacuático en Kirov

[Strategies for European mink preservation]

ESTRATEGIAS PARA LA PRESERVACIÓN DEL VISÓN EUROPEO

RESUMEN

La primera colonia del mundo de visón europeo (Mustela lutreola) criado en cautividad fue establecida en el Instituto de Sistemática, Ecología y Animales (Novosibirsk, Rusia) en 1971. Para mantener un grado de biodiversidad representativo, los animales fundadores fueron capturados en diferentes regiones de la Unión Soviética, como: Tverskaya, Vologodskaya, Leningradskaya y Novgorodskaya. Durante más de tres décadas, un total de 190 hembras reproductoras de visón europeo parieron 473 crías; el número total de crías nacidas en cautividad en la Estación hasta la fecha es de 1.924. Las distancias genéticas y reproductoras entre visón europeo (M. lutreola) y americano de granja (M.vison) son mayores de lo esperado. La duración de la gestación en el primero es de 39-44 días y en el último de 45-61 días y que no hay retraso en la implantación del visón europeo. Además, el número de cromosomas (2n) es diferente: 38 en M. lutreola y 30 en M. vison. Los numerosos intentos de hibridación llevados a cabo en la Estación no proporcionaron crías tras el apareamiento entre machos de M. vison y hembras de M. lutreola (y viceversa). Los análisis complementarios revelaron la muerte prenatal de los fetos en todos los casos en que se produjo fecundación. También se demostró que los machos

Running title:
[European mink preservation]

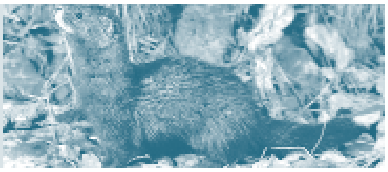
YULIA G. TERNOVSKAYA[1] , GALINA ZUDOVA[1] , SERGEI AMSTISLAVSKY[2]

[1]Institute of Systematics and Ecology of Animals, Russian Academy of Sciences, Siberian Division, 630091, Frunze str.11, Novosibirsk, Russia.
[2]Institute of Cytology and Genetics, Russian Academy of Sciences, Siberian Division, 630090, prosp. Lavrentjeva 10, Novosibirsk, Russia.

Sergei Amstislavsky, Institute of Cytology and Genetics,
Russian Academy of Sciences, Siberian Division,
630090, prosp. Lavrentjeva 10, Novosibirsk, Russia
E-mail: amstis@bionet.nsc.ru
Fax: (383) 233-1278. Tel.: (383) 233-3859

ABSTRACT

The world first captive bred European mink (*Mustela lutreola*) colony was established in the Institute of Systematics and Ecology and Animals (Novosibirsk, Russia) in 1971. To maintain representative range of biodiversity, the founder animals were caught in different regions of the former Soviet Union, i.e: Tverskaya, Vologodskaya, Leningradskaya and Novgorodskaya oblast. During more than three decades, totally 190 stud European mink females gave birth to 473 litters; the total number of kits born at the Station in captivity till recently is 1,924. The genetic and reproductive distances between European (*M. lutreola*) and American (farmed) mink (*M. vison*) are larger than expected. The gestation length in the former is 39-44 days and in the latter is 45-61 days and there is no implantation delay in the European mink. Moreover, the chromosome numbers (2n) are different: 38 for *M. lutreola* and 30 for *M. vison*. Numerous attempts of hybridisation undertaken at this Station, resulted in no offspring after mating *M. vison* males to *M. lutreola* females (and vice versa). Further analysis revealed the prenatal death of



the foetuses in all the cases when impregnation has occurred. American mink males start their breeding season about one month earlier than European mink males. Due to this reproductive advantage of *M. vison* males, it is possible that some of *M. lutreola* females are impregnated in the wild by the former without offspring delivery. The feasibility of hybridisation, combined with the subsequent pregnancy failure, may represent possible mechanism of well known adverse effect of American mink on the European mink. Three hundreds of European minks born at the Station have been adopted by Zoos and by some commercial fur farms in Russia. Moreover, 388 European minks were released into wild in Iturup and Kunashir islands. In the farther East Russian, these big islands are free of American minks and we believe that the lack of that invasive species is a guarantee of successful acclimatisation of European mink. More recently, our main efforts were invested into developing innovative ex -situ strategies of this species conservation, like embryo transfer and embryo cryobanking. This new approach was developed in co-operation with associates from the University of Kuopio (Finland). The first embryos of European mink have been frozen and are preserved in liquid nitrogen. Accompanying technologies, i.g.: embryo collection and interspecies embryo transfer have been adapted to European mink. We believe that creating of the "frozen Zoo" is an additional option for this endangered species preservation. Currently one of our main goals is to develop an integrated packet of reproductive technologies for ex-situ preservation of the European mink. Conclusion: comprehensive studying of reproductive biology, ecology, genetic and behaviour of European mink made it possible to use a variety of species preservation strategies: from acclimatization into Iturup and Kunashir islands, through the installing this species onto commercial fur farms and Zoos, to the modern reproductive ex situ technologies.

Key words: captive breeding, cryobanking, European mink, preservation strategies, release into the Nature.

de visón americano comienzan su periodo de reproducción aproximadamente un mes antes que los machos de visón europeo. Debido a esta ventaja reproductora de los machos de M. vison, es posible que algunas hembras de M. lutreola sean fecundadas en libertad por aquellos, sin que se produzca descendencia. La viabilidad de la hibridación, combinada con la subsecuente ausencia de preñez, puede representar un posible mecanismo del bien conocido efecto adverso del visón americano sobre el europeo. Trescientos ejemplares de visón europeo nacidos en la Estación han sido adoptados por Zoológicos y por algunas granjas comerciales peleteras en Rusia. Además, 388 visones europeos fueron puestos en libertad en las islas de Iturup y Kunashir. En el extremo oriental de Rusia, estas grandes islas están libres de visón americano y creemos que la ausencia de esta especie invasora es una garantía de aclimatación satisfactoria del visón europeo. Más recientemente, nuestros principales esfuerzos fueron invertidos en desarrollar estrategias innovadoras de conservación ex situ de la especie, como transferencia de embriones y crio-bancos de embriones. Este nuevo enfoque se desarrolló en cooperación con asociados de la Universidad de Kuopio (Finlandia). Los primeros embriones de visón europeo han sido congelados y conservados en nitrógeno líquido. Tecnologías complementarias, como recogida de embriones y transferencia de embriones, han sido adaptadas al visón europeo. Creemos que la creación de un "zoológico de muestras congeladas" es una opción adicional para la conservación de esta especie amenazada. En la actualidad, uno de nuestros principales objetivos es desarrollar un conjunto integral de tecnologías reproductoras para la conser-

vación ex situ del visón europeo. Conclusión: estudios exhaustivos de biología reproductiva, ecología, genética y comportamiento del visón europeo hicieron posible usar una variedad de estrategias de conservación de especies: desde la aclimatación en las islas de Iturup y Kunashir, pasando por la instalación de la especie en granjas peleteras comerciales y Zoológicos, hasta las modernas tecnologías de reproducción ex situ.

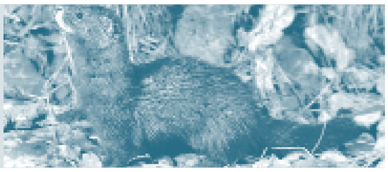
Palabras clave: cría en cautividad, crio-bancos, visón europeo, estrategias de conservación, liberación en la naturaleza.

INTRODUCTION

The rapid decline of European mink populations in the USSR and diminution of the historical range of this species was indicated by Igor Tumanov and by Dmitry Ternovsky (Tumanov and Ternovsky 1972). During 1970- 1986 Dmitry Ternovsky performed seven expeditions into the European part of USSR (Arhangelskaya, Vologodskaya, Pokrovskaya, Leningradskaya, Astrahanskaya oblast and Estonia). The aim of all these expeditions was to monitor the European mink populations in their natural habitat and to study the ecology and biology of this species. Observation and monitoring of wildlife European mink populations let Dmitry Ternovsky to conclude that wherever American mink (*Mustela vison*) appears, the native European mink (*Mustela lutreola*) either rapidly declines or even disappears (Ternovsky 1975).

The data about biology and ecology of the European mink were sparse and controversial at those times. There was only one monograph concerning European mink (Novikov 1938), and this single monograph confirmed the apparent lack of knowledge. It is not surprising, that the lack of real knowledge caused a variety of opinions and polarized the scientific community in Russia. There were different and sometimes antagonistic hypothesis explaining species decline: varying from the appreciation of the decrease the animal numbers in the European mink populations as a cyclic fluctuation of the species dynamics (Shubnikova 1978) to the fatal inevitability of the disappearing and vanishing of this species (Rozhnov 1992).

To elucidate the problem based on the thorough studying of reproductive biology and ecology of European mink, the Research Station has been established in the Institute of Systematic and Ecology of Animals of the Siberian Department of the Academy of Sciences. The initial population of captive bred European mink was founded by animals caught in different parts of the range, e.g.: in Leningradskaya, Pskovskaya, Novgorodskaya, Tverskaya oblast and in Estonia. Throughout the year, the animals were exposed to the outdoor temperature, maximally imitate the natural conditions. The Scientific priorities chosen for this Research Station were: reproductive biology, genetics and systematic of mustelids with a special emphasis on



European mink. The technological priority was to develop strategies of ex- situ European mink preservation and propagation.

1. Basic knowledge on the reproductive biology and systematic of European mink obtained in Novosibirsk Research Station: Some practical applications.

Long-term studies of European mink on the Research Station are summarized in two monographs (Ternovsky 1977, Ternovsky and Ternovskaya 1994) and in more than 30 original and review papers. Some part of this comprehensive research was done in fur Animal farm of the Astrahansky National park, where a number of captive bred animals were transported from Novosibirsk. This Astrahan population of European mink was monitored and studied by Nikolay Moshonkin under supervision of Dmitry Ternovsky.

The studies on the Research farm in Novosibirsk comprises more than 30 years of active research. The multidisciplinary studies on the Research farm have been performed in collaboration with many other researchers and fur breeding organizations. Recent collaboration with the Institute of Biotechnology (Kuopio, Finland) and with the Institute of Cytology and Genetics, Russian Academy of Sciencies makes it possible to adapt the most modern reproductive technologies for the purposes of European mink ex-situ conservation.

Karyotype analysis revealed close similarity of European mink with the European polecat (*M. putorius*). In contrast, karyotypes of American mink (*M. vison*) and European mink (*M. lutreola*) demonstrated lack of similarity (Volobuev and Ternovsky 1974). The number of chromosomes in European mink (38) is characteristic for polecat/ferret species (38-44), but the chromosome number of American mink (30) is out of this range (Volobuev and Ternovsky 1974, Grafodatsky et al. 1976). Based on these karyotyping data and on the results of studying of the reproductive biology of these two species, Ternovsky believed that it is reasonable to classify European mink and American mink not only as two different species, but also as the species belonging to different genera (Ternovsky and Ternovskaya 1994). More recent molecular phylogenetic analysis (Davison et al. 2000) confirmed that European mink is genetically most closely related to polecat species, but has lack of genetic similarity with American mink.

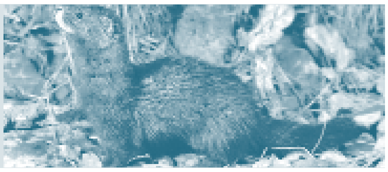
In the Northern hemisphere, American mink starts breeding season in February and continues until March, with the peak of breeding activity observed in early March (Ternovsky and Ternovskaya 1994). The breeding season in European mink in captivity extends from March to June, with a peak in the late April (Moshonkin 1983, Ternovsky and Ternovskaya 1994). The gestation period in American mink is relatively short and variable. According to the observation on the Research station in Novosibirsk, the total pregnancy length in this mustelid varies from 45 to 61 day. European mink is characterized by the short and constant pregnancy. Being impregnated, European mink females deliver kits after 39 to 44 days (an average 41.6 days) (Ternovsky and Ternovskaya 1994). It should be noticed, these two species occupy the same ecological niche, the reproductive physiology of the American and the European mink differs considerably.

For example, implantation delay may happen in the former and is absent in the latter. In American mink implantation delay either occurs or not occurs depending on the date of mating (Mead 1989, Ternovsky and Ternovskaya 1994).

Postnatal development in European and American minks differs significantly. The weight of term kits is approximately the same in these two species, but the ratio of body/tail lengths is different. The body length is relatively longer than in the former, but the tail is relatively longer in the latter. The body shape in term kits differs as well. The newborns of European mink have almost cylindrical body, whereas the body shape of American mink kits is more gusset-like. The upper neck gland is prominent in American mink, but much less developed in European mink (Ternovsky and Ternovskaya 1994).

Mating of the American mink males to European mink females and vice versa results in pregnancy, but then pregnancy failure and reabsorption of the foetuses occurs. The experimental data are represented below in this paragraph. More detailed information and corresponding illustrations are represented in two monographs (Ternovsky 1977, Ternovsky and Ternovskaya 1994). Three females of European mink were mated to the best males of American mink of the proven fertility. In all these cases vaginal smears confirmed impregnation, and later characteristic changes of the nipples as well as abdomen enlargement were observed. These changes indicate the successful impregnation. However, the hybrid embryos failed to develop to term. In one of these cases pregnant female was operated and visual observation of the uterus confirmed the characteristic uterine swellings and the presence of the foetuses inside. However at the time of operation (Day 33 post coitum) all the foetuses were indicated as dead ones, being in the process of reabsorption. Vice versa experiment, when the American mink female was mated to European mink male led to the same result: pregnancy was established, but degeneration and death of the foetuses with concomitant reabsorption of the foetal tissues was confirmed after 3 weeks of the pregnancy. These observations of Ternovsky (1977) corroborate the earlier results of Chang (1968), who artificially inseminated ferret females by American mink epididimal sperm. Eleven of twelve females conceived, and embryos developed, but then degenerated at different stages. In a number of the cases, implantation sites with foetuses were observed, some of which were alive, as ascertained by their heart beats. However, no embryos survived after 26 days of prenatal development and only degenerated embryos have been observed since this time. Examination on the Day 50 after artificial insemination revealed only implantation sites fulfilled with brown fluid. In vice versa experiment, Chang (1968) artificially inseminated American mink females with semen of the ferret male. However, subsequent examination revealed only unfertilized eggs.

Experimental observations of Ternovsky (1977) and Chang (1968) are in good agreement with the Ternovsky's hypothesis of disappearing of European mink. Based on the experimental evidences of the possibility of mating between American mink males and European mink females in captivity and the subsequent pregnancy without any offspring born, Ternovsky hypothesized that because the breeding season of the American mink starts earlier as compared to



European mink, the American mink males have good chances to impregnate European mink females, thus preventing their natural reproduction during the breeding season. Though recent observations revealed some other mechanisms by which the aborigine species may be adversely affected by the invasive American mink (Sidorovich 2000), the intriguing possibility of "sexual aggression" offered by Ternovsky (1977) needs evaluation in the field condition. Whether or not, this mechanism has any impact on the decline of European mink population in natural habitats warrants further elucidation.

Hybridisation between European mink and ferret /polecat species was successful and resulted in live offspring. Hybrids between European polecat males and European mink females have been obtained on a large scale in captivity at the Mustelidae farm in Novosibirsk. The name "Honorik" given to this type of hybrid at this farm was then accepted and widely used in Russian literature. The name Honorik is a combination of the words "Horek", which is the Russian name for polecats/ferrets and "Norka", which is the Russian name for mink (see Ternovsky and Ternovskaya 1994, for details). These hybrids are larger and heavier as compared to both ferret and mink species and may be distinguished by characteristic muzzle and beautiful fur, which resembles the fur of sable (Ternovsky and Ternovskaya 1994). Reverse hybrids originating from mating of male European minks to female European polecats were first obtained at the Research farm in Novosibirsk in 2001 and received the name "Nohorik". The name Nohorik, as well as the name Honorik, reflects the origin of this particular type of hybrids. Females of Honorik as well as Nohorik are fertile. Male Nohoriks are fertile, but male Honoriks are genetically sterile in the great majority of the cases. Twelve of 13 tested males of Honorik were sterile and only single male was fertile. Sterile Honoriks either did not expressed sexual interest and motivation in the presence of females or even demonstrated aggressive behaviour. However, in some cases male Honoriks demonstrate sexual arousal and able to copulate with different Mustelidae species, but no spermatozoa are found in the vaginal smears and mating with these males result in no offspring.

2. Captive breeding of European mink in Zoos and fur farms as a strategy of ex- situ preservation

European minks are able to breed in captivity. During more than 30 years of the history of Research Station in Novosibirsk, 473 litters have been obtained from 190 stud European mink females. Females are sexually mature and able to breed already at the age of 10-11 months. In contrast, only the minority of males (about 30%) achieve sexual maturity during the first year of their life. The other males either participated breeding season at the age of two years or are unable to breed successfully in captivity.

The fecundity of females strongly depends on their age. Average litter size in the first three years of their life is correspondingly 4.5 ± 0.14, 4.7 ± 0.16 and 4.5 ± 0.19. The maximal litter size ever registered on the Research Station was nine kits. After the first three years of their life the fecundity in European mink declines. However, some males and females are still fertile up to 6-7 years of their life. The highest life span of European mink in captivity is eight years. With the use

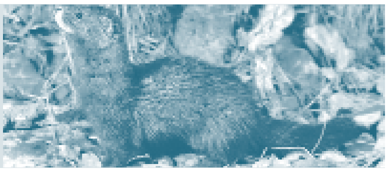
of special tricks, it is possible to obtain two litters per one female during the year. On the Research Station in Novosibirsk 17 females delivered two litters during one year (Ternovsky and Ternovskaya 1994). In Astrahan, 7 females delivered two litters per one year (Moshonkin 1983). Some of stud females on the research Station gave birth and nurtured altogether up to 28 kits. Polygamy is characteristic of some (though not of all) European mink males. In some cases males of European mink impregnated up to 9 different conspecific females within one breeding season. More than three decades of highly successful captive breeding program in Novosibirsk Research Station confirms the possibility of using captive breeding strategy for preservation of this species. This strategy may be used in the Zoos and regular fur farms. Some stud European minks were forwarded from our Research Station to the Zoo of Novosibirsk. This captive population reproduced so well in Novosibirsk Zoo, that in some years the number of European mink in the Zoo was even larger than on the Research Station.

Some animals were forwarded also to the regular fur farms: "Znamenskoe "(Tver region), "Lesnoe" (Altay), Pushkinsky (Moscow region) and some others. In some cases European mink reproduced well in the fur farms conditions. Fur farm of Astrahan National park received some animals from Novosibirsk Research Station. Captive breeding was successful there and an important basic knowledge on reproduction of this Mustelidae species was collected (Moshonkin 1983). Twenty European minks were sent to Institute of hunting and fur animals breeding (Vjatka) for the purposes of reintroducion into Nature. A number of animals were sent also to Ilmen National park. Altogether during the existence of the Research Staion in Novosibirsk, more than 300 animals from Research Station have been sent to the Zoos, fur producing farms and National parks.

3. Introduction and reintroduction to the islands as a strategy of ex situ preservation of European mink

Some earlier attempts to reintroduce European mink in Yaroslavskaya oblast and into the Valaam island in Karelia were undertaken. However, four years after the attempt, in 1986, Ternovsky and Rudin monitored the Valaam island and did not find European mink there. There were a number of reasons of the failure (Tumanov 2002). Ternovsky and Ternovskaya (1994) considered the possibility of invasion of Valaam by American mink from the Ladoga coast as the main reason of the destruction of the re-established population of European mink there. Range of the little islands connect the coast line and Valaam; this makes it possible the invasion of Valaam by American mink (Ternovsky and Ternovskaya 1994).

In 1986, the Institute of Systematic and Ecology (former Biological Institute) in Novosibirsk prepared application for inclusion of European mink to the list of endangered species and this application was sent to scientific counsel for the problems of Biosphere. There was no any official reply, and in Russia this species (European mink) is still officially not considered as an endangered species despite the number evidences. However, recently some progress has been achieved: in 2001 the Caucasian subspecies of European mink was included into the Red book of Russia.



After thorough investigation, it has been concluded by Ternovsky, that the two biggest islands of the Kuril range (Kunashir and Iturup) suit well for the purposes of establishing wildlife populations of European mink there. Kunashir and Iturup cover the territory about 1,550 square km and 6,725 square km correspondingly. Both islands are situated far away from the mainland and from other islands; the long distance of open water prevents the invasion of American mink into the both islands.

Young European minks were trained on the farm for this purpose and systematically released into wildlife. The actions usually have been undertaken in September. Eight groups, altogether 388 animals, have been released in 1981-1989. Seven animals were caught in Nature, but the rest 381 European mink were born in captivity on the Research farm in Novosibirsk. The latter group had better chances to survive, because these animals were five months old, had good pedigree, and were trained on the special territory belonging to Research Station, e.g.: trained to swim, to build living place, to explore environment and to hunt. This territory resembles the natural habitat of the European mink. As a result of this large scale action, two viable populations of European mink were established in Kunashir and Iturup correspondingly, these populations based on the protected territories “Kurilsky” and “Ostrovnoy”.

The monitoring of these populations by zoologists as well as evidences of the local hunters confirmed that the populations are well established and reproducing. Since November 16 till December 15 1984, two zoologists (G. Voronov and A. Zdorikov) monitored the rivers: Tjatina, Filatovka, Kamishovka, Nochka and the closest streams in Kunashir. The presence of 72 European minks has been confirmed. As was revealed by these zoologists, the diet of the European mink in Kunashir consists of frogs, fish, mammals (mainly voles and mice), birds, crayfish and even insects. In stomachs of European mink the residue of plants (leafs, steams and conifer) and even sand was found as well (Voronov 1989, 1992).

On the other island (Iturup) also there were evidences of well established population of European mink (Sautsky 1990). Since July 1987, when animals have been released there for the first time, fishermen and hunters indicated the presence of European mink on this island (e.g. with kits).

However, there were some controversies about density of European mink population on these islands. According to Voronov (1989), the total number of the animals living on these two islands was around 500. He also suggested that density of European mink distribution is in range between 0,1 and 3,5 animals per one km of streams and river coasts line. According to another study (Schvarts and Vaisfeld 1993) the density of animal distribution on both islands does not exceed one animal per one km of the stream/river coast line.

According to our knowledge, till recently this large- scale release of European mink into Iturup and Kunashir is still lonely successful attempt to establish viable population in wildlife. However there are opposite opinions in literature. Vaisfeld (2003) believes that the population of the European mink introduced on the Kunashir has become extinct. The critical issues of the action

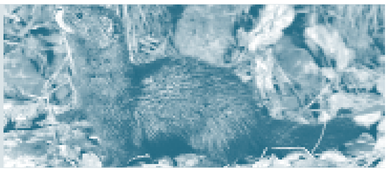
have been discussed elsewhere (Maran 2000) and unfavorable political conditions in USSR was considered as one of the main obstacles.

The local Kuril authorities, however, were highly cooperative and in 2000 European mink was even included into the Red book of Sahaline area of Russia. In fact, the initiative of Ternovsky and Ternovskaya received enough political/ juridical support both at the local and at the governmental levels from the very beginning and the expeditions have been sanctioned and granted. However, there was a strong leadership of Dmitry Ternovsky, based on his knowledge of the biology of the species and related Scientific and practical issues. We believe that this was a single possibility to achieve real result and agree with the opinion discussed elsewhere (Maran, 2000) that "rejecting attempts of wider collaboration was the only way to achieve results in the former USSR. If not, the actual activities undertaken in Novosibirsk might have been inhibited, with the leading role shifted to Moscow for political gain, but without much conservation".

However, the initiative of Ternovsky and Ternovskaya with the release of European mink on the Kurils islands has been approved also in Moscow. On the high level meeting in Moscow (13.07.1989) concerning acclimatization of European mink on the Kurils islands, these efforts and initiatives have been approved and sanctioned by the leading government and Scientific Institutions of the Soviet Union.

The action with the release of European mink onto Kurils islands polarized Scientific community in Russia and beyond of Russia. Currently different, and sometimes opposite, opinions can be find in literature and this issue was one of the hottest topic to discuss on the International Congress on the Conservation of European mink (Spain, November 2003). According to Vaisfeld (2003) the population of European mink has become extinct at least on Kunashir. In contrast, Gennady Voronov, who monitored the European mink population in Kunashir since the beginning of action and has some published results (Voronov 1989, 1992), has opposite opinion and suggests that the reproducing population of European mink exists on the islands (personal communication to Julia Ternovskaya). The third opinion, unpublished, but persistent during informal part of communication on the International Conference of the Conservation of the European mink (Spain, November 2003), was that a number of American mink animals were brought onto the islands during "perestroika" period and was used as fur animals in tiny private farms. Then some American mink escaped and have established a feral population. This opinion needs verification, and if there will be any official / scientific confirmation of the American mink presence on the islands, the situation might be considered as critical for European mink population there. Despite all the controversial opinions, the great majority of the scientific community agree, that the expedition to Kurils islands aiming a survey and monitoring the situation there is highly warranted.

Most recently a preliminary survey of European mink population has been performed on Kunashir island by Gennadii Voronov (December 2004) and indicated the existence of viable European mink population throughout the whole island. Moreover, local hunters confirmed that



occasionally European mink is found in the sable traps. No signs of the American mink invasion/presence on Kunashir have been found during this survey (G. Voronov pers. com.).

4. Embryo cryobanking combined with interspecies embryo transfer as a strategy for European mink preservation

Recently our main efforts were concentrated on the adoption of the methods of reproductive biology, e.g.: embryo cryopreservation and embryo transfer and related modern reproductive technologies to European mink. These studies have been conducted for a number of years in close collaboration with the researchers from the University of Kuopio (Finland). Part of this project has been done on the Research farm in Novosibirsk, another part was performed in the University of Kuopio (Finland).

Though embryo cryopreservation and embryo transfer have a long history of successful use for preservation laboratory animal collections and are important tools in agricultural biotechnology (Mobraaten 1986, Amstislavsky et al. 1991), only recently these reproductive technologies have been applied for preservation of the wildlife species. There are very few of successful attempts of embryo cryopreservation reported in *Carnivora* so far (see Pope 2000, Farstad 2000 for the reviews). Till recently, only in *Felidae* family alive kittens were produced after transferring of frozen-thawed embryos. Live offspring have been successfully born after transfer of frozen-thawed embryos in the domestic cat (Dresser et al. 1988). More recently, ocelot (Felis pardalis) has been born after transfer of frozen-thawed embryos (Swanson 2001).

Intra- and interspecies embryo transfer have been investigated as methods to use within the framework of endangered species ex situ preservation programs. Though a number of successful interspecies embryo transfers have been done, felids are the only *Carnivora* on this list (Pope et al. 1993, Pope 2000). Even so, there have been several unsuccessful attempts at interspecies embryo transfer in carnivores and rodents (Adams 1982). Moreover, even in the successful attempts of interspecies transfer, pregnancy rates have been low (Adams 1982, Kraemer 1983; Anderson 1988, Bainbridge and Jabbour 1998, for reviews).

Earlier we obtained the evidences of viability of Mustelidae embryos after freezing-thawing and cryopreservation, because these embryos developed in vitro (Amstislavsky et al. 2000). Our recent paper describes the world first term kits obtained after embryo cryopreservation in Mustelidae (Lindeberg et al. 2003). The young were obtained in European polecat after cryopreservation, storage in LN_2, thawing and intraspecies transfer into recipient European polecat female. This result makes it feasible to create embryo cryobank in endangered mustelidae species, e.g. European mink.

Apparently, to overcome interspecies barrier between European mink and related polecat/ferret species is one of the most important goals. This has been done successfully on the research farm in Novosibirsk with the use hybrid (Honorik and Nohorik) females as recipients for transfe-rring of European mink embryos (see Amstislavsky et al. paper in this issue).

These achievements, as well as development of non-invasive method of embryo collection in European mink (Lindeber et al. 2003) strengthen the idea of "frozen Zoo" and make it applicable to European mink as a feasible option and strategy of this species conservation in future.

ACKNOWLEDGEMENTS

This study was supported by Finnish Academy, grant No. 52680 and Russian Academy, grant No. 11. The authors thank Victor Kolpakov for the help with translation to Spanish and Heli Lindeberg for the help during preparing this paper.

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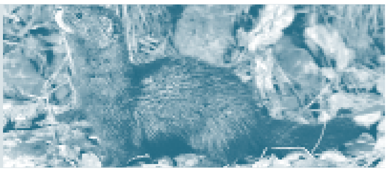

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[Situation and distribution of the European mink (*Mustela lutreola* L.) in Russia]

SITUACIÓN Y DISTRIBUCIÓN DEL VISÓN EUROPEO (*Mustela Lutreola*) EN RUSIA

RESUMEN

En la actualidad, el visón europeo ha desaparecido completamente de la mayoría de países europeos y sus ejemplares se han reducido drásticamente en Rusia. La población total de la especie en Rusia no excede de 19,000-21,000 ejemplares. Los datos recogidos prueban que el declive del número de visones europeos tiene lugar independientemente de la presencia de visón americano en la misma área. La fuerte presión antrópica sobre el hábitat de la especie, que perturba las características físico-químicas del ambiente, podría ser considerada el factor más importante que influye en su desaparición. La estrategia de conservación del visón europeo debería incluir trabajos de monitorización de la población bien organizados, una aproximación diferencial a la caza en los biotopos no habitados por mamíferos semiacuáticos, la creación de una red de reservas y la intensificación de la investigación sobre la biología de la especie en zoos y granjas peleteras.

Palabras clave: visón europeo, ejemplares, distribución, Rusia.

Running title:
[Situation with the European mink in Russia]

Igor L. Tumanov

Research Institute of the Arctic and Antarctic. Russia
Naberezhnaya Chornoy Rechki, 8, ap. 40, St. Petersburg, 197183, Russia
E-mail: itumanov@rambler.ru

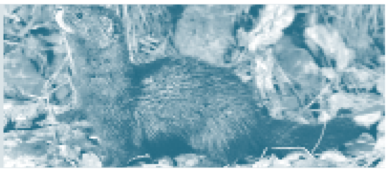
ABSTRACT

By now the European mink has completely disappeared in most European countries and its resources have been drastically decreasing in Russia. The total population size of the species on the North Russia does not exceed 19-21 thousand specimens. The data collected prove that the number decline of the European mink takes place independently of the presence of the American mink in the same area. Strong anthropogenic press on habitats of the species disturbing physical-chemical characteristics of the environment should be considered as the most important factors, which leads to its disappearance. The strategy of conserving the European mink should include well-organized accounting works, differential approach to hunting in the biotopes inhabited by semi-aquatic mammals, creating a net of reserves and intensifying research on biology of the species in zoos and fur farms.

Key words: European mink, resources, distribution, Russia.

INTRODUCTION

A decrease of number of the European mink became noticeable in 50-60s in Russia, when it because disappearing intensively at the borders of its area. In the second part of the 70s its resources decreased harshly through quite all the area of the species' distri-



bution. According to the results of analysis of the correspondent's data, the literature data and the expert's opinion, a reserve of species is not more than 30-32 thousands of animals in Russia at present. Thus, a sharp change of the European mink resources for the worse is maintaining, which has begun in the 50s in the Eastern part of its area, and only resolute death out in nature.

The strong anthropogenic affect to a place of residence of the European mink and a change of non biotical conditions with a violation of physical and chemical properties of environment providing the entire live cycle of development are important factors, determining the procedure of its elimination. A high level of using of natural resources, the building of line structure and the intensification of agriculture and forest complexes caused noticeable contradictions between measures, aimed to the nature protection and an increase of amount of production laying in various brunches.

METHODS

We have carried out the monitoring of the European mink during 35 years what allowed to follow the changes of the species range boundaries and periodically to evaluate the state of its resources (Tumanov and Ternovsky 1972, Tumanov and Zverev 1984, 1986, Tumanov 1992, 1996). The results of my own field investigations, carried out in different regions of Russia, of literature researches, of inquiries and questionnaire data (about 1,500), obtained from colleagues, hunters and departmental materials of the local hunting organizations, were used in the present work.

RESULTS

In Russia aboriginal mink begin intensively to disappear along the boundary of its range at the end of 50s and in 70s its resources drastically decreased already along the whole species distribution range. According to our expert estimation to the beginning of 80s on the territory of the former USSR its number does not exceed 40-45 thousands of individuals and its main resources were concentrated in the number of Central and Northern regions of Russia (Tumanov and Zverev 1984, 1986). An intensive worsening of the European mink's numbers and shrinkage of its range continues to be observed until the present time. Hence, only decisive means directed at its restoration can save the species from totally disappearing from nature within several decades.

What is the number of the European mink in Russia? The results of the analysis of the gathered materials in the main economic regions of the country, i.e. within the whole eastern range of the species, are given below.

North-Western and Northern Regions: The North-Western border of the European Mink's distribution in general always coincided with the administrative border between the Murmansky region and Karelia (Danilov and Tumanov 1976). However, to the present time in Karelia and

adjacent to it regions of Leningrad area it had already disappeared. The water bodies of Leningrad area are mainly inhabited by American mink. It appeared here due to the runners from the farms and dispersion of animals from Karelia, where the introduction of the species was carried out in 1962-1965.

The range of the European mink in the Leningrad area is constantly decreasing. If at the end of the 70-ies it inhabited here the area of 4.5 mln ha already to the beginning of 90-ies this territory diminished up to 2.0 mln ha and resources - from 3.0 –3.5 up to 1.0 – 1.3 thousands individuals.

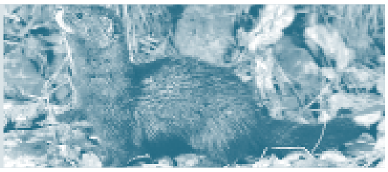
In the adjacent Pskov and Novgorod areas, in the basins of the rivers Velikaya, Shelon', Lovat', Polist', Msta considerable populations of European Mink are still remaining. According to the data of census of 2003 on some water bodies of the given territory the density of species population achieved 1.5 –2.2 individual per 10 km of the river and general resource comprises 2,700-3,000 minks. Unfortunately, according to the information available, practically in all regions of Pskov and Novgorod areas during the last years American mink had also dispersed.

In Arkhangelsk area and Komi Republic the European mink inhabits, mainly, the basins of rivers Onega, Pechera, Mezen' and Vychegda. In Komi Republic the density of species population comprises 0.5-0.7 individuals per 10 km of river, and the number – about 4,000 individuals. Although the population density of European mink is everywhere small, taking into account the length of the rivers, the species resources in Arkhangelsk territory we evaluate approximately in 7-8 thousands individuals.

In Vologda area the aboriginal mink occupies the rivers of Volga and North-Dvinsk water basins, where it density sometimes achieves 3-5 individuals per 10 km of the river. American mink here only started to penetrate into the Western regions of the area and during the last 10 years occupied it forth part. Nevertheless, the analysis of census data for 1982, 1987 and 1995 years has shown, that in this region the number of the European mink is at the comparatively stable level and its fluctuation correspond to the natural course of the population dynamics. In the last years the resources of the aboriginal mink in the area are fluctuating within the 3-4 thousands. Thus, its general resources within the North-Western and Northern boundaries of the range comprises at the moment not less than 19-21 thousands individuals.

Ural region: The major part of this territory is inhabited by American mink. In Bashkiriya, Udmurtiya and Sverdlovskaya areas the marks of occurrence of the aboriginal species are already not followed. In Chelyabinsk, Orenburg and Perm' areas it could be met singular (Kiseleva 1999, Rudi 1999). In Omskaya area attempts to find *Mustela lutreola* were unsuccessful. The last reliable case of its not intentional capture is referred here to 1984 (Malkova and Sidorov 1999, Sidorov 1999).

The territory of Volga: Practically all water bodies in the Volga region, suitable for habitat of the mink are occupied by the American species. In Tatarstan, Chuvashiya and Volgograd areas the aboriginal mink, apparently, has not remained and in Kuibyshev, Saratov and Ul'yanovsk areas could be met solitary animal.



North-Caucasian region: The southern boundary of the eastern part of the European mink's range is going along the territory of Fore Caucasus. Here lives the large and becoming everywhererare subspecies *M. lutreola turovi*. If in 20-30s Caucasian Mink was widely distributed within the given region, already to the beginning of 70s it has been considered to be the form under the threat of extinction. Particular noticeable the decrease of its number is taking place in the floating and steppe biotops and less intensively - in the forest -steppe and mountain-forest biotops. The center of the range of the aboriginal mink draws towards the western part of the North Caucasus and decreasing in the eastern direction.

On the territory of republics of Fore Caucasus the European mink is still meeting solitary along the tributaries of the river Terek. In Rostov area, Krasnodar and Stavropol' regions, along the basins of the rivers Kuban', Don, Severnyi Donetz, Kuma and others it also remained in the small number (Dr. A.M.Gineeva and Dr. A.M. Kudaktina pers. com.). The total number of the species in the region, apparently, does not exceed 1,000 individuals. Unfortunately, American mink in these places lives practically everywhere.

The central part of Russia: The territory of Central Russia and Volga-Byatka region is still has small resources of European mink. First of all this is referred to the rivers of Volga, Don and West-Dvina basins. However in many of these the representatives of the American species are markedly prevailing. For example, according to data of V.A. Kochanovsky (1999) in Tver' area computed number of American mink comprises 7,200 and European only 1,200 individuals. American mink intensively settled also and on the territories of Moscow, Tula, Kursk, Lipetzk and Orlov areas. Here the individuals of the aboriginal species are meeting solitary or in small groups. At the same time in Smolensk, Yaroslavl', Ivanov, Kostroma and Bryansk areas the European mink is rather common, though not numerous. Thus, according to the materials of our census (1995 and 1996) in Yaroslav area lives not less than 1,300-1,500 individuals, in Ivanovo area – 0.9 – 1.0, in Kostroma – 2.0-2.5 and in Smolensk areas – 1.2-1.5 thousands individuals. The number of this species is markedly lower (500 – 600 individuals) in Voronezh (Ryabov et al. 1991) and Bryansk areas (300 –400 individuals).

In Volgo-Vyatsk region the European mink is on the threshold of disappearing. In Kirov area its small groups live mainly on some water bodies (Cheptza, Muravlevka and others), relating to the basin of the river Vyatka (Saveljev and Skumatov 2001). In Nizhniy Novgorod area and Republic Mari-El it practically absent and main suitable for living water bodies are occupied by the American species. According to our expert estimation the resources of the European mink in the central part of Russia do not exceed at the present moment 7.5-9.0 and in general within the territory of the country - about 30,000-32,000 individuals.

Thus, the number of the European mink in the examined regions is constantly decreasing and the tendency towards the range reduction that started to show in the 50-60s nowadays is displaying very clearly. As and in previous years the main resources of the species are placed in the Northern and North-Western part of the European Russia and in some of its central regions

(Fig. 1). The comparative analysis of our data with the data, published earlier (Tumanov and Zverev 1984, 1986) have shown, that during the period of last 2 decades the range of the species decreased very markedly and its resources have fallen in average more than on 20%. All this gives rise to serious anxiety for the safety of the European mink in its natural habitats.

Conserving the way the situation turned up, the strategy of protection (to be more exact, saving) of the European mink must have an integrated character. It's necessary to base this principle on the terms of optimization of relations of nature protection, science, agriculture and hunt organizations.

It's essential to maintain settlements of the animal in its ranges, to stop tilling soil with erasing of bank plants in flood lands of rivers, floating of cut forest by rivers and throwing of agricultural waste down into watercourses.

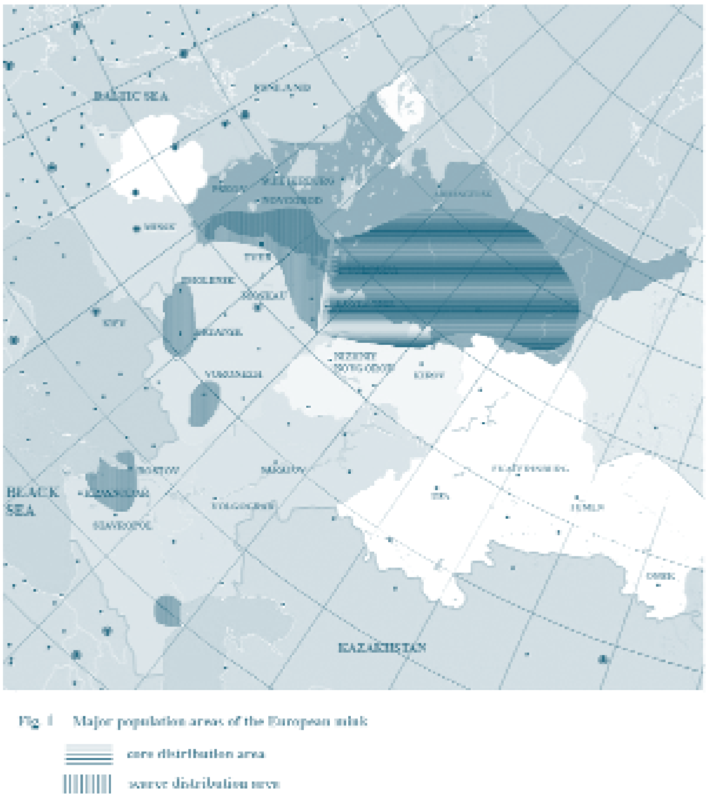
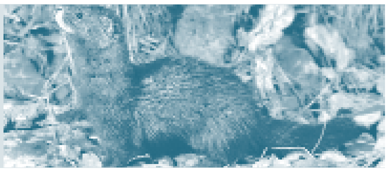


Figure 1. Major population areas of the European mink (core distribution area, scarce distribution area).

Figura 1. Principales areas de población de visón europeo en Rusia (area de distribución núcleo, area de distribución con escasos efectivos).



It's necessary in the nearest future to find opportunities of calculations holding for discovering a contemporary condition of the European mink resources and their placing in the European part of Russia.

After fixing its number and distribution through the range, it's necessary to start organization of measures for management of a resources potential of local populations. Variety of local terms and a level of engagement of ranges by the aboriginal species require an individual approach to dissolving of the problems of the European mink conservation security.

CONCLUSIONS

By now the European mink has completely disappeared in most European countries and its resources have been drastically decreasing in Russia. Its general resources within the North-Western and Northern boundaries of the range comprises at the moment not less than 19,000-21,000 thousands individuals. The data collected prove that the number decline of the European mink takes place independently of the presence of the American mink in the same area. Strong anthropogenic press on habitats of the species disturbing physical-chemical characteristics of the environment should be considered as the most important factors, which leads to its disappearance. The strategy of conserving the European mink should include well-organized accounting works, differential approach to hunting in the biotopes inhabited by semi-aquatic mammals, creating a net of reserves and intensifying research on biology of the species in zoos and fur farms.

ACKNOWLEDGEMENTS

We would like to thank the all colleagues for their assistance during the course of this study.

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[OTRAS COMUNICACIONES]

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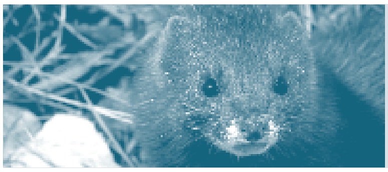


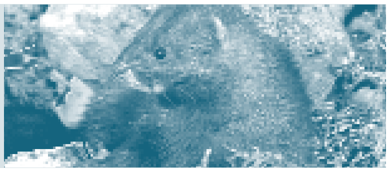
[European mink (*Mustela lutreola*) in russian scientific collections]

Alexei Abramov
(Zoological Institute Russian Academy of Sciences, Saint-Petersburg, Russia)

The European mink is one of most endangered European mustelids. Formerly it was widely distributed in Europe. Recently this species disappeared from most of European countries. Now a few small viable populations exist in Spain, France, Romania, and Byelorussia. The largest population there is in Russia. Up to 1950th *Mustela lutreola* inhabits all European part of former Soviet Union from western boundary up to the Urals and from Arkhangelsk Province to the Northern Caucasus. Recently the European has declined in numbers to the extent that its future survival is in doubt.

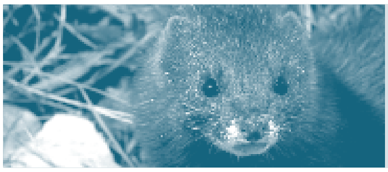
In this situation the scientific collections of this endangered species are very important. Scientific specimens in museums have been collected over large spatial and temporal scales so are invaluable in environmental research concerned with geographic and long-term patterns such as in conservation management. The Russian scientific museums and institutes have large collections of the European mink specimens from territory of former Soviet Union (Yakhontov, 1993; Abramov, 1994; Korablev, 1997). These collections house innumerable specimens collected over centuries. According to our preliminary data in Russian museums there are more then 300 specimens from a vast area collected during 1890-1999. Most of them origin from the Central and North-West parts of Russia. Preliminary assessment suggests that substantial collections also exist in Europe. Youngman (1982) studied 168 specimens from some European museums, most of them (145) from territories of France, Finland and Romania and only few specimens from other parts of Western and Central Europe. Nevertheless these specimens are very interesting because they originated from the populations which completely extinct.

The specimens are rich in information about life history, ecology, distribution, growth, and many other subjects. The museum specimens can be used to investigate spatial or temporal variation in growth, size-at-age, and many other subjects that provide general or specific information relevant to conservation and management. The modern molecular methods might be used for estimation of genetic variability of this endangered species and for databank of genetic information.



In recent years museum collections have been used increasingly for environmental studies because many collections are large and have been made over large geographic and temporal scales that cannot be addressed in short-term studies.

I propose to survey Russian and European scientific collections of European mink in detail and compile associated data. It is necessary to know what collections exist, how large they are, proportions of sexes present, and geographic and time periods represented. The creation of the united Register of European mink specimens stored in world collections is needfull.



[Cranial variation among three sympatric mustelids in North-west of Russia]

ALEXEI ABRAMOV & IGOR L. TUMANOV
(Saint-Petersburg, Russia)

INTRODUCTION

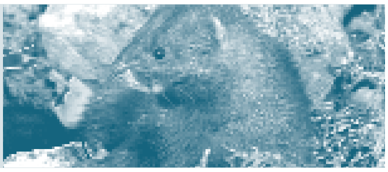
Three close relative species of semi-aquatic mustelids occur in the European part of Russia: the European mink *Mustela lutreola* (EM), the European polecat *M. putorius* (EP) and the American mink *Neovison vison* (AM). EM and EP are indigenous species and AM is an introduced one. The diets of these species are partly overlap as well as ecological niches. Sometimes an interspecific competition between EP and AM with EM is thought to cause of declining of EM populations. Morphological differences among sympatric animal species often been taken as evidence for competition.

MATERIALS AND METHODS

A morphometric variation in 22 cranial characters of 86 EM, 130 EP and 110 AM from the NW part of Russia (Leningrad, Pskov and Novgorod provinces) has been analysed. The specimens examined are kept at the Zoological Institute Russian Academy of Sciences (Saint-Petersburg, Russia), and in the collection of Dr. I. Tumanov (Saint-Petersburg). Only adult specimens were studied. Multivariate statistical techniques were used to examine craniometric variation. We studied inter- and intraspecific relationships simultaneously, viewing each sex as a separate morphospecies.

RESULTS AND DISCUSSION

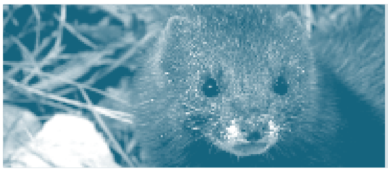
Cranial sizes differed and were fairly evenly spaced between species and sexes within a set of these mustelid species. The female EP, male and female EM form the same-sized group, and male EP and male and female AM form another group. The morphological variability of cranial characters in AM is larger than that in EP and the EM. A degree of sexual size dimorphism of EM is less than that of EP or AM. It is likely that the relative size similarity of the sexes in this popula-



tion of EM can be explained by a higher food specialization as compared to other sympatric small mustelids (EP, AM) and narrowness of its ecological niche conditioned by the riparian specialization of EM. Behavioural studies demonstrated that EP and AM have noticeably more aggressive interpersonal relations than the EM. This difference in the social behaviour might be a possible reason for EM to be less sexually dimorphic than EP and/or AM. We can find no evidence for the presence or absence of AM or EP correlating with changes in size or sexual dimorphism in EM. But we caution that narrow temporal sample sizes may mask any pattern or trend.

The studied mustelids comprise a set of related predators with similar body size and hunting strategies, and similar occupied habitats. It is suggested that the difference in sizes of sympatric carnivore species is supporting the resources partitioning theory. But EP and AM is more similar in sizes, so they must have stronger competition for food in the same biotopes, then AM and/or EP and EM. In this case the density of population of EP and AM must be correlated. We investigated the character displacement in same mustelid guild from Western Siberia – AM, *Mustela eversmanii* and *M. sibirica*. Anyway no any evidences about the declining of populations of Siberian weasel or steppe polecat in these habitats after appearing of AM.

The obtained data on difference in morphological variability of AM, EP and EM can testify to different degree of plasticity these species. Probably, EM has appeared is unfit to adapt to changed environments, and that is reason of declining of its populations. At the same time more ductile AM has occupied liberated territory.



[The control of the feral American mink (*Mustela vison*) population of South-western France : Methodology and preliminary results]

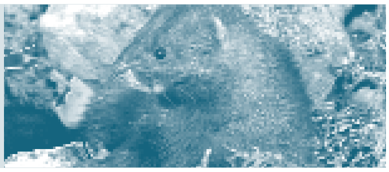
Pierre Barrault[1], Pascal Arlot[2], Fabrice Crabos[3], Yan Ducournau[4], Alain Girard[5], Laurent Joubert[6], Jean-Paul Laborde[7], Robert Mozzi[8], Jean-Jacques Lalanne[9], François Sabathé[10], Serge Trichet[11], and Pascal Fournier[1,12]

[1]GREGE, Route de Préchac, F-33730 Villandraut, [2]Espaces Naturels d'Aquitaine, F-64000 Pau, [3]Conseil général des Landes, F-40000 Mont-de-Marsan, [4]Conseil général du Gers, F-32022 Auch, [5]Office National de la Chasse et de la Faune Sauvage, Service départemental de Lot-et-Garonne, F-47160 Damazan, [6]Réserve Naturelle de l'Etang de la Mazière, SEPANLOG, F-47400 Villeton, [7]Fédération départementale des chasseurs des Landes, F-40104 Dax, [8]Office National de la Chasse et de la Faune Sauvage, Service départemental du Gers, F-32550 Pavie, [9]Office National de la Chasse et de la Faune Sauvage, Service départemental des Landes, F-40990 Saint-Paul-les-Dax, [10]Fédération départementale des chasseurs du Gers, F-32000 Auch, [11]Association départementale des piégeurs de Lot-et-Garonne, F-47410 Lauzun, [12]Corresponding author (email: pfournier@wanadoo.fr)

One of the main actions of the French conservation action plan for the European mink (*Mustela lutreola*) is the control of the feral American mink (*Mustela vison*) population of south-western France, that largely overlaps the distribution of the European mink.

The framework of this program is: (1) Organising and supervising a network of trained trappers in charge of standardised trapping campaigns (2) Controlling the American mink population by sterilising the individuals before release.

Sterilisation, by vasectomy or ligature of Fallopian tubes, has several advantages compared to the destruction of the animals: (1) Territorial and sexual behaviour of the individuals are maintained, limiting the settlement of new individuals. Moreover sterilised males can preclude the reproduction of non-sterilized females by provoking their ovulation. (2) Tagging the animals with a transponder should allow to estimate the population size by capture-recapture modelling and so to survey the efficiency of the control. (3) Recaptures should avoid the loss of trappers' motivation, generally observed when captures become rare.

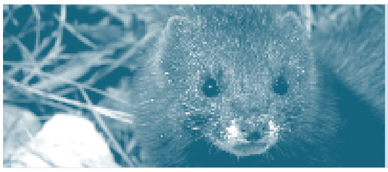


The program was first conducted in the Landes department in 2001-2002, and was extended to the Gers and Lot-et-Garonne in 2002-2003. About 240 voluntary trappers integrated the network. Hundred and thirty-five campaigns of 100 trap-nights (10 traps installed for 10 consecutives nights on 5-10 km of rivers) were carried out in 2001-2002, and 350 in 2002-2003. Eighty eight data related to 84 different individuals were collected, including 44 captures during standardised operations, other data came from animals captured or killed during pest control, or found dead in nature. Eight of the 62 alive animals were positive for antibodies to Aleutian mink disease parvovirus and were euthanized; the 53 others were released after sterilisation.

These preliminary results show that organising an extent network was possible, the pest trappers were very interested in participating in the conservation of the European mink. However capture rates were relatively low, partly because the trappers were unpractised with this species. The efficiency of the control should be improved by a greater field training of the trappers.

According to its geographical distribution the French south-western American mink population reveals a big colonizing potential, confirming that intensifying control is urgent to preserve the European mink area.

Key-words: American mink, control, France, *Mustela vison*, population, sterilisation.



[Genetic variability of the west population of European mink (*Mustela lutreola*) based on mtDNA control region sequence data]

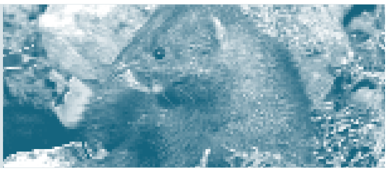
Cabria, M.T.[1], Rubines, J.[1], Zardoya, R.[2], Gómez-Moliner, B.J.[1]

[1]Department of Zoology and D.C.A. Facultad de Farmacia, Universidad del País Vasco. C/ Paseo de la Universidad, 7. 01006 Vitoria. Spain. EM: ggpgomob@vc.ehu.es

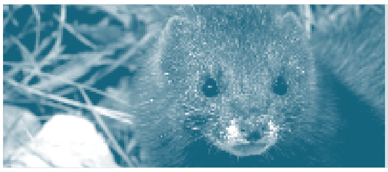
[2]Department of Biodiversity and Evolutionary Biology. Museo Nacional de Ciencias Naturales (CSIC). C/ José Gutiérrez Abascal, 2. 28006 Madrid. Spain.
EM: mcnrz560@mncn.csic.es

Ever since the first report of European mink in the Iberian Peninsula in 1951, the origin of the Iberian populations has been controversial. The origin could be recent, whether by a rapid expansion from the southernmost populations of France, or by human introduction. Nevertheless, an ancient origin cannot be rejected with current evidence. The similiarity of European mink and the polecat, *M. putorius* could have maintained its presence undetected until the last century. A recent study (Michaux et al., 2003. Biol. Conservation, in press) based on mitochondrial control region and cytochrome b sequence data revealed low genetic variation in the west population of European minks and apparently no geographic structure. However, in this study most samples were from west France and only four specimens were from the Iberian Peninsula.

Here, we present mitochondrial control region sequence data from samples that cover the whole distribution range of European minks in the Iberian Peninsula. The aim of this study is to determine genetic variability of European mink populations in the Iberian Peninsula and compare it with that reported for french populations. DNA was extracted from hair (with a standard phenol/chloroform method), from faeces (with silica) or from muscle and liver (with CTAB). Two fragments of the mitochondrial control region were amplified by PCR with the primers L15774 and H16498 (Shields and Kocher 1991. Evolution 45: 218). The largest fragment (600 bp) was cloned and sequenced. Standard genetic population parameters were estimated for the Iberian populations of European mink. A phylogenetic analysis of the analyzed samples was also performed.



Samples were provided mainly by LIFE projects: "Conservación del visón europeo (*Mustela lutreola*) en La Rioja" LIFE 00/NAT/E7331, "Álava" LIFE 00/NAT/E7335 y "Castilla León" LIFE 00/NAT/E7229. Samples from Navarra were provided by S. Palazón. Samples from Bizkaia are from J. R. Ahiartza, I. Garin, J. Zabala, and I. Zuberogoitia. The sample from Gipuzkoa is from J.González. Other samples were provided by the Museo de Ciencias Naturales of Alava.



[The european mink (*Mustela lutreola*) population's evolution in Álava and the mink conservation LIFE-Environment Programme]

EVOLUCIÓN DE LA POBLACIÓN DEL VISÓN EUROPEO (*Mustela lutreola*) EN ÁLAVA Y PROYECTO LIFE-NATURALEZA DE CONSERVACIÓN DEL VISÓN

Servicio de Conservación de la Naturaleza. Diputación Foral de Álava

- Síntesis de la evolución de los datos de la población de la especie en Álava desde los años 50 a la actualidad.

Primeros datos en los alrededores de Vitoria-Gasteiz en el río Zadorra y afluentes. Datos en la Llanada Alavesa en los años 80. Extensión al Ebro en los años 90. Constancia del visón europeo en todo el Territorio de Álava en el año 2001. Población de visón americano e incidencia con el visón europeo.

- Proyecto Life-Naturaleza de Conservación del Visón Europeo (Mustela lutreola) en Álava.

Aprobado por la Comisión Europea el 5 de julio de 2001.

Período de ejecución en el período 2001-2004.

Presupuesto: 383 025 euros (63 730 000 pta)

Financiación: 50 % Comisión Europea; 25 % Ministerio de Medio Ambiente; 25 % Diputación Foral de Álava

PRINCIPALES AMENAZAS SOBRE LA ESPECIE

Actuaciones previstas

Redacción y aprobación del Plan de Gestión del visón europeo

Chequeo periódico de la población en Álava.

Joseba Carreras de Bergaretxe, Mónica Soto del Río, África López de Ipiña, Javier Pinedo

Nature Conservation Service. Alava Provincial Government.

– Synthesis of the evolution of population data for the species in Alava from the 1950s to today.

First data collected near Vitoria-Gasteiz on the Zadorra river and affluents. Data from La Llanada Alavesa in the 1980s. Expansion to the Ebro in the 1990s. Confirmation of the presence of European Mink throughout Alava in 2001. American Mink population and its effect on the European Mink.

– LIFE-Nature project for the Preservation of the European Mink (Mustela lutreola) in Alava.

Approved by the European Commission on 5 July 2001.

Implementation period: 2001-2004.

Budget: 383,025 euros.

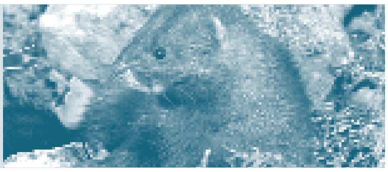
Financing: 50% European Commission; 25% Spanish Ministry of the Environment; 25% Alava Provincial Government.

MAIN THREATS TO THE SPECIES

Actions Anticipated.

Drafting and Approval of the Management Plan for the European Mink.

Periodic checks on the population in Alava.



Monitoring of European Mink specimens using radio-tracking techniques to increase the understanding of its population structure, habitat use, diseases, etc.

Eradication of feral populations of American Mink.

Acquisition of islands and copses on the Ebro river of particular importance for the reproduction of the European Mink.

Habitat regeneration actions in river SCIs related to the European Mink.

Dissemination programmes on the species, its threats and the actions of the various public administrations aimed at its preservation.

CHANGES IN THE PLANNED ACTIONS WITHIN THE LIFE PROJECT

In view of the major threat posed by the feral population of the American Mink in Alava, more funds will be allocated to the eradication of this species.

Also, with the European Mink Captive Breeding Project in place, funds will be diverted to contribute to a genetic survey of the European Mink and sub-populations in Spain, France and Eastern Europe (mainly Russia and Romania)

The funds derive from actions B and C (acquisition of land and restoration of river banks). An agreement has been reached between the Alava Provincial Government and the Water General Directorate of the Basque Government, to the effect that the purchase of copses and islands on the Ebro river and their restoration will be taken care of by the Water Directorate, using its own funds.

Monitoreo con radio seguimiento de ejemplares de visón europeo para el conocimiento de su estructura poblacional, utilización del hábitat, afecciones,..

Erradicación de las poblaciones asilvestradas de visón americano

Compra de islas y sotos de importancia para la reproducción del visón europeo, en el río Ebro

Actuaciones de regeneración del hábitat en los LIC fluviales relacionados con el visón europeo.

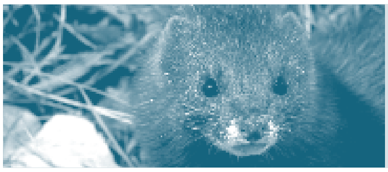
Programas de divulgación sobre la especie, sus amenazas y las actuaciones de las distintas administraciones en su conservación.

CAMBIOS EN LAS ACTUACIONES PREVISTAS EN EL PROYECTO LIFE

Debido a la gran amenaza que supone la población asilvestrada del visón americano en Álava, se van a dedicar más fondos para el descaste de esta especie.

Igualmente, estando en marcha el Proyecto de Cría en Cautividad del visón europeo, se van a desviar fondos para contribuir en el estudio genético del visón europeo y de las subpoblaciones de España, Francia y Europa del Este (Rusia y Rumania principalmente)

Estos fondos provienen de las actuaciones B y C (compra de terrenos y restauración de riberas). Por acuerdo entre la Diputación Foral de Álava y la Dirección General de Aguas del Gobierno Vasco, la compra de sotos e islas del Ebro y su restauración las asumirá la Dirección de Aguas con fondos propios.



[Substitution of the European mink (*Mustela lutreola*) for the American mink (*Mustela vison*) in the Zadorra river basin (Basque country, Spain)]

SUSTITUCIÓN DEL VISÓN EUROPEO (*Mustela lutreola*) POR EL VISÓN AMERICANO (*Mustela vison*) EN LA CUENCA DEL RÍO ZADORRA (PAÍS VASCO, ESPAÑA)

El río Zadorra se sitúa en la margen izquierda de la cuenca alta del Ebro. Se conoce la presencia regular del Visón Europeo en su cuenca desde los años 50 del siglo XX (RODRIGUEZ DE ONDARRA, 1955), habiendo sido citado desde entonces frecuentemente, en especial en su tramo central. A comienzos de los años 90 se obtienen citas de Visón Americano en libertad, procedentes de escapes producidos en pequeñas granjas peleteras instaladas en la zona. A mediados de los años 90, el Visón Americano constituye un núcleo estable de población en el Zadorra, centrado en el Municipio de Vitoria-Gasteiz; coincidiendo con este proceso, en el año 2000 el Visón Europeo desaparece del tramo central de este río (CEÑA, A. et al. 2001).

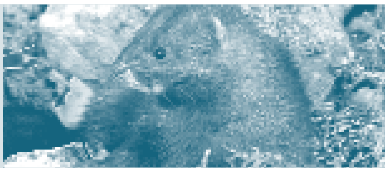
En 2001 la Diputación Foral de Álava puso en marcha un Proyecto LIFE destinado a la conservación del Visón Europeo, en el que el control del Visón Americano supone la actuación más importante. Para este fin, se está empleando un método que consiste en el trampeo continuado de todas las riberas fluviales mediante jaulas-trampa 'de vida', seguido del sacrificio de los Visones Americanos colectados, utilizando métodos incruentos; el trabajo se lleva a cabo por parte de la Guardería Forestal y el concurso de técnicos especialistas. Paralelamente, se efectúa el control de los ejemplares de Visón Europeo presentes en la cuenca, mediante su captura periódica y marcaje; en un área relicta,

JOSEBA CARRERAS DE BERGARETXE, JAVIER LÓPEZ DE LUZURIAGA, Mª ASUNCIÓN GÓMEZ, ALFONSO CEÑA, JAVIER PINEDO, LUIS LOBO AND JUAN CARLOS CEÑA.

The Zadorra flows on the left side of the upper Ebro basin. The presence of European Mink was detected regularly in this basin since the 1950s (RODRIGUEZ DE ONDARRA, 1955), and has been quoted frequently since then, particularly in its central area. At the beginning of the 1990s, specimens of feral American Mink were detected, owing to their escape from fur farms in the area. In the mid-1990s, the American Mink constituted a stable population group in the Zadorra, mainly within the Municipality of Vitoria-Gasteiz; coinciding with this process, in 2000 the European Mink disappeared from the central stretch of this river (CEÑA, A. et al. 2001).

In 2001 the Alava Provincial Government instituted a LIFE project for the preservation of the European Mink. The most important action within this project is the control of the American Mink population. To this purpose, continuous trapping is being carried out in all river banks, using "live" cage traps, followed by the slaughter of captured American Minks with humane methods. The work is carried out by the Forestry Service together with specialists. At the same time, the specimens of European Mink present in the basin are monitored through periodic capture and marking actions. In a remote area near the source of the river various native specimens are being monitored using radio-tracking methods to ascertain their response to the invasion of American Mink.

Within this framework, the intensive trapping campaigns carried out in the Zadorra basin in 2001 and 2003 have confirmed a



strong expansion of the American Mink population to the detriment of the European Mink. During the last year, over 80 specimens American Mink were removed, which represent a significant part of the population. Currently, this species occupies the entire Zadorra river basin and has reached the Ebro. In the autumn of 2003 the average density calculated from captures was more than 12 specimens/10 km. This figure doubles the concentration of European Mink in its densest areas in Spain (CEÑA J.C. et al 2003).

The population of European Mink is reduced to a few isolated specimens at the source and at the mouth of the river, as well as in some affluent creeks (Ayuda, Alegría), areas where the populations of American Mink are less dense. Not a single specimen of European Mink has been trapped in the middle part of the river, where they use to be quite common a few years ago.

In the control area monitored (Alegría River - Salburua Marshes), the males of the European Mink have managed to coexist with the populations of American Mink (which are trapped) at low densities. The females disappeared quickly after the arrival of the foreign species and the settlement in the area of a breeding group (2002). In 2000-01, there were at least 2 males and 5 females of European Mink in the area. In 2001-02, the minimum of 2 males and 5 females remained, but in 2002-03 there were only 2-3 males. The females are more sensitive and more difficult to recover if total eradication of American Mink is not achieved.

Survey carried out within the framework of a LIFE project for the Preservation of the European Mink in Alava (00NAT/E/7335), Alava Provincial Government.

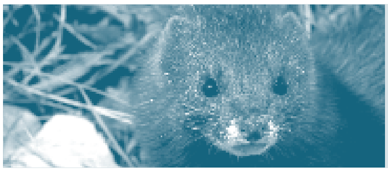
situada en la cabecera, se ha realizado el radio-seguimiento de varios ejemplares de la especie autóctona para conocer su respuesta frente a la invasión del Visón Americano.

En este marco, las campañas de trampeo intensivo desarrolladas en la cuenca del Zadorra durante los años 2001 a 2003 han constatado una fuerte expansión del Visón Americano en detrimento del Visón Europeo. En el último año se han extraído más de 80 ejemplares de Visón Americano, lo que supone una parte significativa de la población. En la actualidad, esta especie ocupa toda la cuenca del río, habiendo llegado al curso del Ebro. En otoño de 2003, su densidad media, obtenida mediante capturas, fue superior a los 12 ejemplares/10 km.: este valor es el doble del que presenta el Visón Europeo en sus mejores áreas de presencia en España (CEÑA J.C. et al 2003).

La población de Europeo se reduce a la presencia de unos pocos ejemplares aislados en los sectores de cabecera y curso bajo, además de algunos arroyos afluentes (Ayuda, Alegría), zonas estas en las que las poblaciones de Visón Americano son menos densas; no se ha colectado ni un solo ejemplar de Visón Europeo en todo el tramo medio del río, donde hace unos años era frecuente.

En el área-testigo monitorizada (Río Alegría-Humedales de Salburua), los machos de Visón Europeo han soportado la convivencia con poblaciones de Visón Americano (que son objeto de trampeo) en baja densidad; las hembras desaparecieron con rapidez, tras la llegada de ejemplares de la especie alóctona y el asentamiento en la zona de un grupo reproductor (2002). En 2000-01, existían en este área al menos 2 machos y 5 hembras de Visón Europeo; en 2001-02, se mantenía un mínimo de 2 machos y 5 hembras, pero ya en 2002-03 sólo quedan 2-3 machos. Las hembras son el segmento de población más sensible y posiblemente el más difícil de recuperar en caso de no conseguirse la erradicación total del Visón Americano.

Estudio realizado en el marco del Proyecto-LIFE de Conservación del Visón Europeo en Álava (00NAT/E/7335), Diputación Foral de Álava.



[Comments to the European mink study through signs of presence, trapping and molecular genetics techniques]

COMENTARIOS AL ESTUDIO DEL VISÓN EUROPEO MEDIANTE INDICIOS DE PRESENCIA, TRAMPEO Y TÉCNICAS DE GENÉTICA MOLECULAR

El estudio de una especie requiere siempre de un debate constructivo con vistas a una gestión óptima de sus poblaciones, y más si cabe en el caso de animales en peligro de extinción como es el caso del Visón Europeo Mustela lutreola (Linnaeus 1761).

Los indicios de presencia (excrementos, huellas de pisadas y otros) pueden aportar una información previa, de gran utilidad en la localización en el campo de algunas especies; como es el caso de los visones. Es bien conocido que los excrementos de Visón Americano (Mustela vison Schreber, 1777) son fáciles de hallar, depositándolos muchas veces en letrinas (reconocibles sin dificultad); lo que ha permitido desarrollar estudios de distribución de la especie abarcando grandes áreas (por ejemplo, Bueno y Bravo 1990). En el Visón Europeo, sin embargo, nunca se le ha observado este comportamiento en España, ni se ha demostrado que lo manifieste en otros países europeos. Bien al contrario, según nuestra experiencia, sus heces se hallan en muy bajo número incluso en áreas de alta densidad poblacional.

Esta peculiaridad (junto con otros indicios) ha permitido delimitar rápida y correctamente las áreas de distribución de ambas especies en el Municipio de Vitoria-Gasteiz (Ceña et al. 2003), y convierte en muy dudosa la utilidad generalizada, en el estudio de la distribución del Visón Europeo, de las técnicas moleculares sobre heces señaladas por Gómez-Moliner et al. (2003). El método de obtención de pelos en teóricas trampas de pelos (en la frontera entre

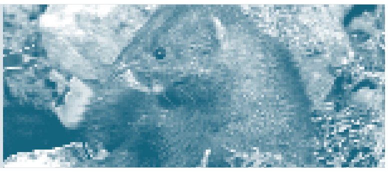
ALFONSO CEÑA MARTÍNEZ.

The study of a species always requires constructive debate with a view to achieving an optimal management of its populations, and this is even more so in the case of endangered species, such as the European Mink (*Mustela lutreola*, Linnaeus 1761).

The signs of presence (scats, paw prints and other indicators) can provide a priori information which may be very useful in locating some species in the field, and such is the case with minks. It is well known that the scats of the American Mink (*Mustela vison* Schreber, 1777) are easy to find, as they are often deposited in latrines (easy to recognise). This has allowed for distribution surveys of the species covering large areas (for example, Bueno and Bravo 1990). However, the European Mink has never shown this behaviour in Spain, nor has it been known to occur in other European countries. On the contrary, from our experience, European Mink droppings are noticeably low in number, even in areas of high population density.

This peculiarity (together with other signs) has made it easy to quickly and accurately delimit distribution areas for both species in the Municipality of Vitoria-Gasteiz (Ceña et al. 2003), and casts serious doubts upon the general usefulness of using the molecular techniques on excrements indicated by Gómez-Moliner et al. (2003) in the study of the distribution of the European Mink. The method of obtaining hairs in theoretical hair traps (on the border between invasive and non-invasive methods) is yet to be properly defined.

The usefulness of trapping using cage traps has been repeatedly demonstrated and allows, among other things, to see the subject animal and unequivocally collect its droppings (in the cage) which



can be used in basic biosanitary and diet studies. Capturing specimens is essential to appreciate phenotypical traits, which are the basis for taxonomy, and to carry out a specific (or hybrid) assignation, apart from the fact that molecular techniques used to seek certain sequences of nitrogenated bases in problem samples are extremely useful in corroborating classifications. The use of cage traps also allows for radio tracking, which provides essential and irreplaceable information for animal management.

Depending on the species under study and on the goal sought, a method can be valid or not. Vilá and Ayuso (2002) defend population monitoring using genetic methods for Wolves, a species difficult to capture which lives in family groupings that implement precise territorial markings. The European Mink, on the other hand, has a biology in many aspects opposite to that of the Wolf. Because of this, its study using molecular genetics has to be limited to purely genetic characteristics, as it would be much less efficient than a combination of trapping and radio tracking.

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los métodos invasivos y no invasivos) está también por definir.

El trampeo mediante jaulas-trampa presenta una utilidad demostrada repetidamente y permite, entre otras cosas, ver al animal objeto de estudio y recoger inequívocamente sus heces (en su propia jaula), que se usarán en estudios básicos como biosanitarios y de dieta. La captura del ejemplar resulta fundamental para apreciar sus caracteres fenotípicos, que son la base de la taxonomía, y realizar una asignación específica (o híbrida); independientemente de que la aplicación de técnicas moleculares, en base a la búsqueda de determinadas secuencias de bases nitrogenadas en muestras-problema, sea de gran utilidad para corroborar la clasificación realizada. El uso de jaulas trampa posibilita, además, el desarrollo del radioseguimiento, que aporta una información imprescindible e insustituible para la gestión de la fauna.

Dependiendo de la especie de estudio y del objetivo perseguido, todo método puede o no ser válido. Vilá y Ayuso (2002) defienden el seguimiento poblacional con métodos genéticos del Lobo, especie difícil de capturar y que vive en grupos familiares que efectúan un nítido marcaje territorial. El Visón Europeo, por el contrario, tiene una biología en muchos aspectos opuesta a la del Lobo. Por ello, su estudio por métodos de genética molecular debe limitarse a aspectos púramente genéticos, ya que podría resultar mucho menos eficaz que la combinación de trampeo y radioseguimiento.

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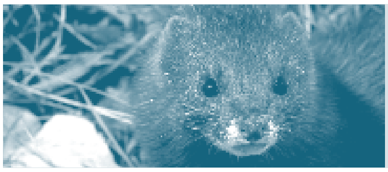


[Use of a combined method (intensive trapping-radio tracking) for the study of the European mink in the Najerilla river (Spain)]

ALFONSO CEÑA AND JUAN CARLOS CEÑA.

During the period 2001-2003 four trapping campaigns were carried out using live animal cage traps on a 17 km stretch starting from the mouth of the Najerilla river (La Rioja, Spain) at the Ebro river. Through the intensive use of trap stations (100 traps/day and 50 traps/day) most of the area under study was covered, with traps distributed at 100 metre intervals in order to catch all the European Minks (*Mustela lutreola*, Linnaeus 1761) that inhabit the area.

The specimens captured were subjected to a biosanitary check and individually identified with ear tags and subcutaneous microchips. A significant number were also fitted with long-life (14 months) intraperitoneal transmitters for continuous monitoring of their activities.

The trapping operations revealed a very favourable sex-ratio for females and allowed us to extrapolate a minimum mink density for the area. In addition, the capture-recapture method used to estimate the population density allowed us to come up with a figure that was very close to real density and, by comparing it with trapping successes, we were able to define a reliable ratio between trapping successes and real density —of great importance for large-scale population surveys. Monitoring over a period of several years allowed us to confirm that the method is innocuous for the population. Among the aspects of interest studied are the definition of two sub-areas of different density within the district surveyed and questions regarding reproduction and mortality.

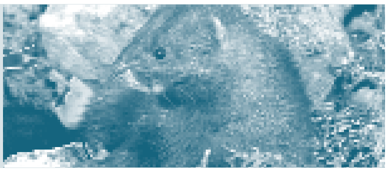
Radio tracking helped, among other things, to determine the use made by the European Mink of the area under study. A clear

USO DE UN MÉTODO COMBINADO (TRAMPEO INTENSIVO-RADIO SEGUIMIENTO) PARA EL ESTUDIO DEL VISÓN EUROPEO EN EL RÍO NAJERILLA (ESPAÑA)

Durante los años 2001-2003 se realizaron cuatro tandas de trampeo, mediante jaulas-trampa "de vivo", en los 17 km. finales del río Najerilla (La Rioja, España), antes de su confluencia en el río Ebro. Mediante un uso intensivo de estaciones de trampeo (de 100 trampas-jornada y 50 trampas-jornada) se cubrió la gran mayoría del área de estudio, distribuyendo las trampas con un intervalo de 100 metros, con el objeto de capturar la totalidad de Visones Europeos Mustela lutreola (Linnaeus 1761) que la habitaban.

A los ejemplares capturados se les sometió a un chequeo biosanitario, y se les individualizó mediante chapas en orejas y chips subcutáneos. Un número importante de ellos fueron provistos también de emisores intraperitoneales de larga duración (14 meses), para efectuar el seguimiento continuo de sus actividades.

El trampeo descubrió una sex-ratio muy favorable a las hembras y permitió obtener una densidad mínima de Visones presentes en el área. Además, por el método de captura-recaptura se estimó la densidad poblacional real, que resultó muy próxima a la El radioseguimiento definió, entre otras cosas, el uso del área de estudio realizado por el Visón Europeo. Apreciándose una nítida territoriali-



territoriality was found, so that each female and each male (the territory of a male includes 2-5 females) are found to live in a stretch of the river that does not overlap with the territories of other specimens of the same sex. Since the specimens captured covered a large part of the area under study, we can conclude that the number of territorial specimens not captured must be very small.

In view of the population of European Mink found compared to other river basins in the Iberian Peninsula, this area clearly represents an optimal habitat for the species which it would be highly advisable to preserve in order to prevent the species from becoming extinct.

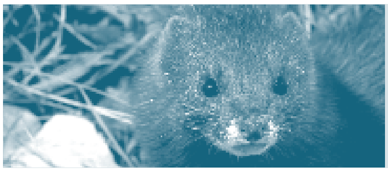
(1) Survey carried out within the framework of the LIFE project "Preservation of the European Mink in La Rioja" (00NAT/E/7331).

dad, de tal manera que cada hembra y cada macho (el territorio de un macho engloba a los de 2-5 hembras) vivieron en una porción del río no solapante con la del resto de ejemplares de su mismo sexo. Como los ejemplares capturados cubrieron de este modo gran parte del área de estudio, se concluye que el número de ejemplares territoriales no capturados presentes en el área, debe ser muy pequeño.

densidad real y, al cotejarla con el éxito de captura obtenido en el trampeo, definió una relación fiable entre éxito de captura y densidad real, de gran utilidad en estudios poblacionales a gran escala. El seguimiento durante varios años permitió comprobar que el método resulta inocuo para la población. Aspectos de interés estudiados fueron, entre otros, la definición de dos zonas de distinta densidad en el área de estudio y cuestiones reproductivas o de mortalidad.

población de Visón Europeo en comparación con otras cuencas fluviales estudiadas en el Península Ibérica, por lo que debe representar un hábitat óptimo para la especie que sería muy necesario preservar de cara a evitar su extinción.

(1) Estudio realizado en el marco del Proyecto-LIFE de "Conservación del Visón Europeo en La Rioja" (00NAT/E/7331).



[European mink (*Mustela lutreola*) and American mink (*Mustela vison*)[1] foot sole character]

CARACTERES DE LA PLANTA DEL PIE DEL VISÓN EUROPEO (*Mustela lutreola*) Y EL VISÓN AMERICANO (*Mustela vison*)

Se analizaron 65 ejemplares de Visón Europeo Mustela lutreola (Linnaeus, 1761) (procedentes de La Rioja, Álava, Burgos y Navarra), 89 de Visón Americano Mustela vison Schreber, 1777 (de procedencia Álava, Burgos y La Rioja) y un híbrido entre Visón Europeo y Turón Europeo (Álava). En la planta del pie de una pata posterior y otra anterior se midieron hasta un total de 18 variables, y se apreciaron de visu otros caracteres como desarrollo de pilosidad y existencia de malformaciones (dedos girados). Además, se anotó para cada ejemplar: sexo, edad estimada, peso y longitud total.

Por comparación fueron estudiados, también, los caracteres de la planta del pie de otros 37 pequeños carnívoros: Turón (12), Comadreja (5), Garduña (5), Armiño (4), Gato Montés (3), Gineta (3), Marta (2), Hurón (2) y Nutria (1).

Se definió el modelo de planta del pie (diseño y tamaño) de los visones Europeo y Americano, que resultó ser característico y prácticamente idéntico entre sí; a pesar de que el Visón Americano tiene un tamaño corporal notablemente mayor que el Europeo. Se consideró de interés práctico, en el estudio de las huellas de pisadas de los visones, una medida determinada de la longitud de la planta del pie. Para esta medida, los Visones Europeos alcanzaron un valor medio de 25,5

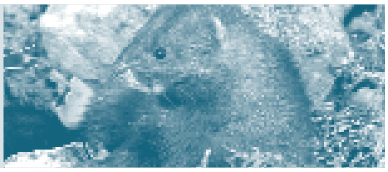
ALFONSO CEÑA AND J. CARLOS CEÑA.

65 specimens of European Mink (*Mustela lutreola*, Linnaeus, 1761) were analysed —from La Rioja, Alava, Burgos and Navarre— 89 specimens of American Mink (*Mustela vison*, Schreber, 1777) —Alava, Burgos and La Rioja— and a hybrid between the European Mink and the European Polecat (Alava). A total of 18 variables were measured in the soles of a forepaw and a hind paw of each specimen. Other traits were also observed de visu such as the development of hairiness and the existence of malformations (turned toes). In addition, the following data were collected for each specimen: gender, estimated age, weight and total length.

For comparison purposes, the characteristics of the foot sole were also studied in 37 small carnivores: Polecat (12), Weasel (5), Beech Marten (5), Stoat (4), Wildcat (3), Genet (3), Pine Marten (2), Ferret (2) and Otter (1).

A model for the foot sole (form and size) was defined for both the European and American Minks, which turned out to be characteristic and practically identical, despite the fact that the American Mink is considerably larger than the European Mink. Of practical interest in the study of paw prints is the total length of the paw: the European Minks had an average length of 25.5 mm and the American Minks of 26.1 mm; the hypothesis of equal lengths for both species being significantly rejected (σ = 0.01). In addition, the values for this variable are 4 mm higher in males than females for both species, a difference which is statistically very significant.

The conclusions of the joint analysis of this and other measurements with the sex, weight and total length variables resulted in



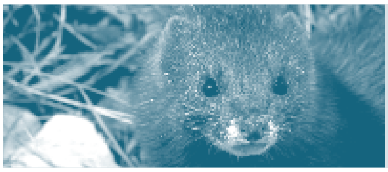
both theoretical and practical usefulness for intersexual studies and interspecies studies of carcasses and signs of presence.

(1) Survey carried out within the framework of the coordinated LIFE projects for the Preservation of the European Mink in La Rioja (00NAT/E/7331), Alava (00NAT/E/7335) and Castilla-León (00NAT/E/7299).

mm. y los Visones Americanos de 26,1 mm.; rechazándose muy significativamente (∂ = 0,01) la hipótesis de la igualdad de medias en ambas especies. Además en ambas especies los valores para esta medida son 4 mm mayores en machos que en hembras, diferencia estadísticamente muy significativa.

Las conclusiones del análisis conjunto de ésta y otras medidas con las variables sexo, peso y longitud total, resultaron de utilidad teórica y práctica en el estudio intersexual e interespecífico de carcasas e indicios de presencia.

(1) Estudio realizado en el marco de los Proyectos-LIFE coordinados de Conservación del Visón Europeo en La Rioja (00NAT/E/7331), Álava (00NAT/E/7335) y Castilla y León (00NAT/E/7299).



[Use of space and population composition of the European mink (*Mustela lutreola*) in the upper Ebro river basin (Spain)[1]]

USO DEL ESPACIO Y COMPOSICIÓN DE LA POBLACIÓN DE VISÓN EUROPEO (*Mustela lutreola*) EN LA CUENCA ALTA DEL RÍO EBRO (ESPAÑA)

Entre octubre de 2001 y octubre de 2003 se han estudiado las características relativas al uso del espacio desarrollado por la población de Visón Europeo que ocupa varios ríos del sector occidental de su área de distribución Ibérica, dentro de las provincias de La Rioja, Álava y Burgos. El área estudiada comprende parte de seis cursos fluviales: Ebro (70 km.), Oca (60 km.), Ayuda (20 km.), Alegría-Salburua (15 km.), Tirón (25 Km.) y Najerilla (17 km.). Los 207 km. que comprende este área han sido trampeados sistemáticamente para conocer los Visones Europeos presentes y marcarlos; una parte importante de ellos fueron provistos de emisores intraperitoneales de larga duración (14 meses) para su radio-seguimiento.

Los resultados muestran que los Visones Europeos controlados se ha comportado como residentes, siendo muy rara la presencia de ejemplares transeúntes. Estos animales presentan por lo general un patrón de uso del espacio de tipo territorial: machos y hembras mantienen dominios vitales exclusivos que defienden de ejemplares del mismo sexo; los territorios de los machos contienen a los de las hembras. La estabilidad observada en los territorios ha sido grande a lo largo del periodo de estudio; las variaciones interanuales en su disposición corresponden a cambios de pequeño alcance, fundamentalmente ajustes originados por la formación de territorios vacíos –tras la desaparición de sus componentes- que han sido reocupados por individuos de áreas próximas, lo que sugiere una corta capacidad dispersiva (algunos kilómetros).

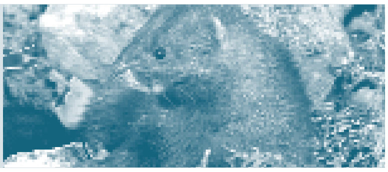
El tamaño observado en el 'área de campeo' de los machos es casi siempre mayor que el de las

Juan Carlos Ceña, Alfonso Ceña, Mª Asunción Gómez and Javier López de Luzuriaga.

Between October 2001 and October 2003 a study took place of the characteristics related to the use of space by the population of European Mink in various rivers in the western part of its Iberian distribution area, within the provinces of La Rioja, Alava and Burgos. The area under study includes six river courses: Ebro (70 km), Oca (60 km), Ayuda (20 km), Alegría-Salburua (15 km), Tirón (25 Km) and Najerilla (17 km). The 207 km covered by this area were systematically trapped to ascertain the number of European Minks present and tag the specimens. A large part of these were provided with long-life (14 months) intraperitoneal transmitters for radio tracking.

The results show that the controlled European Minks behave as residents and that the presence of transient specimens is very rare. These animals generally exhibit a use of space pattern which is territorial in nature: males and females maintain exclusive life-long domains that they defend against specimens of the same sex; the territories of males comprise female territories. The observed stability of territories was significant during the duration of the survey. Interannual variations correspond to small changes, mainly adjustments arising from the availability of empty territories after the disappearance of their owners which are then occupied by individuals from nearby areas, suggesting a limited dispersal capacity (a few kilometres).

The observed size of the home range of the males is almost always larger than that of the females, although differences are less obvious if we compare average surface areas for both sexes. Seasonally, the size of the home ranges in autumn and winter are larger for both sexes than in spring and summer. In basins with a



high population density, the home ranges are smaller than in low density areas, this difference being more noticeable in the case of females.

The males usually occupy the whole of the river area, while the presence of females is only found in certain areas. The number of females per male is variable, ranging from 0 to 5 females. Thus, the population density in each river basin is largely determined by the percentage of existing females. In this sense, noticeable differences have been observed from one basin to the next: The Tirón and Najerilla rivers —which seem to offer an optimum habitat for the species— have a dense population (5-8 individuals/10 km) with a large number of females for each male, normally between 3 and 5. The whole river length is occupied by the adjoining territories of males and females. In the other rivers (Ebro, Oca, Alegría and Ayuda) the density is low or very low (0-3 individuals/10 km), with 0-2 females for each male. The males are distributed along extensive areas —although they do not occupy all available space— while there are only a few females in specific stretches.

This space use model (laid out linearly along successive large territories belonging to the various specimens) prompts the isolation and atomisation of populations, as the existence of a given risk (road, etc.) can eliminate the population located in a large river stretch. On the other hand, it makes it easier to create artificial barriers, which can be used to defend the specimens against threats that might affect areas of greater interest, i.e., rivers with a denser population and a larger number of females.

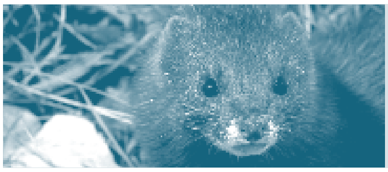
(1) Survey carried out within the framework of the coordinated LIFE projects for the Preservation of the European Mink in Alava (00NAT/E/7335), La Rioja (00NAT/E/7331) and Castilla-León

hembras; la diferencia se hace menos patente si se comparan las superficies medias ocupadas por ambos sexos. Estacionalmente, el tamaño de las áreas de campeo en los meses de otoño e invierno es superior en ambos sexos al de primavera y verano. En las cuencas con una densidad de población elevada, las áreas de campeo son menores que en las zonas de baja densidad, siendo esta diferencia muy notable en el caso de las hembras.

Los machos suelen ocupar de modo encadenado todo el área fluvial, mientras que sólo se observa presencia de hembras en ciertas áreas. Se ha observado que el número de hembras por macho es variable, con rango entre 0 y 5 hembras; de este modo, la densidad de población presente en cada cuenca fluvial viene en gran medida determinada por el porcentaje de hembras existente. En este sentido se han observado notables diferencias entre cuencas: Los ríos Tirón y Najerilla −que deben representar el hábitat óptimo de la especie-cuentan con una población densa (5-8 ej./10 km.) con un número importe de hembras por cada macho, normalmente entre 3 y 5; toda la longitud fluvial está ocupada por los territorios encadenados de machos y hembras. En el resto de ríos (Ebro, Oca, Alegría y Ayuda) la densidad es baja o muy baja (0-3 ej./10 km.), con 0-2 hembras por cada macho; los machos se distribuyen por áreas extensas -aunque no comprenden todo el espacio disponible- mientras que sólo existen algunas hembras en tramos concretos.

Este modelo de uso del espacio (con disposición lineal y sucediéndose uno tras otro los amplios territorios de los diferentes ejemplares) facilita el aislamiento y atomización de las poblaciones, ya que la presencia de un determinado punto de riesgo (carretera, etc.) puede acabar con la población asentada en un amplio tramo fluvial. En sentido contrario, favorece la creación de barreras artificiales, utilizables para su defensa ante factores de amenaza que puedan afectar a las áreas de mayor interés: los ríos con población más densa y que cuentan con mayor número de hembras.

(1) Estudio realizado en el marco de los Proyectos-LIFE coordinados de Conservación del Visón Europeo en Álava (00NAT/E/7335), La Rioja (00NAT/E/7331) y Castilla y León (00NAT/E/7299).



[The European mink (*Mustela lutreola*) population's situation at the central and South-western area of the iberian nucleus (2002-2003)[1]]

SITUACIÓN DE LA POBLACIÓN DE VISÓN EUROPEO (*Mustela lutreola*) EN EL ÁREA CENTRAL Y SUROCCIDENTAL DEL NÚCLEO IBÉRICO. (AÑOS 2002-2003)

Durante los años 2002-03 se llevó a cabo un estudió sobre la situación del Visón Europeo en las provincias de La Rioja, Álava y Burgos (España): se obtuvo su área de distribución, se estimó el tamaño de su población y se valoró su estado de conservación; los resultados han sido comparados con los obtenidos en estudios anteriores para conocer la evolución experimentada por esta población.

La distribución se definió fundamentalmente mediante muestreos orientados, realizados con jaulas-trampa. Fueron realizados a lo largo de todo el área de posible presencia de la especie. La unidad de muestreo fue la 'estación de trampeo': constituida por 10 trampas, distribuidas a lo largo de 1 km. de ribera y mantenidas activas durante 10 días (100 jornadas-trampa/estación). Los datos fueron completados con información obtenida en los trampeos destinados a la erradicación del Visón Americano, así como mediante la búsqueda de indicios de presencia (huellas de pisadas) y la recogida de algunos cadáveres de ejemplares, generalmente procedentes de atropellos en carreteras.

En varios ríos con población conocida se estudió la relación existente entre el éxito de captura, obtenido en 'estaciones de trampeo' estandarizadas y el tamaño y composición (sex-ratio) de la población existente. El modelo obtenido en estos ríos se extrapoló al resto de cuencas, de población desconocida, en las que se realizaron muestreos.

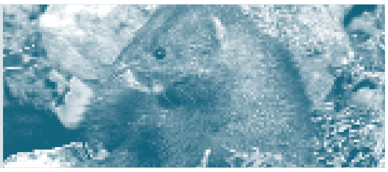
JUAN CARLOS CEÑA, ALFONSO CEÑA, Mª ASUNCIÓN GÓMEZ, JAVIER LÓPEZ DE LUZURIAGA AND ELENA RAFART.

During the period 2002-03 a survey was carried out on the situation of the European Mink in the provinces of La Rioja, Alava and Burgos (Spain): the distribution area was determined, the size of the mink population was estimated and the state of its preservation was assessed. The results have been compared with those obtained from former surveys to ascertain the evolution experienced by this population.

The distribution was mainly determined by oriented sampling, carried out with traps. They were carried out throughout the area where the presence of the species appeared to be possible. The sampling unit was the 'trap station', consisting of 10 traps, distributed along 1 km of bank and maintained active during 10 days (100 trap days/station). The data were completed with information obtained from the trappings used to eradicate the American Mink population, as well as through signs of presence (paw prints) and the collection of some carcasses, generally specimens that had been run over on roads.

In various rivers with a known population, the existing relationship was studied between successful captures obtained at the standardised trap stations and the size and composition (sex-ratio) of the existing population. The model obtained from these rivers was extrapolated to the other basins, of unknown population, where samplings were taken.

The distribution obtained includes the whole basin of the Tirón, Najerilla and Iregua rivers and fragmented populations occupying



some sectors of the basins of the rivers Ebro, Oca, Bayas, Zadorra, Oja, Leza, Ega, Cidacos, Alhama and Nervión. The species has not been found in other rivers. The largest densities are found in the Tirón, Najerilla and Iregua (3-5 individuals/10 km); the other rivers have low or very low densities (0.5-2 individuals/10 km). In the areas with the best populations, the sex-ratio is favourable to females. In the whole area under study (>1,000 km of rivers) the existence of 150 adult specimens is estimated.

The populations of American Mink (*Mustela vison*) found in the centre (Alava) and southwest (Burgos) of the area under study have originated fast substitutions of the native species, although the reduction in population in other areas (Ebro, Ayuda, Oca, Leza, Nervión, etc.) cannot be directly attributed to the American Mink, as there are no stable populations of this foreign species. The trappings carried out after the breeding season (September-November) revealed a low percentage of young specimens in many of the basins, which points to a problem in renovating these populations.

The evolution undergone by the species is markedly recessive, both with respect to the size of the distribution area and of the population contingent. Its number is estimated to have dropped by 30% since 2000. Particularly important is the strong reduction observed in the Ebro and Zadorra rivers —the largest in the area under study— which, should this trend continue, will lead to extinction in a short time. In the area under study as a whole, the species is considered “ENDANGERED”.

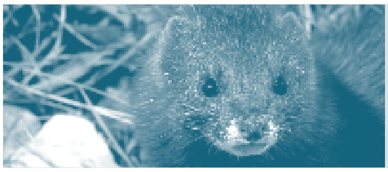
(1) Survey carried out within the framework of the coordinated LIFE projects for the Preservation of the European Mink in La Rioja (00NAT/E/7331), Alava (00NAT/E/7335) and Castilla-León (00NAT/E/7299).

La distribución obtenida comprende toda la cuenca de los ríos Tirón, Najerilla e Iregua; poblaciones fragmentadas ocupan algunos sectores de las cuencas de los ríos Ebro, Oca, Bayas, Zadorra, Oja, Leza, Ega, Cidacos, Alhama y Nervión. En el resto de ríos no se ha encontrado la especie. Las mayores densidades se dan en los ríos Tirón, Najerilla e Iregua (3-5 ej./10 km.); el resto de ríos, presentan densidades bajas o muy bajas (0,5-2 ej./10 km.). En las zonas con mejores poblaciones, el sex-ratio es favorable a las hembras. En el conjunto del área de estudio (>1.000 km. de ríos) se estima la presencia de unos 150 ejemplares adultos.

Las poblaciones de Visón Americano (Mustela vison) que ocupan el centro (Álava) y suroeste (Burgos) del área de estudio han originado rápidas sustituciones de la especie autóctona; si bien, la reducción observada en otras zonas (ríos Ebro, Ayuda, Oca, Leza, Nervión, etc.) no puede achacarse de modo directo al Visón Americano ya que en ellas no existen poblaciones estables de esta especie alóctona. Los trampeos realizados durante la época post-reproductora (septiembre-noviembre) revelaron la presencia de un bajo porcentaje de jóvenes en muchas de las cuencas, por lo que se deduce que existe un problema de renovación de efectivos en estas poblaciones.

La evolución sufrida por la especie es marcadamente recesiva, tanto en lo que respecta al tamaño de su área de distribución como al contingente de población. Su número se estima que ha descendido en un 30 % desde el año 2000; destacando por su relevancia la fuerte reducción observada en los ríos Ebro y Zadorra –los mayores del área de estudio- que, de continuar esta tendencia, puede llevarle a la extinción en poco tiempo. En el conjunto del área de estudio, la especie se considera “EN PELIGRO DE EXTINCIÓN”.

(1) Estudio realizado en el marco de los Proyectos-LIFE coordinados de Conservación del Visón Europeo en La Rioja (00NAT/E/7331), Álava (00NAT/E/7335) y Castilla y León (00NAT/E/7299).



[Habitat selection by the European mink (*Mustela lutreola*) in the upper Ebro river basin (Spain)[1]]

SELECCIÓN DE HÁBITAT POR PARTE DEL VISÓN EUROPEO (*Mustela lutreola*) EN LA CUENCA ALTA DEL EBRO (ESPAÑA)

JUAN CARLOS CEÑA, ALFONSO CEÑA, Mª ASUNCIÓN GÓMEZ AND JAVIER LÓPEZ DE LUZURIAGA.

Se ha estudiado la selección de hábitat realizada por Visones Europeos radio-seguidos a lo largo de todo el ciclo anual. La zona de estudio se incluye en el sector occidental de la cuenca del Ebro (España) y comprende 300 km. de longitud de ríos con tipología variada en lo que respecta a tamaño (1,7-90 m. de anchura), caudal (0,5-90 m3/sg.), altitud (400-950 m.s.n.m.), clima (de suboceánico a mediterráneo-continentalizado) y usos humanos (industrial, recreativo, regadío, pesca de salmónidos, etc.).

La selección de hábitat se estudió comparando las características medias de variables que definen las zonas en que se encontró Visón Europeo, con las obtenidas al azar en el conjunto del área de estudio (disponibles en el medio). La valoración se hizo a dos escalas: a escala MESOHÁBITAT se confrontaron las características medias de las 'áreas de campeo' de cada ejemplar con las disponibles en el medio; a escala MICROHÁBITAT se compararon las características medias de sectores circulares de 100 metros de radio, tomados en torno al punto de localización diaria de los ejemplares, con otros semejantes obtenidos al azar.

Los resultados muestran que los Visones Europeos seleccionan favorablemente para

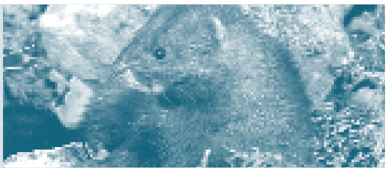
The habitat selection carried out by radio-tagged European Minks was studied throughout the annual cycle. The area under study is included in the western sector of the Ebro river basin (Spain) and includes 300 km of river courses of varying size (1.7-90 m width), flow (0.5-90 m^3/s), altitude (400-950 m a.s.l.), climate (from sub-Oceanic to Continentalised-Mediterranean) and human uses (industrial, recreational, irrigated crops, fishing for salmonidae, etc.).

Habitat selection was studied comparing the average characteristics of the variables that define the areas where European Mink was found with those obtained randomly in the whole of the area under study (available in the environment). Assessment was carried out using two scales: the MESOHABITAT scale compared the home ranges of each specimen to those available in the environment and the MICROHABITAT scale compared the average characteristics of circular sectors with a radius of 100 metres calculated on the daily location of specimens to similar sectors obtained at random.

The results show that the European Minks prefer small- or medium-sized rivers (mesohabitat).

They also prefer stretches with slow currents, multiple courses and dense vegetation on the banks (microhabitat).

Both aspects are particularly obvious in the case of females, particularly during their reproductive period (May-July) when they tend to spend their time in small rivulets with dense vegetation on river banks.



The typology of burrows and sleeping areas was studied and it was observed that the European Mink mainly chooses dense brambles (*Rubus spp.*) close to the water.

The results obtained suggest that the process of homogenisation of ecosystems that is taking place in the region is having a negative effect on the most valuable environments for this endangered species. The progressive destruction of ponds and marshes located on river banks, the channelling of small rivulets and ravines, the elimination of bushes from river banks, particularly in poplar (*Populus x hibrida*) plantations, are progressively reducing the capacity of the habitats to shelter the animals.

(1) Survey carried out within the framework of the coordinated LIFE projects for the Preservation of the European Mink in Castilla-León (00NAT/E/7299), Alava (00NAT/E/7335) and La Rioja (00NAT/E/7331).

instalarse ríos de tamaño medio o pequeño (mesohábitat).

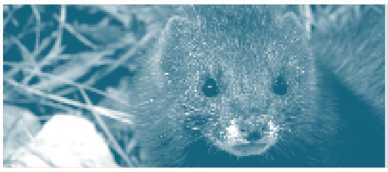
Prefieren también tramos de corriente lenta, con múltiples cauces de pequeño tamaño en los que exista una alta cobertura vegetal de matorral en las riberas y márgenes (microhábitat).

Ambos aspectos son muy patentes en el caso de las hembras, especialmente en la época de reproducción (mayo-julio) en que frecuentan pequeños arroyos con elevada cobertura vegetal ubicados en las márgenes de los ríos.

También se estudió la tipología de las madrigueras y encames, observándose que el Visón Europeo elige principalmente para este fin matorrales densos de zarzas (Rubus spp.) situados junto al agua.

A tenor de los resultados obtenidos, se sugiere que el proceso de homogeneización de los ecosistemas fluviales que se viene experimentando en la región, está influyendo negativamente sobre los medios más valiosos para esta especie amenazada: la progresiva destrucción de charcas y zonas húmedas situadas en las márgenes fluviales, el encauzamiento de los pequeños canales y arroyos, y la eliminación de la vegetación arbustiva en las riberas, en especial para extender los cultivos de chopo (Populus x hibrida), están repercutiendo en una progresiva disminución de la capacidad de acogida de estos hábitats.

(1) Estudio realizado en el marco de los Proyectos-LIFE coordinados de Conservación del Visón Europeo en Castilla y León (00NAT/E/7299), Álava (00NAT/E/7335) y La Rioja (00NAT/E/7331).



[Breeding behaviour aspects of European minks (*Mustela lutreola*) females in their natural habitat[1]]

ASPECTOS DEL COMPORTAMIENTO REPRODUCTOR DE LAS HEMBRAS DE VISÓN EUROPEO (*Mustela lutreola*) EN SU MEDIO NATURAL

El radio-seguimiento de 12 hembras de Visón Europeo, provistas de emisor intraperitoneal, ha aportado información sobre aspectos de la reproducción de esta especie en su medio natural. Los animales fueron controlados en la época de cría (marzo a agosto) de los años 2002 (10 hembras) y 2003 (2 hembras). Las áreas de trabajo comprenden cinco ríos de diferente tipología, situados en la cuenca alta del río Ebro (norte de España): Ebro (4 hembras), Oca (3 hembras), Najerilla (3 hembras), Ayuda (1 hembra) y Alegría-Salburua (1 hembra).

Las hembras desarrollan el celo entre mediados de marzo y finales de abril. Tras la fecundación presentan un patrón de desplazamientos amplios, similar al seguido durante el otoño e invierno previos. Entre mediados de mayo y finales de junio, se sedimentan en un punto concreto para realizar el parto; posteriormente, a lo largo de julio, el grupo familiar va ampliando progresivamente su pequeña área de campeo.

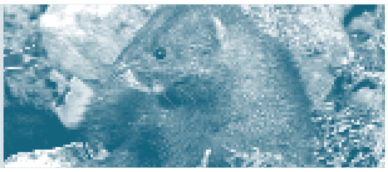
Las zonas seleccionadas para parir y criar a los cachorros presentan características peculiares. Se sitúan junto a pequeños arroyos y zonas húmedas emplazados en las márgenes de los cursos fluviales regentados habitualmente; en esta situación, evitan las frecuentes crecidas que se dan en el mes de mayo tras episodios de tormentas. Estas áreas cuentan con una muy densa cubierta vegetal de arbustos y vegetación semiacuática que brinda a los visones un buen refugio. Como madrigueras de cría eligen agujeros en el suelo, protegidos por grandes zarzales (Rubus sp.), y acúmulos de detritus vegetales depositados por las riadas. Después del parto,

JUAN CARLOS CEÑA, Mª ASUNCIÓN GÓMEZ, ALFONSO CEÑA AND JAVIER LÓPEZ DE LUZURIAGA

Radio tracking of 12 European Mink females provided with an intraperitoneal transmitter, has provided information on aspects of the reproduction of this species in their natural habitat. The animals were monitored during the breeding season (March to August) in 2002 (10 females) and 2003 (2 females). The areas covered by the survey include five rivers with different typologies located in the Upper basin of the Ebro (northern Spain): Ebro (4 females), Oca (3 females), Najerilla (3 females), Ayuda (1 female) and Alegría-Salburua (1 female).

The females came into heat between mid-March and late April. After fertilisation, they exhibited a pattern of considerable travelling, similar to that of the previous autumn and winter. Between mid-May and late June, they tended to focus on a particular area to give birth. Then, throughout the month of July, the family group gradually expanded its small home range.

The locations selected to give birth and raise the kits share particular characteristics. They are found near small rivulets and in marshy places on the banks of the rivers they usually inhabit, thus avoiding areas which are typically flooded in May after thunderstorms. The areas have dense vegetation consisting of shrubs and semiaquatic plants that provides a good shelter for the minks. The burrows chosen for breeding are holes in the ground, protected by large bramble bushes (*Rubus sp.*), and the accumulated plant waste deposited after floods. After giving birth, the females remain stationary in the burrow for the 40-50 day lactation period. After this period, the kits begin to leave the burrow, taking shelter



in the dense surrounding vegetation. Some time later, the family group ventures out on short trips to places which are highly protected, gradually increasing the distance. The family group remains for a few days in each of these places, exploring the environment. It is difficult to observe the kits directly, as they tend to hide in the dense vegetation and their behaviour pattern is basically nocturnal. During the first stages of development, after leaving the burrows (July), the tracks left by the family group help to date the reproduction.

Of the 10 females monitored in 2002, it is estimated that 9 tried to reproduce, as they exhibited behaviour consistent with a possible birth (long stays in the burrow). Of these, 6 stayed in their burrows during the theoretical lactation period and 3 did not complete this period. It was confirmed that 3 females bred successfully, eventually coming out with 2, 2 and 4 kits, as evinced from observing family groups in July. It was also estimated <<probable>> that another two raised at least one kit, although no certain signs were observed of their presence in the reproduction areas. One female died after the lactation period. One of the two females that were radio-tracked in 2003 is currently (late June) beginning the raising process.

The low reproductive success observed in this small sample suggests that there is a low annual renovation rate of the population. This is corroborated by the prevailing absence of young specimens obtained during trappings carried out in autumn in a large part of the Ebro basin. We consider that a detailed understanding of the aspects that affect reproduction and survival rates is an essential prerequisite to be able to establish efficient preservation strategies for this endangered species.

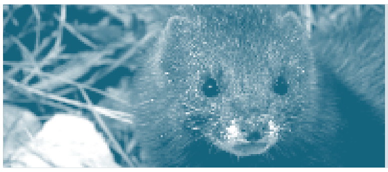
(1) Survey carried out within the framework of the coordinated LIFE projects for the Preservation of the European Mink in La Rioja (00NAT/E/7331), Alava (00NAT/E/7335) and Castilla-León (00NAT/E/7299).

las hembras permanecen muy estáticas en la madriguera de cría o su entorno durante los 40-50 días que dura la lactancia. A partir de este periodo, los cachorros salen de la madriguera y se refugian en espesos matorrales situados en las inmediaciones. Posteriormente, el grupo familiar comienza a realizar pequeños desplazamientos hasta lugares que ofrecen alta protección, situados progresivamente más lejos. En cada uno de estos lugares, el grupo familiar permanece durante algunos días explotando los alrededores. La observación directa de los cachorros resulta difícil ya que se ocultan en la densa vegetación y su patrón de actividad es fundamentalmente nocturno. En los primeros estadios de su desarrollo, tras salir de la madriguera (mes de julio), las huellas de las pisadas dejadas por el grupo familiar ayudan a datar la reproducción.

De las 10 hembras controladas en 2002, se estimó que 9 intentaron la reproducción, al observarse en ellas actitudes relacionadas con el posible parto (permanencia durante un largo periodo en la madriguera). De ellas, 6 regentaron el cubil durante todo el posible periodo de lactancia de los cachorros y 3 no lo completaron, muriendo una de ellas al final de este periodo. Se comprobó que 3 hembras culminaron con éxito la cría, sacado adelante 2, 2 y 4 cachorros, según se desprende de la observación de los grupos familiares en el mes de julio; así mismo, se estimó <<probable>> que otras dos más sacaran adelante algún cachorro, aunque no se obtuvieron indicios seguros de su presencia en las zonas de reproducción. Una hembra murió tras concluir el periodo de lactancia. Una de las dos hembras que están siendo radio-seguidas en el año 2003 se encuentra en la actualidad (finales de junio) iniciando el proceso de crianza.

El bajo éxito reproductor observado en esta pequeña muestra, sugiere la existencia de una baja renovación anual de la población. En este mismo sentido apunta la escasez generalizada de jóvenes obtenida en los trampeos llevados a cabo en otoño en gran parte de la cuenca del Ebro. Consideramos que el conocimiento en detalle de los condicionantes que afectan a la reproducción y supervivencia juvenil es un requisito esencial a la hora de establecer actuaciones de conservación eficaces para esta especie amenazada.

(1) Estudio realizado en el marco de los Proyectos-LIFE coordinados de Conservación del Visón Europeo en La Rioja (00NAT/E/7331), Álava (00NAT/E/7335) y Castilla y León (00NAT/E/7299).



[National strategy for European mink Conservation in Spain: first borrador]

European Mink Working Group. National Commission for the Protection of Nature. Spain.
Abstract written by Santiago Palazón, Coordinator for National Strategy for European mink Conservation in Spain.

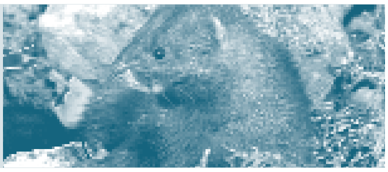
The conservation of the European mink populations in Spain is the main goal of this Strategy. This must be a useful tool for conservation and recuperation of species. Besides, it must guide the next reviews and the elaboration of Recuperation or Conservation Plans, conjointly. A coordination among different sectors involved, a firm determination of different manager of its application, working for a common objective, and a endowment of a legal covering for the figure of Conservation Strategy are necessary to get a effective compliment of Strategy.

First, a diagnosis of present situation is included in the Strategy, with information from unpublished reports, documents public and scientific literature about this species. The strategy also starts with the description of present status of European mink population, with the protection legal situation, and with LIFE projects, currently working.

The goal of this strategy is assure the viability, long time, of Spanish European mink populations, increasing its distribution area and the number of minks. As European mink distribution area affects directly to five Autonomic Communities, the Strategy must be the base to bring up to date the Recuperation, Conservation or Management Plans, and the elaboration and redaction of next plans.

The participants are the Administrations of Spanish Government and Autonomous Communities with direct competence in conservation of species. All them have participate in the elaboration of this Strategy. Local Communities, Hydrographical Conferences, Non Profit Organizations and another institutions of Civil Society worried by European mink conservation are invited to participate. French institutions and organisms, as Environment Ministry of France are also invited to collaborate.

The basic lines of direct actuation for the European mink conservation are: survey of the European mink presence, increase the small size of population, avoid the isolation of different population nuclei, eliminate the death of European minks by non natural causes, study of the competition and predation by another carnivores, prevention and fight against diseases



affecting to species, study of viability of a ex-situ conservation project and next re-introductions and contribution for conservation of this species internationally.

The basic lines for habitat manage are: the conservation and restoration of habitats, the connection between populations and reproductive nuclei and the decrease of level of pollutants and toxic substances in the water.

The basic lines for scientific research are: scientific research applied to management, establish an standarizated method of population survey and new researches about biology, ecology and genetic aspects.

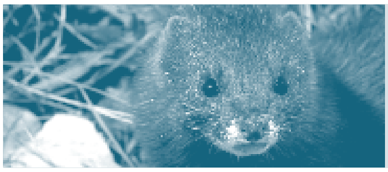
Another basic lines are the sensibilización, the communication, broadcasting and environmental education, the public participation and the rural development.

The Strategy development includes the development of different Recuperation Plans, the coordination among Environment Ministry and the different Autonomous Communities implicated, by means of the Working Group, the inter-administrative coordination and the different human resources. The performance of legal acts and the economical resources will be very important and useful in the future of this Strategy.

This Strategy was made inside the European Mink Working Group (Wild Fauna and Flora Committee, National Commission for the Protection of Nature) with the recommendations from most of their members. Sara Brizuela, Joseba Carreras, Juan Carlos Ceña, Asun Gómez Gayubo, Luis Mariano González, Jorge González-Esteban, José Luis González, Luis Lopo, Sisco Mañas, Íñigo Mendiola, Ignacio Molina, Jordi Ruiz-Olmo, Consuelo Temiño and Idoia Villate suggest important corrections to write this Strategia.

This Action Plan was made inside the European Mink Working Group (Wild Fauna and Flora Committee, National Commission for the Protection of Nature) with the recommendations of all their members.

The construction of a breeding center and the maintenance of a captive European mink stock is included in the Life Project for the Preservation of the European Mink in Catalonia (LIFE02NAT/E/8604) that is co-ordinate with other Life projects in progress proposed by the Autonomous Governments of La Rioja (LIFE00NAT/E/7331), Junta de Castilla-León (LIFE00NAT/E/7299) and Alava (LIFE00NAT/E/7335) in which the Ministry of the Environment participates as a partner in all.



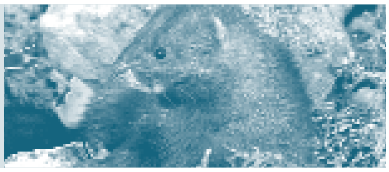
[Is there a problem with generations in captive European mink breeding groups?]

Wolfgang Festl, Claudia Bodenstein,
EuroNerz e.V., Borgloher Str. 13, D-49176 Hilter a.T.W., Germany;
Wolfgang.Festl@euronerz.com

The association for the conservation of the European mink EuroNerz e.V. participates in the European Endangered species breeding Program (EEP). Breeding takes place in cooperation with the EEP-coordinator Tiit Maran (Foundation Lutreola, Estonia) and the Dept. of Ethology at the University of Osnabrück (Prof. Dr. R. Schröpfer). Since 1999, all observations of the individual behaviour of the European minks during the mating season, the mating attempts and the reproduction success are documented. On this data base, some striking features concerning the average litter size became obvious.

In our breeding group a fluctuation over 3 years is visible: From the first to the third year the average litter size decreases about ca. 50%, followed by a rapid recovery towards the initial value in the fourth year. This fluctuation may be driven by the “reproductive life history” of the females as well as by introducing new, inexperienced males into the breeding group.

To prevent breakdowns in a local breeding population it therefore seems to be important to ensure a normal age-structure.

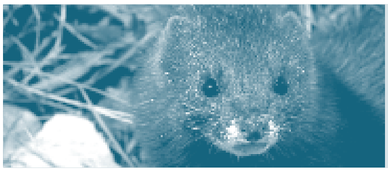


[The influence of handling during the mating season on the reproduction success of captive European mink, *Mustela lutreola*]

Wolfgang Festl,
EuroNerz e.V., Borgloher Str. 13, D-49176 Hilter a.T.W., Germany
Wolfgang.Festl@euronerz.com

In 1932, the European mink *Mustela lutreola* was bred successful in captivity for the first time in the Moscow zoo. Since then, only a few large scale breeding groups were founded: for example in Novosibirsk (Russia; Institute of Zootaxy and Ecology of Animals, Russian Academy of Sciences; Dr. D.V. Ternovsky & Dr. Yu. Ternovskaya), in Tallinn zoo (Estonia; Foundation Lutreola, T. Maran) and since 1997 at the University of Osnabrück (Germany; Dept. of Ethology; Prof. Dr. R. Schröpfer). With the foundation of the European Mink Conservation & Breeding Committee (EMCC) and the inclusion of *Mustela lutreola* in the European Endangered species breeding Program (EEP) in 1992 the base were set up for a coordinated, international breeding project. EuroNerz e. V. participates in this EEP since 1998 with a breeding group of about 60 individuals. In a close cooperation with the University of Osnabrück (Dept. of Ethology; Dr. E. Peters) among other topics the behaviour during reproduction and the effects of "stress" in this season is studied.

The main problem in the captive breeding of European mink is the very aggressive behaviour towards conspecifics, which occurs also during the mating season. According to our observations, in 75% of the males and 25% of the females mating is impossible due to these aggressions. Also, in comparison with other institutions (e. g. Tallinn and Novosibirsk), in our breeding group a high number of unsuccessful copulations and a low mean litter size is striking. Due to this, only a small part of the individuals do actually contribute to the gene pool of our breeding group. An analysis of our breeding data proved, that some kind of handling of the European mink individuals during the mating season seems to be stressful and cause negative effects on the reproduction success. Especially this is true for the females during their days of conception: Handling for behavioural observations and/or successive mating attempts with different males let the reproduction success decrease up to 50%. On the other hand, no negative effects were found for the handling in the context of keeping or cleaning work. The same is true for the transport of females to zoos and wildlife parks during their pregnancy.

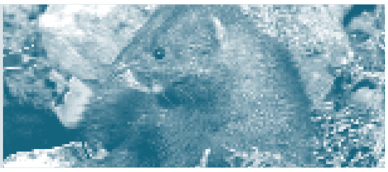


[Captive breeding program for the European mink, *Mustela lutreola* – Can new methods of keeping solve the problems with breeding?]

Wolfgang Festl, Claudia Bodenstein & Christian Seebass,
EuroNerz e.V., Borgloher Str. 13, D-49176 Hilter a.T.W., Germany;
Wolfgang.Festl@euronerz.com

The association for the conservation of the European mink EuroNerz e.V. participates in the European Endangered species breeding Program (EEP) since 1998 with a breeding group of about 60 individuals. The main problem in the captive breeding of *Mustela lutreola* is the very aggressive behaviour, which is shown by a high proportion of the individuals towards their conspecifics, also during the mating season. According to our observations, in 75% of the males and 25% of the females mating is impossible due to these aggressions. This problem is also observed by other institutions engaged in the ex situ conservation work.

Due to this problem, not only the proportion of individuals contributing to the gene pool of the breeding group is decreased. In addition, the reproduction success is significantly decreased, when a copulation was forced by the male against the defence and/or agitation of the female during the "foreplay of mating". To solve these problems, EuroNerz e.V. cooperates with the Dept. of Ethology of the University of Osnabrück (Prof. Dr. R. Schröpfer, Dr. E. Peters). In addition, starting in 2000 we changed the methods of keeping subadult European minks. Instead of housing all individuals separately after the break-up of the mother-offspring-family (visible by the occurrence of increasing aggressive encounters) we now separate the female from the litter, when the cubs are about 12 weeks old. In this phase, normally no aggressions occur. The litter mates can be kept together until late autum or winter. According to our first results, the new keeping method has a strong positive effect on the behaviour of the individuals towards potential mates in the mating season. Thus, we suggest that the new method leads to an enhanced "socialization".



[Monitoring of the European mink (*Mustela lutreola*) population in France]

Pascal Fournier[1, 13], Stéphane Aulagnier[2], Guy Chézeau[3], Stéphanie Darblade[4], Franck Ducours[5], Béatrice Froidurot[6], Hubert Galineau[7], Gilles Guiral[8], Stéphane Hispiwack[9], Alain Maurillon[10], Jean-Louis Moura[11], Christian Pignier[12]

[1]GREGE, Route de Préchac, F-33730 Villandraut, [2]SFEPM, F-75000 Paris, [3]Nature Environnement 17, F-17000 La Rochelle, [4]Réserve Naturelle de l'Etang Noir, F- 40510 Seignosse, [5]SMEAP, F-24600 Ribérac, [6]Conseil Général de Dordogne, F-24019 Périgueux, [7]Fédération départementale des chasseurs de Charente, F-16400 Puymoyen, [8]Communauté de communes de Haute Saintonge, F-17500 Jonzac, [9]Office National de la Chasse et de la Faune Sauvage, Service départemental de Dordogne, F-24750 Boulazac, [10]Fédération départementale des groupements de lutte contre les organismes nuisibles de Dordogne, F-24140 Douville, [11]Parc Naturel Régional des Landes de Gascogne, F-33830 Belin-Beliet, [12]Association pour la Gestion et la Régulation des Prédateurs de Charente-Maritime, 17430 Tonnay-Charente, [13]Corresponding author (email: pfournier@wanadoo.fr)

As part of the French conservation action plan for the European mink (*Mustela lutreola*) initiated by the French Ministry of Environment in 1999, the distribution of the species is surveyed for detecting an evolution.

Standardised trapping campaigns of 10 traps, installed on 10-20 km of rivers for 10 consecutives nights, are conducted from September to April by the "European mink network" of trained trappers, on eight departments of south-western France. The network also collects some more data: animals accidentally captured during pest control and animals found dead in nature.

Manipulations of captured European mink, under ketamine-medetomidine anaesthesia, included a clinical examination, a blood sample collecting and individual tagging with a transponder. A comprehensive necropsy was performed on animals found dead.

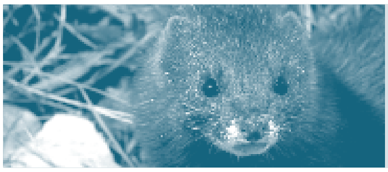
Since 2000, 257 data for 149 different individuals have been collected. Their geographical distribution shows that the limits of the distribution area of the species in France did not vary significantly since 10 years. However, no data has been collected since several years in the core area of the distribution, despite a heavy trapping effort, suggesting an ongoing fragmentation process of the population.

Thirty percent of the data were accidental captures during pest control trapping and 20 % referred to animals found dead in nature. These results confirm that improving awareness and organising training session of pest trappers must be carried on, and that contending with direct causes of mortality must be intensified.

Capture data show that 40 % of the individuals were recaptured at least once and that 16 % were recaptured at least 6 months after the first capture, generally 0 to15.2 km away from the initial place. Four males displayed exceptional movements of 22 to 72 km, going from a river valley to another. This suggests that distant population nuclei could remain in contact.

The data obtained since 2000 combined with the study conducted from 1991 to 1999 by Maizeret et al. are used to draw up a map of the French rivers where the species is currently present for the period 1991-2003.

Key words: Distribution, European mink, France, *Mustela lutreola*, population, survey



[Pace and habitat use of the european mink (*Mustela lutreola*) in the landes de Gascogne region (France) and preservation guidelines]

Pascal Fournier[1,6], Christian Maizeret[2], Stéphane Aulagnier[3], Jean-Pierre Chusseau[4], Christine Fournier-Chambrillon[1], Nicolas Ilbert[2], David Jimenez[2,5], and François Spitz[3]

[1]GREGE, Route de Préchac, F-33730 Villandraut, 2 Conseil Général des Landes, F-40000 Mont-de-Marsan, [5]IRGM/INRA, F-31326 Castanet-Tolosan, 4 Fédération départementale des chasseurs de Gironde, F-33028 Bordeaux, [5]Office National de la Chasse et de la Faune Sauvage, 78610 Auffargis, 6 Corresponding author (email: pfournier@wanadoo.fr)

Space and habitat use of the endangered European mink (*Mustela lutreola*) has been investigated in the Landes de Gascogne region (south-western France), in order to assess suitable conservation measures for the species.

Nine European minks have been radiotracked from March 1996 to August 1999. Each animal was located every day to identify its diurnal resting place and continuous monitoring (one location every 10 min) was performed on a basis of 24 hours of tracking each month. Mapping of habitats was achieved from a Landsat TM® satellite scene.

Animals showed linear home ranges spreading along rivers and streams valleys. In males, the home ranges varied from 1080 to 4856 ha, stretching from 9.4 to 16.2 km. In females, they were from 141 to 396 ha along 2.5 to 10.1 km river. Moreover, two males exploited two and three different hydrographic systems, respectively, ranging over very large areas of 152300 ha and 5642 ha.

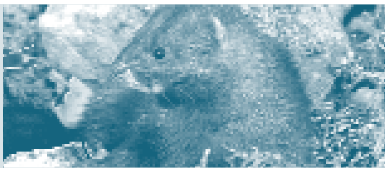
In the whole home range small focal zones were intensively exploited, representing more than 85% of the locations.

During activity periods, animals preferentially used permanent water, open marshes, willow-alder flooding woodlands and moorlands, all these habitats being strongly productive and providing a high diversity of preys.

Resting places were mainly located in the same habitats, generally on the ground, in a cavity between tree-roots or on a tree stock. They were mostly located in a partially or totally flooded environment (70 %), probably in relation with an anti predator strategy.

In conclusion, the European minks of the Landes de Gascogne region have great home range dimensions including dispatched small activity zones, and the presence of water is one of the main factors in habitat selection. According to these results, conservation of the habitats requires maintaining the water level in the flood plains and preserving particularly the areas with permanent water or a long lasting flooding period. Intensification of forestry must absolutely be avoided and riverbanks management must be limited as far as possible. Moreover, the conservation strategy should aim at maintaining the quality of the whole system of rivers and humid zones on a very large area, and it seems unlikely that European mink can survive in the confinement of small natural reserves.

Key words: European mink, *Mustela lutreola*, France, Landes de Gascogne, home range, habitat, river, wetland, conservation.



[Aleutian mink disease parvovirus in free-ranging riparian mustelids from France: recommendations for the conservation of the European mink (*Mustela lutreola*)]

Christine Fournier-Chambrillon[1,11], Bent Aasted[2], Dominique Pontier[3], Christian Arthur[4], Michel Bégnier[5], Bernard Cazeau[6], Cati Ducailar[7], Hubert Galineau[8], Emmanuel de Joantho[9], Alain Maurillon[10], and Pascal Fournier[1]

[1]GREGE, Route de Préchac, F-33730 Villandraut, [2]Royal Veterinary and Agricultural University, DK-1870 Frederiksberg, [3]Université Claude Bernard de Lyon I, F-69622 Villeurbanne, [4]Parc National des Pyrénées, F-65000 Tarbes, [5]Association des Piégeurs Agréés de Charente, F-16000 Angoulème, [6]Conseil Général de Dordogne, F-24019 Périgueux, [7]Réserve Naturelle de l'Etang Noir, F-40510 Seignosse, [8]Fédération départementale des chasseurs de Charente, F-16400 Puymoyen, [9]MIFEN, F-64990 Urcuit, [10]Fédération départementale des groupements de lutte contre les organismes nuisibles de Dordogne, F-24140 Douville, [11]Corresponding author (email: c.fournier-chambrillon@wanadoo.fr)

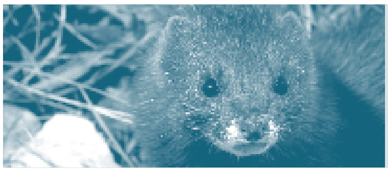
As part of the French conservation action plan for the European mink (*Mustela lutreola*), a serologic survey of Aleutian mink disease parvovirus (ADV) has been conducted from March 1996 to March 2003 in 455 free-ranging riparian mustelids trapped in south-western France.

Blood was collected under anaesthesia after a comprehensive clinical exam. Serum samples were tested for the presence of antibodies to ADV by counter-current immunoelectrophoresis and counter-current line absorption immunoelectrophoresis. Serum electrophoresis was performed on all positive samples in order to quantify the gammaglobulin.

The occurrence of positive animals was 20 % in American mink (*Mustela vison*) (n=113), 12 % in European mink (n=131) and 8,5 % in polecats (*Mustela putorius*) (n=211). Seropositive individuals with gamma globulin levels over 20%, indicating a progressive infection, were observed in about one third of the positive European- and American mink, and not in any polecat, suggesting that the viral strains are at least pathogenic for both mink species in the wild. The geographic distribution of the positive animals shows that the virus has spread all over the European mink's area.

Though further investigations are necessary to evaluate the possible role of ADV in the decline of European mink, the frequency of the virus in the wild already suggests some recommendations for the conservation of this species: i) It is urgent to limit the other factors of decline including the causes of death, because there is no way of preventing the spread of the disease in the wild, ii) As the feral American mink population represents a major source of virus, the control of the species should be greatly strengthened. iii) Strict disinfections measures should be intensified in our trapping network, and awareness should be delivered to pest control trappers. iv) If a captive breeding program proves necessary, very strict sanitary protocols must be applied in the breeding farms to prevent contamination.

Key words: Aleutian mink disease parvovirus, France, *Mustela lutreola*, *Mustela putorius*, *Mustela vison*, riparian mustelids, serological survey.



[Causes of mortality in free-ranging european mink (*Mustela lutreola*) from France]

Christine Fournier-Chambrillon[1,8], Bernard Dassé[2], Gérard Delas[3], Serge Lanièce[4], Yvan Letellier[5], Philippe Millet[6], Pascal Pouzenc[7], and Pascal Fournier[1]

[1]GREGE, Route de Préchac, F-33730 Villandraut, [2]Réserve Naturelle du Courant d'Huchet, F-40550 Léon, [3]Association des Piégeurs Agréés de Gironde, F-33190 Montgauzy, [4]Office national de la Chasse et de la Faune Sauvage, Service départemental de Charente-Maritime, F-17100 Courcoury, [5]Réserve Naturelle des Marais de Bruges, SEPANSO, F-33520 Bruges, [6]Fédération départementale des chasseurs de Charente-Maritime, F-17414 Saint-Julien-de-l'Escap, [7]Office national de la Chasse et de la Faune Sauvage, Service départemental de Gironde, F-33141 Saillans, [8]Corresponding author (email: c.fournier-chambrillon@wanadoo.fr)

The objective of the French conservation action plan for the European mink (*Mustela lutreola*) is to stop the decline of the species. In order to improve the knowledge of the causes of regression, direct causes of mortality were identified for 69 dead European mink collected by the "European mink network" from 1990 to 2003 in south-western France.

A comprehensive necropsy was performed within 48 h after the discovery of the animal; otherwise the carcass was frozen until autopsy. Necropsy included a clinical examination (sex, weight, age, physical condition, corpulence) and the determination of the direct cause of death.

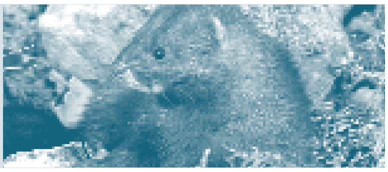
Forty-three animals (62%) were traffic victims. The monthly distribution of data shows two months during which the species seems to be particularly vulnerable to this cause of mortality: (1) in March (n=8), at the end of the mating season, when males are particularly mobiles; (2) in August (n=14), at the end of the breeding period and during the dispersal season.

Fourteen animals (20%) were killed by carnivores, but none was eaten. In six cases, we could determine that the predator was a dog. These animals were found mainly during spring (n=8), from April to June, but they were not preferentially pregnant females.

Five animals were killed by trappers by ignorance or confusion with a polecat. Three skinny and dehydrated females were found dead in live-traps. Other causes of death were diversified.

These results probably do not report the real causes of mortality of the whole population, but they point out the importance of some of them, particularly car collisions and predation by carnivores. Considering that 20% of the data collected during the monitoring of the French European mink population are animals found dead (see the poster), it is very urgent to prevent and reduce the road mortality by specific measures.

Key words: Causes of mortality, France, *Mustela lutreola*, necropsy



[Field evidence of secondary poisoning of free-ranging european mink (*Mustela lutreola*) and other riparian mustelids by anticoagulant rodenticides in France]

Christine Fournier-Chambrillon[1,10], Philippe J. Berny[2], Yann Dumas[3], Didier Laban[4], Alain Maurillon[5], Jean-Louis Moura[6], Laurent Précigout[7], René Rosoux[8], André Sedano[9], and Pascal Fournier[1]

[1]GREGE, Route de Préchac, F-33730 Villandraut, [2]Laboratoire de Toxicologie, Ecole Nationale Vétérinaire de Lyon, F-69280 Marcy-l'Etoile, [3]Fédération départementale des chasseurs de Dordogne, F-24001 Périgueux, [4]Office National de la Chasse et de la Faune Sauvage, Service départemental des Pyrénées-Atlantiques, F-64160 Morlaas, [5]Fédération départementale des groupements de lutte contre les organismes nuisibles de Dordogne, F-24140 Douville, [6]Parc Naturel Régional des Landes de Gascogne, F-33830 Belin-Beliet, [7]Charente Nature, F-16000 Angoulème, [8]SFEPM, F - 75000 Paris, [9]Association des Piégeurs Agréés de Dordogne, F-24200 Sarlat-La-Caneda, [10]Corresponding author (email: c.fournier-chambrillon@wanadoo.fr)

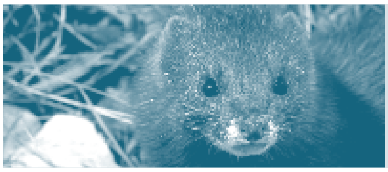
The objective of the French conservation action plan for the European mink (*Mustela lutreola*) is to stop the decline of the species. In order to identify the possible causes of mortality, exposure of riparian mustelids to secondary poisoning by Anticoagulant (Ac) rodenticides has been investigated in 122 free-ranging mustelids of south-western France collected by the "European mink network" from 1990 to 2003.

Thirty one European minks, 47 American minks (*Mustela vison*), 33 polecats (*Mustela putorius*), and 11 European otters (*Lutra lutra*) were autopsied and liver concentration for eight Ac rodenticides was measured by High Performance Thin Layer Chromatography, with a limit of quantification of 0.2 µg/g.

Residues of bromadiolone were found in one European mink, three American minks, five polecats and two otters, i.e. 9% of the sample; liver concentrations ranged from 0.6 to 9.0 µg/g. Residues of chlorophacinone were found in four American mink and one otter, i.e. 4% of the sample; liver concentrations ranged from 3.4 to 8.5 µg/g. Two polecats and one American mink carried lesions proving that bromadiolone was directly responsible for their death. Most cases of Ac poisoning were recorded during the period of field-treatment (fall and late winter).

Our data mainly include animals that survived the secondary poisoning until their capture, and this study certainly underestimates the extent of fatal exposure of mustelids to rodenticides. Moreover, Ac poisoning could increase their vulnerability to other causes of death. The current status of the European mink population cannot tolerate such a supplementary risk of death. Therefore, the use of Ac rodenticides should be quickly restricted in France, and replaced with alternative methods of pest control.

Key words: Bromadiolone, chlorophacinone, *Lutra lutra*, *Mustela lutreola*, *Mustela putorius*, *Mustela vison*, riparian mustelids, secondary poisonning.



[Biometric differences between two populations of American mink (*Mustela vison*) and one population of European mink (*Mustela lutreola*)in an area of interaction between both species in Spain[1]]

DIFERENCIAS BIOMÉTRICAS ENTRE DOS POBLACIONES DE VISÓN AMERICANO (*Mustela vison*) Y UNA DE VISÓN EUROPEO (*Mustela lutreola*) EN UN ÁREA DE INTERACCIÓN ENTRE AMBAS ESPECIES EN ESPAÑA

Se ha estudiado la biometría externa de dos poblaciones de Visón Americano (A y B) que han invadido recientemente el área de presencia del Visón Europeo en España, comparándolas entre sí y con la especie autóctona:

POBLACIÓN- A. Establecida en el centro el área de presencia del Visón Europeo. Es pequeña y tiene una antigüedad de unos 10 años; se formó a partir de escapes de granjas locales. Ocupa las cuencas de los ríos Zadorra y Bayas; a partir de ellas, ha llegado recientemente al río Ebro (2002).

POBLACÍON- B.- Ocupa una amplia superficie del centro y oeste de España. Su origen es antiguo (más de 30 años) y su tamaño de población muy grande. Procede de escapes en el área de Sistema Central, aunque más recientemente se ha reforzado a consecuencia de escapes producidos en el sur de Burgos. Los ejemplares estudiados proceden principalmente de ríos de la cuenca del Duero (Arlanza, Arlanzón y el propio Duero) limítrofes al área de distribución del Visón Europeo (cuenca del Ebro).

POBLACIÓN DE VISÓN EUROPEO. Se han estudiado ejemplares colectados principalmente en ríos de la cuenca del Ebro (Zadorra, Bayas, Ayuda, Alegría, Oca, Tirón, Najerilla, etc.) situados en áreas de contacto con las poblaciones de Visón Americano.

Mª Asunción Gómez, Javier López de Luzuriaga, Juan Carlos Ceña and Sisco Mañas.

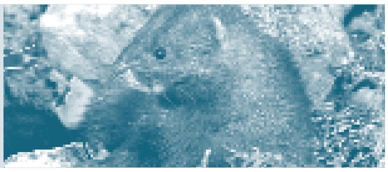
A study was carried out on the external biometrics of two populations of American Mink (A and B) that have recently invaded an area inhabited by European Mink in Spain, comparing these populations with each other as well as with the native species:

POPULATION A. It is established in the centre of an area inhabited by European Mink. This is a small population, less than 10 years old, the result of escapes from local farms. It occupies the basins of the Zadorra and Bayas rivers and has recently reached the Ebro.

POPULATION B. It occupies a large area in central and western Spain. Its origins are old (more than 30 years) and its size is quite large. It comes from escapes in the area of the Central System, although more recently it has been reinforced by escapes from farms in southern Burgos. The specimens studied come mainly from the Duero basin (Arlanza, Arlanzón and the Duero itself) adjacent to the distribution area of the European Mink (Ebro basin).

POPULATION OF EUROPEAN MINK. The specimens studied were collected mainly in the rivers of the Ebro basin (Zadorra, Bayas, Ayuda, Alegría, Oca, Tirón, Najerilla, etc.) located in areas of contact with the populations of American Mink.

The American Mink specimens come mainly from campaigns aimed at controlling this foreign species carried out by the Forestry services of Alava and Burgos in 2001-2003. They were captured with live- animal cage traps and then slaughtered using humane methods. Measurements and weights were taken immediately after slaughter in order to minimise physiological variation. The specimens of European Mink studied come from captures



carried out during distribution and ecology surveys. Biometrics were taken with live, anesthetised animals.

RESULTS:

Significant differences were observed in size and weight between the American and European Mink populations, the latter being notably smaller.

The size of the specimens of American Mink from the Ebro basin (POPULATION- A) is noticeably larger than that of the specimens from the Duero basin (POPULATION- B).

COMMENTS:

The larger size of the American species would help its domination in case of direct physical interaction (aggression). This agrees with the permanence observed for larger (male) European Minks in areas that have been recently invaded by American Mink; the smaller specimens (females) are the first to flee these areas.

The smaller size of the American Mink of the older population (B) compared to the more recent one (A), may be due to a progressive adaptation to the environment or to differences in the parents selected in the original farms.

(1) Survey carried out within the framework of the coordinated LIFE projects for the Preservation of the European Mink in Alava (00NAT/E/7335), Castilla-León (00NAT/E/7299) and La Rioja (00NAT/E/7331).

Los Visones Americanos proceden principalmente de las campañas de control de esta especie alóctona que han desarrollado las Guarderías Forestales de Álava y Burgos, durante 2001-2003. Han sido capturados con jaulas-trampa 'de vida' y posteriormente sacrificados con métodos incruentos; la toma de las medidas y el peso se ha realizado inmediatamente después de su sacrificio, con el fin de minimizar posibles variaciones fisiológicas. Los ejemplares de Visón Europeo estudiados proceden de capturas realizadas con motivo de estudios de distribución y ecología; la biometría se ha realizado con el animal vivo, previa anestesia.

RESULTADOS:

Se han observado diferencias muy significativas de tamaño y peso entre las poblaciones de Visón Americano y la de Visón Europeo, siendo la especie autóctona notablemente menor.

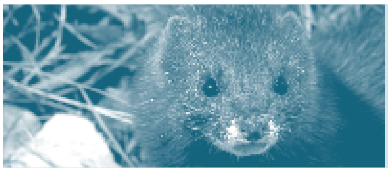
El tamaño de los ejemplares de Visón Americano procedentes de la cuenca del Ebro (POBLACIÓN- A) es sensiblemente mayor que el de los procedentes de la cuenca del Duero (POBLACIÓN- B).

COMENTARIOS:

El mayor tamaño de la especie americana facilitaría su dominio sobre la europea en caso de interacción física directa (agresión). Esto concuerda con la permanencia observada de los Visones Europeos de mayor tamaño (machos) en las zonas recientemente invadidas por el Visón Americano; los ejemplares de menor tamaño (hembras) son los primeros en desertar de estas zonas.

El menor tamaño de los Visón Americano de la población más antigua (B) frente a los de la más moderna (A), puede deberse a su progresiva adaptación al medio o bien a diferencias en los progenitores seleccionados en las granjas de origen.

(1) Estudio realizado en el marco de los Proyectos-LIFE coordinados de Conservación del Visón Europeo en Álava (00NAT/E/7335), Castilla y León (00NAT/E/7299) y La Rioja (00NAT/E/7331).



[Development of molecular markers to the study of the conservation, management, and action plans for the endangered European mink]

Gómez-Moliner, B.J.[1], Cabria, M.T[1]., Rubines, J[1], González, E.G[2], and Zardoya, R.[2].

[1] Dpto. de Zoología y D.C.A.; Fac. Farmacia; Universidad del País Vasco; C/ Paseo de la Universidad, 7. VITORIA 01006; SPAIN. EM: ggpgomob@vc.ehu.es

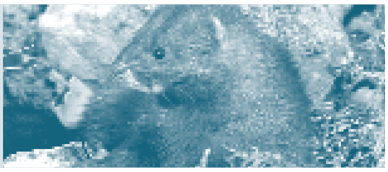
[2] Dpto. de Biodiversidad y Biología Evolutiva; Museo Nacional de Ciencias Naturales (CSIC); C/ J. Gutiérrez Abascal, 2; MADRID 28006; SPAIN.

Conservation genetics encompasses genetic management of small populations, resolution of management units, knowledge of genetic diversity and genetic flow between populations, as well as detection of genetic bottlenecks and inbreeding depression of isolated populations. Molecular tools are also of great interest to understand the biology of the species. It is known that inappropriate management is likely to result if genetic factors are ignored in threatened species.

Monitoring programmes of the European mink (*Mustela lutreola*), one of the most endangered carnivorous of the world, include the simultaneous studies of American mink (*M. vison*), and polecats (*M. putorius*). Therefore, we are developing molecular markers to work not only at the intra-specific level, but also at the inter-specific level. In this context, we have developed a PCR-RFLP technique to differentiate these three species from scat samples or hair traps after non-invasive sampling methods. Two haplotypes for *M. lutreola*, two for *M. putorius* and one for *M. vison* can be distinguished by this surveys. This technique is of particular interest to be used in those areas where *M. lutreola* and *M. vison* are living simpatrically or parapatrically. We are also working in the study of the phylogeography and phylogeny reconstructions of the different lineages of the European mink by means of sequencing a fragment of the mitochondrial control region of nearly 600 bp. These researches will be very useful to proceed to the identification of the OCUs and ESUs for conducting correct management programmes. Microsatellites have become the most powerful genetic tool for studies within and between populations. We are currently working in the development of specific microsatellites for the European mink after the construction of a genomic library for this species.

All these molecular tools will be very useful for future researches on the population biology knowledge of the species, on the identification of hybrids between *M. lutreola* and *M. putorius*, as well as in the captive breeding programmes of minks.

We are grateful to the collaboration of the LIFE projects: “Conservación del visón europeo (*Mustela lutreola*) en Álava” LIFE 00/NAT/ E 7335; “Castilla y León” LIFE 00/NAT/ E 7229 y “La Rioja” LIFE 00/NAT/ E 7331.



[Ecological education towards hunters as a method for the European mink conservation in Russia]

Julia V. Glushkova

The European Mink in Central Russia is not only omitted from the Red Book, it is in fact actively hunted. Most hunters and many specialists in hunting breeds do not distinguish the European Mink from its American cousin. They are all badly informed about the fact that the European Mink is disappearing. In addition, official hunting regulations mention both species under the term "wild mink". To change this situation, a decision was made to work directly with the hunters of European Mink.

In order to clarify the real situation of the population of this endangered species and to gain an understanding of the knowledge people have about this problem, we prepared a special survey with the support of the administration and hunting departments of the regions of Tverskaya, Novgorodskaya and Pskovskaya. The results show a marked decrease of the population of European Mink in all regions and a stable population of the so-called "wild mink".

The most active participants, those who showed their willingness to maintain continued cooperation, were invited to take part in an ecological seminar. Hunters, representatives of the public administration and specialists in hunting breeds participated. The seminar took place on 1-3 September 2001 at the headquarters of the central Forestry reserve. A total of 53 people attended. Talks were given by Russian and CIS specialists on the European Mink, civil servants working at the reserve, and experts in ecology.

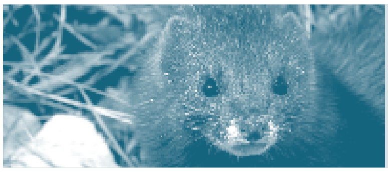
The material produced by the seminar was widely disseminated. 1000 copies of two illustrated brochures were published. The brochures use simple language to present comprehensive information on the European Mink and on the problem of its

EDUCACIÓN ECOLÓGICA ENTRE LOS CAZADORES COMO EL MÉTODO DE LA CONSERVACIÓN DEL VISÓN EUROPEO DE LA RUSIA

El visón europeo de la Rusia Central además de no ser incluído en El Libro Rojo, sigue activamente cazandose. Con eso, la mayoría de los cazadores, y a menudo, de los espesialistas en cinegética no distingue el visón europeo de su omólogo norteamericano; todos ellos están muy mal informados de que el visón europeo está desapareciendo. Además, en la documentación oficial que reglamenta el proseso de la cacería, las ambas especies figuran bajo seudonimo del "visón salvaje". Para cambiar de algún modo la situación formada fue tomada una decisión de trabajar con los participantes inmediatos de la cacería al visón europeo.

En aras de aclarar la situación real de la población de este especie, que está bajo la amenaza de desapareción, y para obtener la visión sobre los conocimientos de la gente sobre este problema, nosotros, con el apoyo de los dirigentes de la administración de los departamentos de la cacería de las regiones Tverskaya, Novgorodskaya y Pskovskaya, preparamos y realizamos una encuesta especial. Como resultado fue confirmada la redución de la población del visón europeo en todas regiones indicadas con la estabilidad relativa de la populacion del " visón salvaje".

Los participantes más activos de esa acción, que mostraron su disposición en cooperación continua, fueron invitados a tomar parte en un ceminario ecólogo-ilustrado. Conjunto con los



explotadores directos de la naturaleza - los cazadores - en ese evento también participaron los representantes de las instituciones de control - los espesialistas en cinegética. El seminario tuvo lugar de 1.09 a 3.09 de 2001 con la cede en la Reserva Forestal Central. La cantidad total de los participantes fue 53 personas. Como ponentes en ceminario participaron los espesialistas del visón europeo de Rusia y del CEI, los funcionarios de la Reserva y los sicólogos en ecología.

Los materiales del seminario fueron divulgados ampliamente. Fueron publicados 2 folletos ilustrados con la edición total de 1000 ejemplares. En ellos con lenguaje simple fue expuesta la información completa sobre el visón europeo y sobre el problema de su desaparición. Esa literatura metodológica fue divulgada entre los cazadores y los espesialistas en cinegética de 5 regiones. De esa manera, esta amplia actividad cubrió el territorio alrededor de 400 mil km cuadrados, el superficie comparado con el teretorio de La España actual, y compone la parte mayor del foco noroeste de la existencia del visón europeo en Rusia. Además fueran realizadas otras acciones con la participación de los medios de la información.

Como resultado de aquel trabajo fue obtenida la información operativa sobre la situación actual del visón europeo. Fueron conseguidos los cambios principales al problema en la actitud de los funccionarios en cinegetica del nivel regional. La divulgación amplia de la información provocó el gran interés entre los cazadores.

De tal modo fue mostrada la posibilidad del trabajo vituo y efectivo de los especialistas en biología y los explotadores directos de la naturaleza – los cazadores, como alternativa del conservatísmo y debilidad del sistema legislativo en área de la protección de la naturaleza.

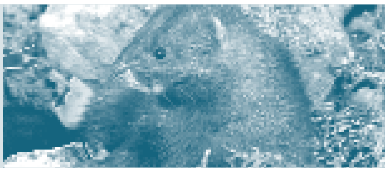
El trabajo está cumplido con el apoyo del National Parks Fund y del Ministerio de los recursos naturales de Rusia.

disappearance. This methodological literature was distributed among hunters and specialists in hunting breeds from 5 regions. This activity thus encompassed an area of around 400,000 square kilometres, comparable to the entire surface of Spain. The area comprises most of the territory in north-western Russia where European Mink is to be found. Other actions were also undertaken in cooperation with the media.

The result of this work was a collection of operational information on the current situation of the European Mink. The most significant achievement was a change in attitude on the part of regional cynegetics in the region. The widespread information inspired great interest in hunters.

The experience shows the possibility of constructive cooperation between biologists and hunters as a means to remedy a weak, conservative legislative system in the area of nature preservation.

The work was carried out with the support of the National Parks Fund and the Russian Ministry of Natural resources.



[The G-, C-, and Ag-Nor banded karyotype of european mink (*Mustela lutreola*)]

Isakova Galina K.
Institute of Cytology and Genetics of the Russian Academy of Sciences, 630090 Novosibirsk, Russia

The karyotype of the European mink, using the G-, C-, and Ag-NOR chromosome banding methods, is described and compared with karyotypes of other Mustelids. Based on these data, a strategy for karyological studies of populations of European mink is suggested to reveal the genotype(s) that have a selective advantage in different environment.

[The european mink in the South Urals]

Kiseleva N.V.
Ilmensky State Reserve of the Urals Branch of Russian Academy of Science

The Urals populations of the European mink is situated on the eastern border of the natural area of this species. Beyond the Urals the European mink doesn't not live.

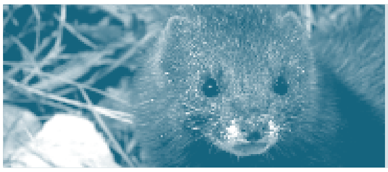
One of the most early mention about Ural populations of the European mink dates from 1762 that the mink was ordinary and numerous animal for hunting. Since the 19th century the intensive exploitation of natural landscapes became the reasons of the degradation of wild nature and of the reduction of species diversity. Now the Urals is one of the most ecologically unfavourable ragion because of overabundance enterprises doing a lot of harm for nature. In spite of this native fauna, flora and games have been remained especially in the mountains.

Recently it was thought that European mink vanished in the South Urals.

Our research was carry out at the rivers of the eastern slope of the Ural mountain range at 400 - 600 m slm in taiga and aimed at the search the inhabitation of the European mink. In 1997 at Tuluk river we found brood burrow of the female of the European mink. Thus, inhabitation of the European mink in Chelyabinsk Region is a proven fact.

Later we found the European mink at the others remote mountains rivers: Uruzan, Berezak. In 2003 at Kutkurka river. The European mink inhabit together with American mink here. The number of the European mink unknoun yet.

The European mink is the most endangered among mammals inhabiting the Urals. It's included in the Red Data Books of the Chelyabinsk, Ekaterinburg, Perm and Orenburg Regions and Bashkiria.



[Comparative analysis of odontologyc anomalies in populations of three kinds of martens (*M. lutreola*, *M. vison*, *M. putorius*)]

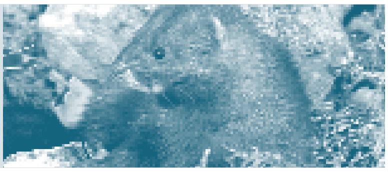
P.Korablev, N.Korablev, V.Korableva
Central – Forest Nature State Biosphere Reserve

There are numerous evidences of the fact, than in small and isolated populations, as well as those of re-introduced ones of animals, the frequency of odontology anomalies grows up considerably. Oligodontia is a commonplace (usual) phenomena in wolves bands (packs) and in cultivating rare breeds of dogs. These facts make it possible to tell with confidence, that the growth in frequency of violations in dental formula has something to do with inbreeding.

Frequency of oligodontia showing has been applied as a qualitative criteria of the inbreeding degree in populations of three kinds of species of marten. Studied have been 987 sculls of American marten (Mustela vizon) and 211 sculls of black marten (Mustela putorius) from the collection of the craniology laboratory of the Central Forest Nature Reserve. The material data were collected (gathered) in the same territory (the Tver Region) within the same time period (in the Years of 1990-2000).

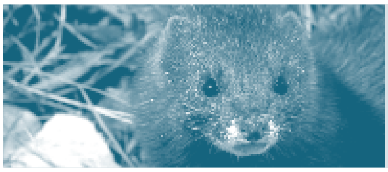
In all three species there were observed similar odontologic anomalies. Most frequently absent there were first premolar tooth (P^1H P_1) and the last lower molars (M_2). However) the frequency of oligodontia showing turned differential (different) (see Table).

Specie	N	Abs.	%
M. lutreola	98	8	8,2
M. vison	228	5	2,2
M. putorius	211	6	2,8



Discovered have been plausible differences (under Fisher' criteria) in frequency of oligodontia showing between M.1. and M. v. (F=5,49), as well as between M.1 and M.p. (F=4,02). Differences between M.v. and M.p. are not plausible (F=0,16).

If hypotheses for an impact if inbreeding onto odontological abnormality is true, one may confirm, that in the population M.1 there is an increased level of inbreeding capacity. At that, previously held comparative studies of three kinds of Marten species on the basis of a wide spectrum of phenetic (phenotype?) characteristics (100 non-metric variations of 20 craniology characteristics) have demonstrated the absence of a broad scale genetic degradation of the European Marten. Enhanced level of inbred capacities with M.1 may give an evidence of insulation of a single unbroken , but not too broad area for a single specie. That results in the formation of isolated groups, which in their totality have sufficient genetic differences. Yet, in case the exchange of genetic data among them turn difficult, that may bring along disastrous consequences, one of the first signs of which is an increased level of oligodontia.



[European mink germplasm cryobank: now or newer]

George Maksudov[1], Vladimir Katchanovsky[2]

[1]Moscow Zoo, B. Gruzinskaya 1, 123242 Moscow, Russia; popovsv@orc.ru

[2]Central Forest State Biosphere Reserve 172513 Tver region, Nelidovo district

AIMS

Because of the dramatically reducing of natural populations, the situation of European mink (*Mustela lutreola*) is alarming and we suppose that foundation of germplasm cryobanks would preserve genetic resources of this species.

METHODS

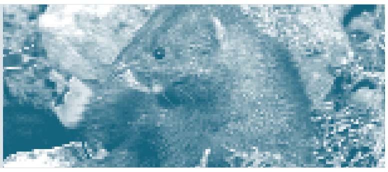
At the beginning, we assumed that the natural population of *M. lutreola* in Nelidovo district is still large enough. Now we are shocked. The reducing rate of this population was extremely high. For three years (2001-2003), we could not capture sufficient European mink males to our goals.

In our experiments we use *M. lutreola* (n=3) and *M. vison* (n=7) males. These animals were captured in nature and hold in captivity.

Electroejaculation is the main techniques of sperm collection from living males of wild animals. This procedure for American mink males has been described. As there are no information about collection of *M. lutreola* sperm available, we based our study on techniques developed on the *M. vison* and adapted it to *M. lutreola*.

We used programming electroejaculator Pulsator IV with hand-made probes (D=6 mm) with three longitudinal electrodes.

For immobilization was used inner-muscular injection of rometar with imalgen (1:1). Dose of 0,25 ml was enough to immobilize *M. lutreola* for 45 minutes.



Semen samples were examined by standard parameters: volume, motility, concentration, morphology and pH. We tried to analyze concentration of ATP and activity of some enzymes, but the amount of semen samples was insufficient.

RESULTS

Standard program resulted in a successful semen collection for two *M. lutreola* (66.6%) and five *M. vison* (71.4%).

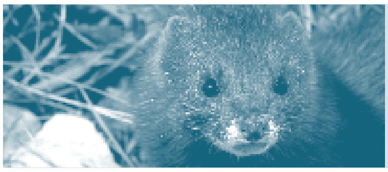
In both species testis volume reduced about three times to the end of reproductive season. Semen parameters varied over wide range: ejaculate volume differs from 45 µl (*M.lutreola*) to 200µl (*M. vison*); sperm concentration - from 3.7 10^7 cells/ml to 2.0 10^8cells/ml accordingly, and motility - from 30 to 80% in different males. The pH was about 6,4. Total semen volume collected from *M.lutreola* males was no more than 100 µl and these samples were used to sperm analysis.

We found out that experimental manipulations did not negative affect for animals health.

CONCLUSIONS

Unfortunately, we could not perform all goals to be sought, but our results clearly demonstrated that creation of *M. lutreola* germplasm cryobank is urgent.

In nearest future cryobanks will be unique sources of genetic resources for restoring biodiversity of natural and artificial populations of European mink.



[Hematologic and serum chemistry values of free ranging European mink]

Sisco Mañas[1], Jaume Rodon[2], Asunción Gómez[3], Santiago Palazón[1,4] and Jordi Ruiz Olmo[1].

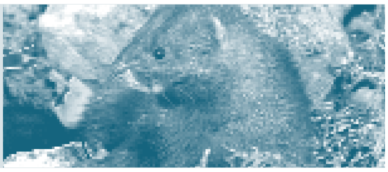
[1]Departament de Medi Ambient, Generalitat de Catalunya, Dr. Roux, 80, 08017 Barcelona, Spain, sisco.emink@terra.es; [2]Laboratorio Vet Lab, Miguel Hernández, 77, Balaguer Centre, 08908 Hospitalet de Llobregat, Barcelona, Spain; [3]Bajada al Molino, 14, 09400 Aranda de Duero, Burgos, Spain; [4]Departament de Biologia Animal, Vertebrats, Facultat de Biologia, Universitat de Barcelona, Avda. Diagonal, 645, 08028 Barcelona, Spain.

The European mink (*Mustela lutreola*) is one of the most threatened terrestrial mammals in the world. Conservation strategy involve captive breeding and reintroductions projects and close management of animals are required.

Normal hematological and serum biochemical values would be essential for evaluation of nutritional status and physiologic and pathologic alterations in wild minks as well as captive minks. Aids in the assessment of health and disease, evolution of diseases and as reference data for the clinical screening necessary before any reintroduction program. Deviation from established standard values may reflect nutritional disorders or the presence of disease.

Hematologic and biochemical values of 46 apparently healthy wild-caught adult European mink are presented as baseline information for use in further medical studies performed. Blood samples were obtained by jugular venipuncture after intramuscular administration of ketamine and medetomidine or direct induction with isofluorane in a den box through precision vaporizer.

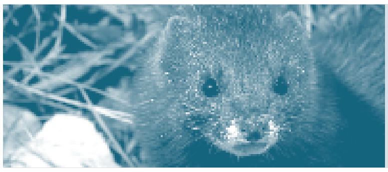
When all animals were pooled, there were some significant differences in hematologic and serum chemistry parameters between sexes. Significant differences were detected for red blood cells, hemoglobin, packed cell volume, total plasma protein, alkaline phosphatase, total serum protein, percentage of albumin, concentrations of Alpha 2 globulin and Beta globulin and albumin/globulin ratio. No significant differences were observed between males and females for the rest of parameters.



In spite that some parameters show significant differences between sexes, we believe that a single reference range can be used for hematologic and serum chemistry data for both male and female European mink because differences found seem to be of little clinical value.

Presence of normal hematological and serum biochemical profiles should be included in the criteria for reintroduction programs

This research is included in the LIFE European mink conservation projects numbers: LIFE00NAT/E/7299; LIFE00NAT/E/7331; LIFE00NAT/E/7335 and LIFE02/NAT/E/8604 developed by the Governments of La Rioja, Junta de Castilla-León, Diputación Foral de Alava, Generalitat de Catalunya and Ministerio de Medio Ambiente.



[Incidence of aleutian mink disease parvovirus in a monitored population of European mink]

Sisco Mañas[1], Asunción Gómez[2], Santiago Palazón[1,3], Alfonso Ceña[4] and Jordi Ruiz Olmo[1].

[1]Departament de Medi Ambient, Generalitat de Catalunya, Dr. Roux, 80, 08017 Barcelona, Spain, sisco.emink@terra.es; [2]Bajada al Molino, 14, 09400 Aranda de Duero, Burgos, Spain; [3]Departament de Biologia Animal, Vertebrats, Facultat de Biologia, Universitat de Barcelona, Avda. Diagonal, 645, 08028 Barcelona, Spain; [4]Mª Teresa Gil de Gárate, 70, 1ºB, 26002 Logroño, Spain.

Aleutian mink disease parvovirus (ADV) is a common persistent viral infection of American mink and ferret population worldwide. ADV is highly persistent in the environment, can be spread by asymptomatic carriers, and transmission can be both horizontally and vertically.

After detection of the first European mink ADV seropositive in 1997 in Spain, health monitoring of the population was considered of importance for its conservation.

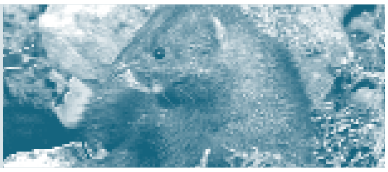
Evolution of serologic results in recapture animals for a long time period provides important information about the presence of the disease in the population.

Between October 2001 and April 2003, 16 European mink were recaptured for a long-term study for census or radiotracking purpose. Blood samples from these animals were taken for serologic study of the disease. Identification of animals were made by subcutaneous transponder.

Preliminary results suggest that incidence of the disease in the monitored population is included in a range between 57,7 and 84,8% per year.

Close study of the population density to assess the effects of the disease in the overall of the population is recommended.

This research is included in the LIFE European mink conservation projects numbers: LIFE00NAT/E/7299; LIFE00NAT/E/7331; LIFE00NAT/E/7335 and LIFE02/NAT/E/8604 developed by the Governments of La Rioja, Junta de Castilla-León, Diputación Foral de Alava, Generalitat de Catalunya and Ministerio de Medio Ambiente.



[How to characterise hyper-aggression in European mink *Mustela lutreola* (L., 1761)? development of a character test with particular emphasis on hyper aggressive males]

Peters E., Kindermann A., Kümmel C. and Seebass C.

University of Osnabrück, Barbarastr. 11, 49069 Osnabrück

email: peters@biologie.uni-osnabrueck.de

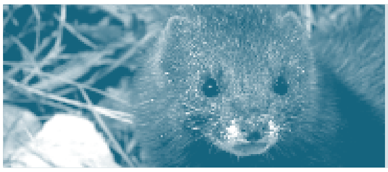
The European mink *Mustela lutreola* (Linné, 1761) is one of Europe´s most endangered carnivores, with few vulnerable populations remaining. In conservation breeding of the European mink about 75 % of males and 25 % of females are not able to reproduce. Both, males and females, react with hyper-aggressive attack and defence when mating is attempted. Although it is not sure, whether this behaviour appears only on a phenomenon of conservation breeding or is shown in nature too, this hyper-aggressive behaviour has to be characterised. Therefore we performed a character-test, in which two groups of European mink males (hyper-aggressive males and kind ones) were first tested in an open field and afterwards confronted with different novel objects, a stone scent-marked by a dominant kind male, different sound sequences recorded from a female E. mink, a mirror, a model of a female E. Mink, as well as living counterparts (male and female). These tests were done in winter and spring, respectively.

We investigated the reaction on novel objects in a test-area consisted of a home cage (containing water), an empty compartment, and a compartment closed by a opaque gate valve, where the test-objects were set up.

The trials were conducted on two consecutive days with two runs in the morning and in the afternoon, respectively. The test-animal was allowed to stay in the test-area (home-cage and empty compartment) one night before tests were started and during the 2 days, tests were performed. Each object was tested three times for 10 min maximum with breaks of ten minutes in between. Before changing the object, the animal was allowed to rest at least 30 minutes. Feeding was done every evening.

To allow a direct contact with the test-objects, tests were started by removing the opaque gate valve. Experiments with living counterparts were not possible by direct contact with each other, so they were done by olfactory and visual contact only.

To witness the minks' reactions towards the test-object, each test was monitored and filmed on video-tape in order to study the males´ behaviour. Results concerning reaction towards the trest objects, will be presented in dependence to mating success.



[Action plan for the captive breeding of European mink in Spain: the Pont de Suert centre]

Sisco Mañas[1], Santiago Palazón[1,2], Jordi Ruiz-Olmo[1], T. Maran[3], W. Festl[4] and C. Seebass[4].

[1]Departament de Medi Ambient, Generalitat de Catalunya, Dr. Roux, 80, 08017 Barcelona, Spain, sisco.emink@terra.es; [2]Departament de Biologia Animal, Vertebrats, Facultat de Biologia, Universitat de Barcelona, Avda. Diagonal, 645, 08028 Barcelona, Spain; [3]Foundation "Lutreola", Tallinn Zoo, Paldiski Road 145, 13522 Tallinn, Estonia.
[4]EuroNerz e.V., Borgloher Str. 13, D-49176, Hilter a.T.W., Germany.

The European mink (*Mustela lutreola*) is one of the most endangered carnivore mammals in the world. Although the species was once widely distributed throughout Europe, its distribution is now restricted to a small fraction of their historic range. This fast process of extinction has led to a very precarious world situation for the species.

Recent studies on phylogeny of the European mink seem to show that there are certain differences that would advise, at least for the moment, to keep its populations from the East of Europe with that ones from the West separated from each other in preservation programmes, captive breeding or reintroduction.

The fact that there is no stock of captive specimens from the western population means the situation is highly vulnerable. Due to the high risk of extinction and lost of genetic material, creation of a captive stock of animals from western population and start of captive breeding was considered essential for its conservation.

Aims of the Action Plan are:

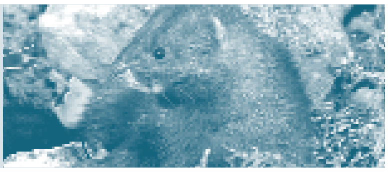
The maintenance of a stock of captive European minks from the western population.

Breeding captive animals to maintain genetic material and production of useful animals, able to reproduce in nature.

Applied research.

Creation of a Bank of Genetic Resources (deep freezing tissues and cells culture).

The major aim of this Action Plan is the recovery and long-term preservation of the species in the western nucleus, assuming that the basis for preservation should be centred on the work carried out "in situ".



The Captive Breeding Programme involve:

Creation of Breeding Centres. Captive stock distributed among several separate centres with high capacity.

Capture of 20 founders specimens from the wild. A demographic study will determine ages, "sex-ratio" and time and areas in which the impact of the removal of specimens on the population will be lowest.

Genetic and demographic programmes with the captive population.

Development of health protocols with regard to the inclusion of new specimens in the stock, maintenance in captivity, exchange-transfer of specimens between centres and projects to reintroduce-reinforce the population.

The proposal to create the breeding centre in El Pont de Suert (Lérida, NE Spain) is due to:

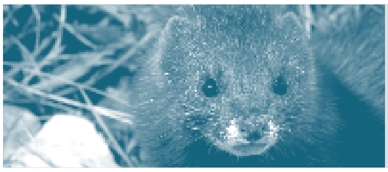
The experience of the centre in handling semi-aquatic carnivores, Climate factors and Separation, both from the distribution area of the species and from the wild populations and farms of American mink.

The property destined has an area of 2.970 m2 and will be divided into two sections: the mink enclosures and the annexed building.

Mink enclosures will be built for 64 adult specimens (64 outdoor naturalised installations with riverbank vegetation and running water). Each enclosure will have an outdoor area of 16 m^2 as well as an indoor area (nesting boxes). The enclosures will be adapted so that they can be divided into two smaller enclosures of 8 m^2 depending on the future needs of the centre. The total number of animals that could be maintained in the future would be 112, in 8 m^2 enclosures.

Annexed building will have a surface area of 140 m^2 with study room, lavatories, kitchen and the handling facilities: quarantine, treatment, hospitalisation and surgery rooms.

To safeguard the assumed subspecies from western mink population it will be necessary to create new centres with large capacity, to start a breeding programme in France with capture of new founders and the co-ordination of animals from western population as a single captive population.



[Hydro-electric power stations ecological affections on the European mink (*Mustela lutreola*, Linnaeus 1761) and design of corrective measures]

EFECTOS AMBIENTALES DE MINICENTRALES HIDROELÉCTRICAS SOBRE EL VISÓN EUROPEO (*Mustela lutreola* Linnaeus, 1761) Y DISEÑO DE MEDIDAS CORRECTORAS

El objetivo de este trabajo es el análisis de los efectos de pequeños aprovechamientos hidroeléctricos sobre las poblaciones de visón europeo (Mustela lutreola Linnaeus, 1761) y la propuesta de diseño de medidas correctoras y protectoras con el fin de compatibilizar la conservación y mantenimiento de esta especie y el aprovechamiento hidráulico de un determinado tramo fluvial.

Desde el punto de vista metodológico, se ha partido del seguimiento de visón europeo y de otras especies afines (nutria y visón americano) en distintas minicentrales de las comunidades autónomas de Galicia y Castilla y León. Así mismo, se ha comprobado la adecuación del diseño y la eficacia que tienen las distintas medidas correctoras en desarrollo y aplicación con objeto de minimizar los impactos residuales en cada uno de los aprovechamientos.

Teniendo en cuenta estas experiencias, se diseñan y proponen las siguientes medidas correctoras para su discusión, ya contempladas en varios proyectos de pequeños aprovechamientos:

Programas de protección y recuperación de riberas

F. Mariño, I. Rodríguez and F. J. Benítez

The goal of this survey was to examine the effect of small-scale hydroelectric power plants on the populations of European Mink (*Mustela lutreola*, Linnaeus 1761) and to make a proposal for the design of corrective and protective measures in order to make the preservation and survival of these species compatible with the hydroelectric use of a given river stretch.

From a methodological viewpoint, monitoring activities were carried out on European Mink and other similar species (Otter and American Mink) in various mini-hydroelectric power plants in Galicia and Castilla-León. Appropriateness of design and the effectiveness of corrective measures were also examined in order to find a way to minimise the residual impact of each of the power plants.

From the experience gained, the following corrective measures —already considered in several power plants— were proposed for discussion:

River bank protection and recovery programmes

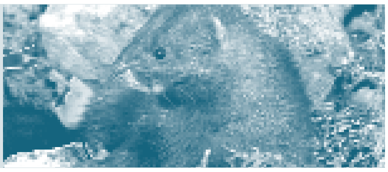
Ravine restoration programmes

Fish passes large enough for minks to pass

Repellent systems based on ultrasounds and light equipment

Passes on the edges of dams

Management and maintenance of ecological flows that take this species into account



To asses the effect of small hydroelectric plants on the European Mink, and to check the effectiveness of the corrective measures, complete environmental monitoring of the power plants during their first ten years was proposed.

From the data obtained during this monitoring process, we will be able to assess and correct residual effects on the European Mink after the application of the proposed corrective measures.

Programas de restauración de galachos

Escala de peces con medidas adecuadas para el paso de visones

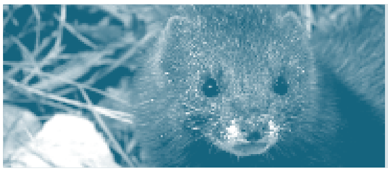
Sistemas de repulsión con ultrasonido y equipos luminosos

Pasos y franqueos de los estribos de los azudes

Gestión y mantenimeinto de un régimen de caudales ecológicos que considere a esta especie

Para valorar los efectos de los pequeños aprovechamiento hidroeléctricos sobre el visón europeo y comprobar la eficacia de las medidas correctoras, se propone, finalmente, un completo seguimiento ambiental de las instalaciones durante sus primeros diez años de vida útil.

A partir de los datos obtenidos en este seguimiento, se estará en disposición de valorar y corregir los efectos residuales sobre el visón europeo que permanecen tras la aplicación de las medidas correctoras propuestas.



[Different methodologies for American mink control]

Santiago Palazón[1,2,3] , Jordi Ruiz-Olmo[2], Yolanda Melero[3]

1Coordinator for National Strategy for European mink Conservation in Spain. 2Environment Departament, Generalitat de Catalunya, Dr. Roux, 80, 08017 Barcelona, Spain, santiago.palazon@correu.gencat.es; 3Animal Biology Departament, Barcelona University, Avda. Diagonal, 645, 08028 Barcelona, Spain.

Before start a control (lethal o de fertility) of an animal population, introduced (American mink) or no, several questions, as environment safety, the level, the urgency and the duration of population decrease, the effective of methodology, the public opinion and ethic attitude, the status, the population dynamic and the ecology of species and, the consequences of nothing to do, must be considered. Every control must be done with the minimum risk, without affect the ecosystem value and without inflict suffering to animal.

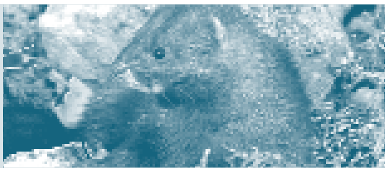
Populations may be controlled by means of: Increase of mortality rate (lethal control). Decrease of natality rate (fertility control). Increase of emigration (repellents and frightened mechanisms). Decrease of immigration (repellents and frightened mechanisms).

In several countries (for instance, Estonia, England, Scotland, France, Dinamarca, Russia), attemps of American mink control or erradication were carried out, mainly using trapping methods. In Spain, American mink trappings are carried out on Teruel, Burgos, Alava, La Rioja and Catalonia.

In New Zealand and Australia, the studies and projects carried out to control and reduce the introduced carnivores populations (weasels, ferrets, stoats, foxes and domestic cats) are very important to develope specifics methods in the future with the object of eradicate the American mink where this species is a invasice exotic species.

The traditional methods (intense trappings) try to get more efficient baits, lures and traps. The poison is a high risky method to apply in Europe, where inhabits a lot of species of native carnivores, although new and very specific poisons will be discovered.

Inside of non lethal methods are the repellents, the fertility control (projects to long time by means of quirurgic sterilization, inmuno-contraception o inmunoesterilización vaccines, agents of mortality, chemical agents –quimioesterilization- and, lethal agents of biocontrol.

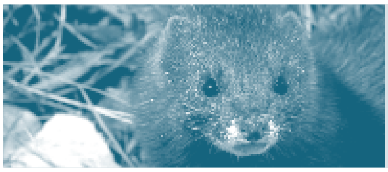


The manipulation of diseases and the biologic control are methods to study in the future.

All this experiences about American mink captures must be puestan en común to redirigir the next trapping campaigns to obtain a higher effectivity. Before to start a intense trapping in great zones with American mink presence is necessary the achievement of tests about the effectivity of capture according to the type of trap used (two types of traps), the bait used (dead or alive baits, eggs, fish, fresh meat, etc.), the lure used (natural or artificial, oil, orine, or mink lure), the capture period -mating season (February-April), breeding season (April-June) and dispersal season (Setember-December).

To undertake the eradication of an American mink population, social structure of species, the mating system (delayed implantation of fecunded óvul, a litter a year, length and period de la gestación), the endocrinology of species, must be taken into consideration.

To choose the fertility control system and timing, the esterilización of females and males (a male can fecundate a lot of females; alpha males and females were not known), to eliminate the offspring before they arrive to reproductive age (female spends much energy in lactación and the care of litter). Use of fertility control vaccines promise to be the best, the most effective method, the most human and the most protector of environment.



[Female choice amongst European mink *Mustela lutreola* (L., 1761) with a particular emphasis on the discrimination against kinship]

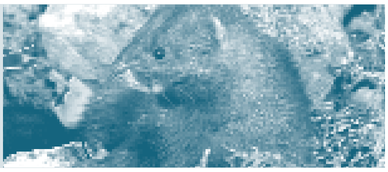
E. Peters, M. Tepe, F. Villwock: University of Osnabrück,
Barbarastr. 11, 49069 Osnabrück, email: peters@biologie.uni-osnabrueck.de

The European mink *Mustela lutreola* (Linné, 1761) is one of Europe´s most endangered carnivores, with few vulnerable populations remaining. In conservation breeding of the European mink about 75 % of males and 25 % of females are not able to reproduce. Both, males and females, react with aggressive attack and defence while paring contact. The reason for this behaviour is probable founded in the artificial and restricted selection of sex partner by means of the breeder. It is not sure whether this behaviour appears only due to a phenomenon of conservation breeding or is shown in nature, too. Therefore, this research concentrates on the mating behaviour of European minks.

In the first study, male and female minks, respectively had the opportunity to choose from two offered partners in a specially built testing arena. Each combination was done once. To witness the minks' reactions towards each other and the process of partner choice, every test was monitored and filmed on video-tape in order to study the test-animals behaviour. In addition to this criterion, the time the test-animal spent with a specific partner was also used for the evaluation. The observations were conducted during the females' mating time between March and June. The sexually mature European minks that have been used in the experiment derived from breeding stock in Novosibirsk, Russia, and their offspring in Osnabrück, Germany.

Results of the first study indicated a female choice amongst E. mink and gave hints for a discrimination against relatives.

To elucidate the femals´s role in mate-choice, research was therefore concentrated on the hypothesis, that during the search for a potential partner the female E. minks discriminate against relatives when having the choice from a range of different males. Thus, in the second study nine female minks had the opportunity to choose from her father, her brother and two other males (non-relatives). Furthermore, the trials were conducted on two consecutive days with one run in the morning and another in the afternoon. The female mink and her chosen partner were then brought together to allow a possible sexual intercourse.

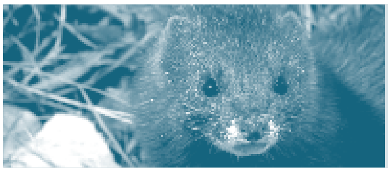


Results showed, that female E. mink chose a male from the offered group more often than they did not choose at all, verifying the first results. They also decided against hyper-aggressive males and against their brothers. However, they did decide on their fathers, which is in contrary to the hypothesis, Mustela lutreola females do discriminate against their relatives in the search for a potential partner.

Since in the second study the range of different males (non-relatives) was quiet low and one of them was known as hyper-aggressive, experimental design was changed in the third study. Seven female E. minks had the opportunity to choose from their father and two other males (non-relatives), all known as reproductive ones. Second, we gave the females the opportunity to choose from a dominate and a subordinated male. Additionally, tests were done in the pre-mating season and in the mating season, respectively.

Results of these trials showed, that all female E. mink chose a non-relative male, indicating a discrimination against relatives within E. mink. Thus, the present study is the first to show that the female E. mink is selective in the choice of its mates.

Furthermore, six female E. minks chose the same male, they preferred the mating season before or during the pre-mating tests. Their decision seems to be made up during the pre-mating season, indicating a female choice in E. mink at least some month before the start of the mating season.



[Observation of the behaviour amongst a European mink family, *Mustela lutreola* (L., 1761) in an outdoor arena with a particular emphasis on the presence of the father]

E. PETERS AND K. ZAKZEK: UNIVERSITY OF OSNABRÜCK,
Barbarastr. 11, 49069 Osnabrück, email: peters@biologie.uni-osnabrueck.de

To ensure the survival of one of the most endangered mammals worldwide, the University of Osnabrück (Germany) in cooperation with Euronerz e.V. (association for the conservation of the European mink) has founded a breeding programme for the European mink *Mustela lutreola* (LINNÉ, 1761) in 1997. Unfortunately, breeding European mink in captivity is highly problematic. The animals' behaviour towards each other, during their mating time is of an extremely hyper-aggressive nature in most cases. In 75% of the attempted couplings a successful copulation is prevented due to males' behaviour. The number of individuals in the breeding stock is therefore dangerously low.

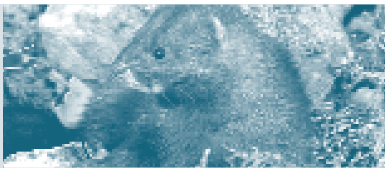
This phenomenon is perhaps caused by the minks' upbringing and their living conditions so that one major field of research at the university is the largely unknown juvenile development of European minks.

As traditional keeping methods cannot guarantee a success in breeding, alternatives have been developed. This research concentrates on the ontogenesis of young European minks growing up in the company of both, father and mother.

For the first time ever, a European mink family were thus kept together in an outdoor arena in order to study the possible influence on the young by the presence of the father.

The observation started at the end of July when the kits were eight weeks old and ended at the age of 13 weeks. Each observation was divided up to two units per day during which the group's behaviour was continuously sampled.

Thus, results show that the father plays a highly important role in the juvenile development of European mink kits. Socio-positive contacts dominated the relationship between the male and his offspring throughout the observation. Extensive play behaviour and friendly encounters were the most common constituents within the contacts. Over sixty per cent of the recorded overall play actions were performed by the father and his young. Moreover, the play sequences were not only initiated by the kits, but also by the male itself.



The female did not show as much socio-positive behaviour as the male. Her most prominent feature was the supplies of food for her offspring which mounted to nearly eighty per cent of her positive actions. Play was hardly ever observed and friendly contacts with her kits were rare.

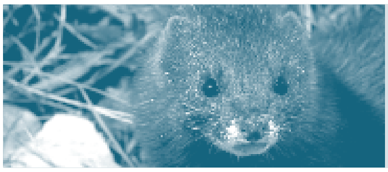
Although both parents exhibited a more friendly than unfriendly attitude towards the young, the mother showed far less socio-positive behaviour.

Socio-negative actions were also recorded throughout the experiment, but only from approximately the twelfth week onwards did they become more serious. Violent attacks against the kits were recorded, every single one originated from the mother. In most cases the recipient was the female kit so that she was taken from the group at the end of the fourteenth week.

The group lasted for another two weeks before the remaining (all-male) kits had to be separated from the parents due to antagonistic behaviour exhibited by the father.

Afterwards, the parents, however, were still being held together in an arena like the siblings until the next mating period. In the following mating season, we have tested these males and all of them behaved kindly with female counterparts in mating processes.

To verify the recorded data the experiment will be repeated in 2003 with a stronger and detailed observation concerning play behaviour and communication. Further results will be presented.



[Social stress during pregnancy and laction affects the male offsprings endocrine status and behaviour in European mink]

PETERS E. AND DEHNHARDT M.*: UNIVERSITY OF OSNABRÜCK,
Barbarastr. 11, 49069 Osnabrück, email: peters@biologie.uni-osnabrueck.de

The European mink *Mustela lutreola* (Linné, 1761) is one of Europe´s most endangered carnivores, with few vulnerable populations remaining. In conservation breeding of the European mink about 75 % of males and 25 % of females are not able to reproduce. Both, males and females, react with hyper-aggressive attack and defence when mating is attempted. The reason for this behaviour is probable founded in a stressful situation during offspring´s ontogenesis. We hypothesised, that stress in European mink ontogenesis might be due to high numbers of animals in breeding stations. It is not sure, whether this behaviour is shown in nature, too. However, since American mink, *Mustela vison* (Schreiber 1777) is occupying breeding areas of the E. mink, the A. mink might be the stress factor in E. minks´ ontogenesis and therefore responsible for its´ extinction.

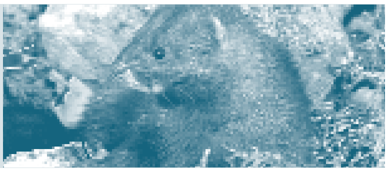
To investigate this effect, we have performed two experiments with females of European mink, living in outdoor-enclosures. Next to them, we caged an American mink female from 2 hours up to 7 days maximum. Exposure time was randomized. The enclosures allowed olfactory and visual contact.

In the first experiment, we have tested females reactions´ towards A. mink for two weeks.

The second experiment, we did during the ontogenesis of their young. One female E. Mink was tested in lactation phase, the other female was tested during pregnancy and lactation-phase, respectively. Exposure-experiments were finished by the end of lactation-phase after 12 weeks. The mothers were separated from their young, which stayed together at least for another 2-3 month.

To witness the minks' reactions towards American mink, the behaviour was recorded on video for at least the contact period.

Cortisol levels were analysed of females of Experiment 1 and of one mother and her offspring (3,1) in the age of 14 weeks (Experiment 2).



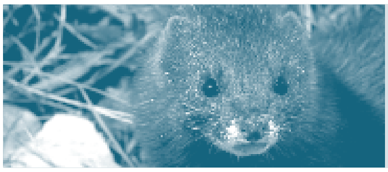
Blood-samples were taken before the experiments have started, after 2 hours, 1, 2, 3, 6 days contact with A. mink, respectively and 2 hours, 1,2, 3 and 6 days after contact with A. mink was stopped.

Within 2 hours of contact with A. mink cortisol levels of mother and her offspring were at least 4 times higher than normally. After 3 days of contact, cortisol started to decrease again. No contact with A. mink for 2 days decreased cortisol to normal. Short exposure to A. mink might therefore be more fatal with respect to stress on the E. mink in early ontogenesis.

During the following three mating periods these kids, raised under stressful conditions, and their mothers were tested in sexual intercourses. Our results show, that all kids (3,4), were hyper-aggressive against potential sexual partners. Both mothers showed not mating readiness during the following mating period and had no reproductive success during the next two years, respectively.

Further results with respect to behaviour during experimental trials and cortisol levels will be presented.

* M. Dehnhard, Institut für Wildtierforschung, Berlin, Endokrinologie, was responsible for analysing cortisol levels



[Humoral immune response after canine distemper vaccination in European mink]

J.D.W. Philippa, T. Maran, M.W.G van de Bildt, A.D.M.E Osterhaus

All families of the order *Carnivora* are susceptible to infection with canine distemper virus (CDV), which is among the most significant infections in these species.

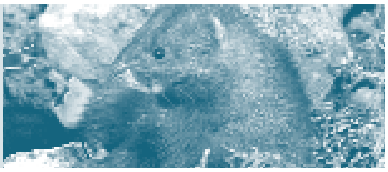
In domestic dogs the pathogenesis and immunoprophylaxis have been well studied, and several commercial vaccines have been produced. These live, attenuated vaccines have induced disease in European mink (*Mustela lutreola*), as well as in several other non-domestic species (e.g. in black-footed ferrets, *Mustela nigripes*, red pandas, *Ailurus fulgens*, gray foxes, *Urocyon cineroargenteus*, fennec foxes, *Fennecus zerda*, maned wolves, *Chrysocyon brachyurus*, bush dogs, *Speothos venaticus*, African wild dogs, *Lycaon pictus* and kinkajous, *Potus flavus*).

Considering the high incidence of vaccine-induced disease, monovalent killed virus vaccine (KV) is therefore recommended for use in non-domestic species. However, there is currently no KV commercially available. Other options are subunit vaccines which cannot induce distemper in the vaccinated animals.

The high susceptibility of European mink to CDV infection underpins the need for a safe and efficacious CDV vaccine to provide an adequate level of protection in rehabilitation/breeding centres, or other places with a high population density.

In this study we compared the humoral immunogenicity of two different vaccines in captive European mink: a recombinant vaccine using a canarypox vector, and an experimental ISCOM vaccine using the haemagglutinin and fusion proteins of CDV. 2 groups of 6 minks were vaccinated with either vaccine, 3 times with 3 weeks interval, and blood was collected at the time of vaccination and 3 weeks after the last vaccination. ELISA and virus neutralisation tests were performed to determine the antibody response.

Both vaccination groups responded with a CDV-specific antibody response, while the control group remained negative.



[New control methodology of the American mink in Alava]

Javier Pinedo, Joseba Carreras, Jacinto García, Fernando Gómez, Juan Carlos Ruiz de Alegría, Andoni Berganza, Tomás Landa, Andoni Díaz, Fernando Santamaría, Ramiro Asensio, Juan Buesa, Miguel Buesa.

Alava Provincial Government. Nature Conservation Service. Alava Land Fisheries Federation

First fur farms with American Mink (*Mustela vison*) in Alava. First appearances of American Mink in the rivers of Alava in the 1980s, in the Zadorra river. Closing of the last two farms in 1999.

A lack of knowledge of the feral potential of the species, a lack of legal control on the fur farms, the difficulty of locating them because of their small size and a lack of knowledge about the situation of the population of the European Mink in Alava resulted in some specimens that had escaped from fur farms colonising the rivers in Alava. The first specimens of American Mink were spotted in the Zadorra basin. At a later date, feral specimens were found in the Bayas river, where many people mistook them for otters.

In June 2000 the first kit of American Mink born in nature was detected in the Zallas river, an affluent of the Zadorra.

Since 1997, different attempts and initiatives have been made to control the American Mink in several rivers in Alava, with few captures except along the Zadorra river. Complete eradication has never been achieved and trapped territories have been colonised again by specimens from neighbouring areas. In 2001 a special box trap was designed for the American Mink and in July 2002 the Fishing and Hunting Forestry Guards of the Provincial Government and the River Supervisors of the Alava Land Fisheries Federation were prepared to design a Strategy of eradication covering the whole province, with teams of two guards acting in specific stretches, with notable success: sixty American Minks were captured in only four months.

The design of the Control Strategy, the areas of implementation, the efficiency of captures and a summary of captures are presented.

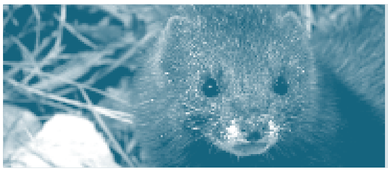
Las primeras granjas de visón americano (Mustela vison) en Álava. Primeros apariciones de visón americano en los ríos de Álava en la década de los ochenta, en el río Zadorra. Cierre de las dos últimas granjas en 1999.

El desconocimiento del potencial de asilvestramiento de la especie, la falta de legalidad de dichas granjas, su difícil localización a ser de pequeño tamaño y el desconocimiento sobre la situacion de la población del visón europeo en Álava, supuso que algunos ejemplares esacapados de las granjas colonizaran los ríos de Álava. Los primeros ejemplares de visón americano se localizaron en la cuenca del Zadorra. Posteriormente se encontraron ejemplares asilvestrados en el río Bayas, donde muchas personas los confudieron con nutrias.

En junio de 2000 se constató la primera cría en la naturaleza del visón americano en el río Zallas, afluente del Zadorra..

Desde 1997 se han desarrollado diferentes intentos e iniciativas de control de visón americano en varios ríos de Álava, con pocas capturas excepto en el río Zadorra y sin conseguir un descaste absoluto al volver a recolonizar los territorios trampeados, con ejemplares de los alrededores. En el año 2001 se diseñó una caja-trampa especial para el visón americano y en julio de 2002 se preparó a la Guardería Forestal de Caza y Pesca de la Diputación Foral y a los Vigilantes de Ríos de Federación Territorial de Pesca de Álava, para diseñar una Estrategia de Control o descaste abarcando en conjunto todo el Territorio, con cuadrillas de dos guardas y actuando en tramos concretos, con notable éxito, capturándose de esta manera más de sensenta visones americanos en sólo cuatro meses.

Se presenta el diseño de la Estrategia de Control, las zonas de actuación, la eficacia de capturas y el resumen de capturas.



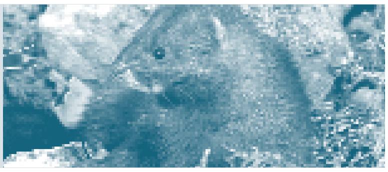
[Trials to test the interspecific aggressiveness between aboriginal European mink (*Mustela lutreola*) and introduced American mink (*Mustela vison*) in captivity]

Merje Põlma

One of the possible causes of the European mink's disappearance could be the introduction of American mink into its range. In Estonia, Belarus and several regions of Russia the decline of European mink and the invasion of introduced American mink have coincided. The impact of American mink has been explained in several non-exclusive ways including direct interspecific aggressivity. Larger American mink may oust smaller native species from optimal habitats.

The aim of our study was to test in captivity is the reaction of minks to the congeneric opponent same as their reaction to the conspecific opponent and are American minks more aggressive towards European minks in the interspecific interactions than vice versa. The study was carried out from early September to late December in 1997 and 2002 at Tallinn Zoo. The behaviour of 24 male and 14 female European minks, 4 male and 4 female American minks was studied, some of them were wild caught, some were born in captivity. Each mink was tested 4 times and his or her reaction to the different opponents (conspecific male, conspecific female, congeneric male, and congeneric female) was recorded. The opponent mink was captured into a wire mesh cage (30 x 30 x 30) and placed to the enclosure of test animal. During 15 minute trials we recorded how long the test animal was in close contact with cage and was this contact aggressive (attacking) or cautious (staring, sniffing).

The results show that males and captive born individuals were longer in close contact with opponent. Male European minks had significantly more close contacts with other male European minks than with American minks. Male American minks approached more to European minks than to conspecific opponents but this difference was insignificant. Male American minks approached more to European minks than vice versa. The difference was significant if we analysed separately wild born males. We did not find significant differences in the reaction of females towards different opponents.



[The activity of the centre for European mink conservation at the Biological Station «Tchernogolovka» of the A.N. Severtsov Institute of Ecology and evolution, Russian Academy Sciences]

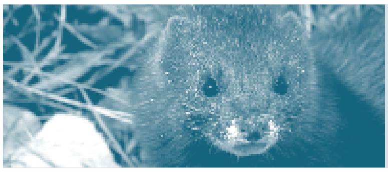
Rozhnov V.V.
A.N. Severtsov Institute of Ecology and Evolution, RAS, Moscow, Russia

The Centre for European mink conservation is created for realisation of actions on the support of the European mink nature populations, at the Biological Station «Tchernogolovka» (60 km from Moscow) of the A.N. Severtsov Institute of Ecology and Evolution, Russian Academy of Sciences.

The main aim of the Centre is creating of the scientific basis and methods of European mink farm-breeding, and studying of possible reasons of its disappearance. One of the purposes of the Centre activity is creating the Strategy of European mink conservation in Russia, according to specific strategies creations in «Strategy of conservation of rare species in Russia». There is a Data Base of captive European mink in the Centre for releasing of the same genetic status European mink to nature populations. One of the first aims is the renewal of the project on European mink re-acclimatisation at Valaam Island in the Lake Ladoga (natural European mink area). We make a reproductive population of European mink in captivity to conservate this species and to set out animals to nature populations as well as to study the relationships of closely related species in experiment and to create a criobank of genetic material.

There are special cages and experimental enclosures of different size including transformed 120 m2 enclosures for European mink farm-breeding and study of peculiarities of interspecific interactions between close-related mink species. It is possible to create natural interior in such enclosures and to use them for the «method of animal adaptation for nature» before releasing in order to support European mink nature populations. Several couples of European mink are kept in the Centre for European mink conservation now. We plan to increase European mink captive population up to 10-20 couples.

The activity of the Centre for European mink conservation at the Biological Station «Tchernogolovka» of the A.N. Severtsov Institute of Ecology and Evolution, Russian Academy of Sciences, is a part of «National Action Plan for biodiversity conservation in Russia», in which the scientific basis of breeding and keeping of some wild animals is of a priority significance.



[European mink and trapping russian phenomenon]

Alexander Saveljev & Dmitry Skumatov

Russian Research Institute of Game Management and Fur Farming (VNIIOZ) RAAS 79, Engels Str. Kirov 610000 RUSSIA

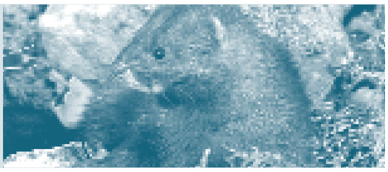
e-mail: saveljev@vniioz.kirov.ru

Today Euromink (EM) trapping is not illegal in Russia, because «wild mink» harvesting is permitted in a taiga zone. Under that name two mink species are meant, including American mink (AM). The role of trapping in EM preservation does not have a single meaning. Formally EM is entered in the lists of endangered species of many regions of the eastern part of European Russia and Ural mnts, but it does not have any impact on the improvement of a situation concerning that species. The purpose of the present paper is to estimate the importance of trapping in population dynamics of two mink species in one of major hunting regions of Russia.

The data were collected in 1995-2003 (in 11 regions of Russian Federation). Field observations, census and capturing of animals were carried out in Kirov, Nizhni Novgorod and Komi regions. The questionnaires of trappers, regular respondents of VNIIOZ, were used. The species identification of wild mink pelts in private fur companies in Kirov was carried out.

Today in the region of studying AM is not found only in the Mezen river basin (Arkhangelsk and Komi), but EM lives here at a density of 0,5 - 2,0 ind/10 km of a river bank. AM is observed in all other large river basins, and EM is met less often than AM or it has been already displaced. While in 1996-98 in Vologda region only EM inhabited certain territories and small rivers, in 2002-2003 AM lived already everywhere. In 1996-1998 in the eastern part of Kostroma region EM was common along small rivers, and AM was met mainly along large streams. But now AM became a major bag of trappers, while EM is rare. The above took place under the conditions of the decreased trappers' economic interest to *Mustela sp.* fur. When mink trapping is carried out, it is directed usually to AM. EM has nowhere economically profitable densities. Small forest streams and brooks are not frequently involved in trapping of semiaquatic animals. The cost of EM fur was about 3-7 euro per pelt in 1997-2003. The cost of AM pelts was higher (about 7-10 euro).

The pessimistic predictions of EM disappearance by the beginning of the XXI century in our territory were not come true. In our opinion, it took place largely due a great demand for wild mink furs and AM active trapping in late 1980s - first half of 1990s. Trapping cannot be considered a major factor of decreasing EM populations at present. The ban on trapping of all semiaquatic furbearers seems to be ineffective for EM conservation. Most likely, it will favor AM expansion and rapid EM displacement.



[Trap barriers as means of maintaining of local European mink populations]

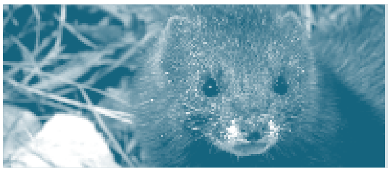
Skumatov D.V., Saveljev A.P.
Russian Research Institute of Game Management and Fur Farming RAAS
79, Engels Street, Kirov, 610000, Russia.
E-mail: mink@mink.kirov.ru

Local populations of European mink have been existing in the taiga zone of the European part of Russia under the conditions of trapping and American mink expansion for a long time (Saveljev, Skumatov, 2001). This suggests that it is necessary to study the efficiency of "trap barriers" for restraining American mink migration to biotopes that are inhabited by aboriginal species now. An artificial population of *M. lutreola* was created to estimate the opportunity of *M. vison* selective trapping with the purpose to preserve local *M. lutreola* populations under the conditions of two species sympatry.

The experiment was executed in 1999-2003 in Kirov region. By the beginning of that experiment aboriginal species didn't live in that area for more then 10 year, and American mink lived along all rivers (2-5 individuals per 10 km of a river bank). During the first stage *M. vison* was completely exterminated (using killing traps) in a small river basin over the area of about 40 sq. km. In that river basin two releases of *M. lutreola* with 11 and 16 animals were carried out in August 2000 and September 2001, correspondingly. 26 *M. vison* and only one *M. lutreola* were taken with life traps and killing traps. The presence of *M. lutreola* and their movements were registered visually and by tracks.

The data obtained show rather a high ability of introduced European mink to adapt to new habitats and natural foods. A part of animals migrated in adjacent river basins during the first month after release and early in spring (6 km, 8 km, 10 km from the place of release). A high level of expansiveness of American mink occupying the artificially created «zone of an ecological vacuum» was noted. At the same time the majority of *M. lutreola* individuals was transmigrated from the mainstream to small tributaries and adjacent biotopes.

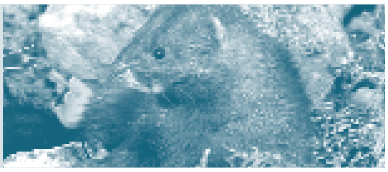
A high efficiency of killing traps and an opportunity of using them in any season resulted in considerable impact on *M. vison* population. The efficiency of life traps is low. The purposeful trapping of *M. vison* is possible when two species of mink inhabit. For catching of *M. vison* traps should be placed in water (under ice) and without baits. Those "trap barriers" may be used in other countries where *M. lutreola* conservation experiments are carrying out actively (Estonia, Germany).



[What can central european country contribute to the conservation of European mink?]

Ales Toman,
Agency for nature conservation and landscape protection of Czech republic.

The knowledge about the historic distribution of the European mink in Central Europe is very scanty. However, there is some data from 19. century from southern Czech Republic and middle of 20 century from Slovakia indicating, that mink have been living here more recently than elsewhere. The Czech governmental nature conservation agency (AOPK) has a high reputation and experience in animal species conservation and research, especially otters, but since the recovery of that species, there were open capacities. This contribution describes the historic distribution of the European and the present distribution of the American mink in Central Europe in and beyond Czech Republic. It outlines the plans of AOPK to breed European mink on a larger scale in their otter breeding and rehabilitation centre and it describes the experiences gained so far in breeding Emink for the International breeding programme and reintroduction programme in Estonia. In this context a main point of discussion is the origin of the founder animals. The favoured option would be to concentrate upon animals from the Danube Delta and the pros and cons of such an approach will be brought up to discussion. Reintroduction area selection criteria (isolation from the American mink, prey communities and their abundance, pollution levels, interactions with man, etc.) will be presented as well as potencial areas in central Europe.



[The European mink introduction on the kunashir islan (South Kurily) attempt to create a new isolated island population of the endangered species]

M. Vaisfeld
Institute of Geography, Russian Academy of Sciences Moscow

The data presented is based on the analysis of reports of various organizations responsible for introduction of the species, as well as on literature and the author's field study undertaken 10 years after the first introduction of the European mink to the island.

The project was realized very quickly and without a thorough scientific discussion. Objections of the opponents, who doubted success of the acclimatization and apprehended negative effects of the introduction for the aboriginal fauna, were ignored.

Introduction of the European mink in three rivers of Kunashir was done in three stages: on 24.09.1981 – 25 animals, on 9.10.1984 – 52, on 27.09.1985 – 50 and on 6.10.1985 – 7 animals were introduced. Of 134 minks 58 males and 76 females were introduced. Only 7 of them had been caught in the wilderness.

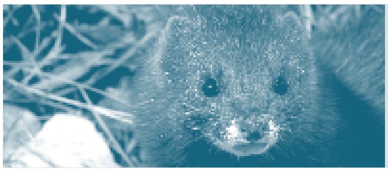
Contrary to expectations of the researchers that had initiated the project and predicted growth of the mink population in 6-8 years after the first introduction up to 3000, our field study and observations of the "Kurilsky" Reserve personnel showed that mink population by 1990-1991 was below its initial abundance at the moment of introduction. No "population explosion" of the introduced species that is typical for a successful introduction was observed.

Actually in 1990-1991 the mink population was at the stage of natural declining. At present there are no signs of the mink on the island. There are reasons to believe that the population of the European mink introduced on the Kunashir Island has become extinct.

One of the main reasons for the unsuccessful acclimatization was the recurrent high (2-3 m) rash floods that at the time of breeding unexpectedly flooded minks' burrows located only 5-10 m from the coast line. Negative effect of birds of prey (especially of the eagle owl) and poaching could also take place. Certainly the failure was caused also by some other factors that have not been identified.

Thus in spite of the optimism of the initiators based on the availability on the island a free ecological niche, stable forage resources, low abundance of enemies and competitors, the results of the introduction should be recognized as negative. The aim of creation of the isolated island population for the purpose of the species genofond conservation has not been achieved.

The story of the unsuccessful attempt to create an isolated mink population on the island where biota, from the point of view of the historical biogeography, in its important ecological parameters differs from the biota within the natural range of the species is rather instructive. It is obvious, that the task of genofond conservation by introducing the species alien for the island ecosystems requires very careful and competent ecological and bio-geographical analysis and is most promising on islands with the biota identical to the biota native for the target species.



[Considerations about the usefulness of coprological methods with regard to necropsy of endangered mammals. The case of *Mustela lutreola* (L., 1761) in Spain[1]]

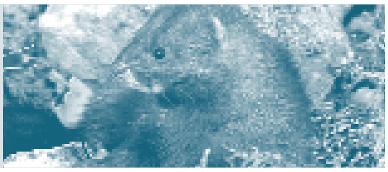
J. Torres[1], J. Miquel[1], S. Mañas[2], S. Palazón[2,3], J.C. Ceña4, & C. Feliu[1]

[1]Laboratori de Parasitologia, Facultat de Farmàcia, Univ. Barcelona, Spain jtorres@farmacia.far.ub.es; [2]Departament del Medi Ambient, Generalitat de Catalunya, Barcelona Spain; [3]Departament de Biologia Animal (Vertebrats), Facultat de Biologia, Univ. Barcelona, Spain; [4]C/ Estambrera 13, 3º B, 26006 Logroño, Spain.

Most Spanish helminth faunas of wild carnivores have been described from examination of adult parasites in host necropsies. However, coprological surveys based on the isolation of eggs and larvae of helminths in fecal samples (coprological methods) should be considered as a useful alternative that provides an acceptable approximation to the real helminth fauna when carcasses of certain carnivore species are difficult to obtain. This is the case of the European mink (*Mustela lutreola*) considered the most endangered small carnivore in Europe. In this context, to present 81 fecal samples of M. lutreola collected in the field and sent preserved in formalin 10% to "Laboratori de Parasitologia de la Universitat de Barcelona" have been analyzed by the conventional coprological method of Ritchie. Previously we owned some qualitative and quantitatively (abundance) data about the helminth fauna of M. lutreola as a consequence of the necropsy of some individuals found dead.

Among digeneans we only found eggs of *Metorchis bilis* and *Euryhelmis squamula* (two abundant species parasitizing *M. lutreola*) and no eggs of other very sporadic digenids (*Pseudamphistomum truncatum*, *Apophallus donicus*) that also affect *M. lutreola* in Spain were observed. Although the abundance of *E. squamula* (11.9) is higher than that of *M. bilis* (2.2) the presence of eggs of this later species in the faeces was much more frequent as a consequence of the very great number of eggs present into their very developed uterus. Some times, when faeces were not quickly fixed, it was impossible to identify the observed eggs because they are very comparable in size (about 35 x 15 mm) and have a similar morphology. Only in one sample we could found an egg of taenid (probably of *Taenia taenuicollis*), a species that usually parasitizes representatives of the genus *Mustela*.

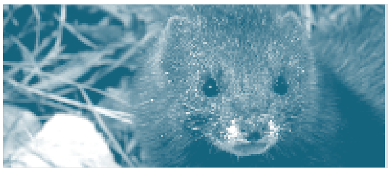
Strongyloides mustelorum is the most prevalent nematode of *M. lutreola* in Spain (46.4%). Females of this species are ovoviviparous and present a short number of eggs in both uteri, fact that difficulties so much the finding of eggs in faeces and makes necessary to employ a lot of time. Although our coprological results (39.5%) are quite consistent with the real parasitation



evidenced by necropsy, we suggest the culture of fresh faeces as the best method to investigate the infection of mustelids by *Strongyloides* specimens in fieldwork or in individuals living in temporal captivity prior to be released.

Larvae of metastrongylid nematodes were present in about one third of the faeces of *M. lutreola* studied. Several times they could not be determined because of they were not appropriately fixed or when only a few specimens very coiled (making impossible to observe the morphology of its tail) can be found. Other times it was possible to identify them as belonging to the species *Aelurostrongylus pridhami* and to the genus *Skrjabingylus* (probably *S. nasicola*). On the other hand, we have also found larvae of *Skrjabingylus* in some surveyed faeces of Mustela *vison* from close localities where *M. lutreola* in present. In our opinion a comprehensive study about the degree of parasitation of at least both mink species by *S. nasicola* should be performed in order to know the real influence of this pathogenic nematode over the Spanish populations of *M. lutreola*.

[1]Study partially supported by the projects BOS2000-0570-CO2-01 and 2001-SGR-00088. Many samples were obtained thanks to the LIFE European mink conservation projects numbers: LIFE00NAT/E/7299; LIFE00NAT/E/7331; LIFE00NAT/E/7335 and LIFE02/NAT/E/8604 developed by the Governments of La Rioja, Junta de Castilla-León, Diputación Foral de Alava, Generalitat de Catalunya and Ministerio de Medio Ambiente.



[On the parasite fauna of *Mustela lutreola* (Linnaeus, 1761) in Spain. Possible cross transmission of some helminths with neighbouring spanish populations of *Mustela vison* (Schreber, 1777) and *Mustela putorius* Linnaeus, 1758[1]]

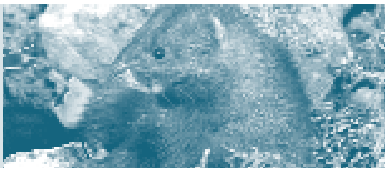
J. Torres[1], S. Mañas[2], J. Miquel[1], S. Palazón[2,3], J.C. Ceña[4], & C. Feliu[1]

[1]Laboratori de Parasitologia, Facultat de Farmàcia, Univ. Barcelona, Spain jtorres@farmacia.far.ub.es; [2]Departament del Medi Ambient, Generalitat de Catalunya, Barcelona Spain; [3]Departament de Biologia Animal (Vertebrats), Facultat de Biologia, Univ. Barcelona, Spain; [4]C/ Estambrera 13, 3º B, 26006 Logroño, Spain.

The populations of the European mink (*M. lutreola*) have declined almost everywhere during the last decades due to several factors among which parasitic diseases should be considered. Nowadays one relatively important population of European minks inhabits in Spain. This population lives in a close contact with other riparian mustelids such as *M. putorius* and the American mink (*M. vison*). This study analyses the possible cross-transmission of some helminths among neighboring populations of these mustelids.

Official Spanish institutions have provided us the viscera of *M. lutreola* (28 specimens), as well as *M. putorius* (17) and *M. vison* (62) from the "zone of influence" over *M. lutreola*. All mustelids were surveyed for helminths and, in a whole, 12 species were evidenced (5 Digeneans, 1 Cestode and 6 Nematodes). The European mink harbored a helminth fauna quite richer than *M. vison* and *M. putorius*, and only shared (with at least another mustelid) four species: *Euryhelmis squamula* (Digenea), *Aonchotheca putorii*, *Strongyloides mustelorum* and *Molineus patens* (Nematoda). On the other hand, *Skrjabingylus nasicola* affects all three mustelids, but we do not have any data about the degree of infection by this intracraneal nematode in the mustelids from this area.

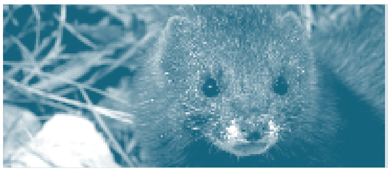
The prevalence and mean intensity of *E. squamula* in *M. putorius* (17.6%; 138.7 individuals) are very similar to those of *M. lutreola* (17.9; 66.4), but quite higher than those of *M. vison* in the same area (3.2%; 11.0). Therefore, this last mustelid is not very important in the maintenance of the digenid in neighboring areas of the current *M. lutreola* range. *A. putorii* was more prevalent in *M. putorius* (29.4%) and *M. vison* (25.8%) than in *M. lutreola* (7.1%). As climatic conditions are similar where all these mustelids live close together, the results obtained should be conditioned by the absence of earthworms (intermediate hosts of the nematode) into the diet of *M. lutreola*. Representatives of the genus *Strongyloides* are potential pathogenic nematodes in immunocompromised hosts, in which not only the intestinal tract but also a large number of body tissues



are exposed to forms of the nematode. *Strongyloides* specimens were often found in *M. lutreola* (46.4%) and more sporadically in *M. putorius* (11.7%). M. vison did not appear to be infected by any *Strongyloides*. The geohelminth M. patens is the nematode best adapted to Spanish mustelids, suggesting that these host-parasite associations have been present for a long period of time.

Taking into account all available data we can conclude that most of the intestinal parasites that affect these aquatic mustelids do not seem to act as an important regulatory factor over the Spanish population of *M. lutreola*. Contrarily, it is possible that *S. nasicola* (a pathogenic nematode that can exert an important negative role over mustelid populations) affects in more or less degree *M. lutreola*, since its first stage larvae was found in some fecal samples. We think that this fact should be more extensively investigated in the future.

(1)Study partially supported by the projects BOS2000-0570-CO2-01and 2001-SGR-00088. Many samples were obtained thanks to the LIFE European mink conservation projects numbers: LIFE00NAT/E/7299; LIFE00NAT/E/7331; LIFE00NAT/E/7335 and LIFE02/NAT/E/8604 developed by the Governments of La Rioja, Junta de Castilla-León, Diputación Foral de Alava, Generalitat de Catalunya and Ministerio de Medio Ambiente.



[The influence of infection by nematodes on the physiological state and the population number of minks (*Mustela lutreola, M. vison*)]

Alla Zhemchuzhina, Igor Tumanov,
Russia

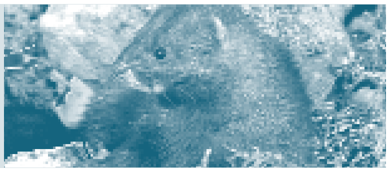
AIMS. We ascertained the influence of Skrjabingylus and Filaroides nematodes on the nature populations of European mink and American mink on the North-West of European Russia (Pskov and Leningrad Prov.).

METHODS. In 1969-1990 we valued the minks number (calculation field works, analysis of the data of the hunter forms) and their infection for study the dependence of animals infection standard on their number. We received from the hunters and analysed 550 ind. of European mink and 680 ind. of ?. vison. We measured the morphology indexes of the fresh animal carcass only.

RESULTS. The nematodes of Filaroides genus are in both species of the minks in 1.4-1.5 rarely of *Skrjabingylus* genus. The infection standard of these animals differs essentially. The extensity of *Skrjabingylus* infection in European mink population is 63.4% and in American mink is 21.7%. The higher standard of *Skrjabingylus* infection was the old individuals of European mink's population, and the young animals had the Filaroides infection also. The intensity of European mink infection by *Skrjabingylus* (6.8 ind.) and Filaroides (4.2 ind.) was significance higher of American mink (3.9 ind. and 1.9 ind., accordingly). The infection by Filaroides of young males European mink was largely, and adult females it was also by *Skrjabingylus*.

The size and mass of body of the infected by nematodes of mink species was much smaller of healthy. This difference we observed as the young as the adult animals. The average difference of the size, body mass males between animals of healthy and infection by nematodes was 55g (young), 122g (adult). It was 91g and 134g in American mink males, accordingly.

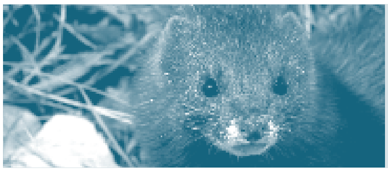
In all age groups the healthy females of these species are fatness more, then the infected by nematode animals (P>90%). This dependence no reveals in most of male variants. The analysis of the principal inner organs of minks of healthy, infected by nematodes no revealed the significance of differences in their relative weight. However, the fertility of infected and non-infected animals differs essentially. So, in the reproduction organs of healthy females in the Pskov



European mink population are average 4,6 (4-6) big non-resorption embryos, but of infected individuals are 3.7 (3-4).

It should be also noted that in the ages of great quantity and often in the next season the part of the infected individual and the intensity of infection increased in the tests of these species populations.

CONCLUSIONS. The negative impact of helminthes on the populations of European mink, in the first turn, is essentially. Probably, the principal role of these parasites reduces to the decrease of immune activity of organism minks, which stipulates the development of bacteriological and virus diseases, decrease of fertility of females and survivorship of the young.



[Advances in the understanding of the European mink in Bizkaia]

AVANCES EN EL CONOCIMIENTO DEL VISÓN EUROPEO EN BIZKAIA

La primera cita de Visón Europeo (Mustela lutreola) en España fue en Gipuzkoa (1951). Doce años después apareció en Bizkaia. Sin embargo, no fue hasta 1985 cuando se realizó un primer mapa sobre la distribución de la especie, como parte del Atlas de los vertebrados continentales del País Vasco encargado por el Gobierno Vasco.

Tras esta aportación no se volvió a saber nada de la especie hasta un nuevo atlas de carnívoros publicado en 1999 y breves reseñas en artículos en los que se recogían las citas que se habían dado de forma esporádica.

Los cambios en la distribución fueron notables entre el primer y segundo trabajo, constatándose una expansión del área de distribución, achacable en cierta medida a los esfuerzos de muestreo, aunque también a la expansión natural de la especie.

A finales de la década de los noventa, tras 36 años de presencia de la especie, se realizó el primer estudio específico. El trabajo se centró en la Reserva de la Biosfera de Urdaibai y dio como resultado un notable avance en el conocimiento de la ecología y etología del visón. Además de obtener datos sobre la pobla

Iñigo Zuberogoitia Arroyo, Javier Zabala and Juan José Torres Barrón

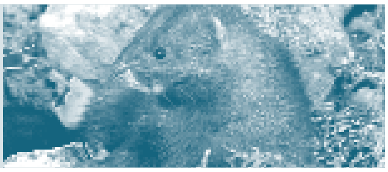
The first European mink (*Mustela lutreola*) detected in Spain was in Gipuzkoa (1951). Twelve years later it appeared in Bizkaia. However, it was not until 1985 when the first distribution map for the species was made, as part of the Atlas of Continental Vertebrates in the Basque Country commissioned by the Basque Government.

After this contribution, nothing more was heard of the species until the new atlas of carnivores published in 1999 and a few articles, mentioning specimens that had been observed *sporadically*.

Changes in distribution were quite noticeable between the two atlases. The distribution area had expanded, although this may also be due to better sampling and not only to the natural expansion of the species.

At the end of the 1990s, after 36 years of the species' presence, the first specific survey was carried out. The work focused on the Biosphere reserve of Urdaibai and resulted in a notable advance of the understanding and ecology of the mink. In addition to obtaining data on the population, it showed the situation to be quite good compared to that of neighbouring provinces.

Almost simultaneously a regional survey was taken throughout the Basque Country on the distribution of the species, and a new Atlas was made. This time, a strong regression was detected. However, two years later a fourth atlas was published with data obtained during the last five years and the trend had reversed, with even a certain increase in the area where the European mink was present.

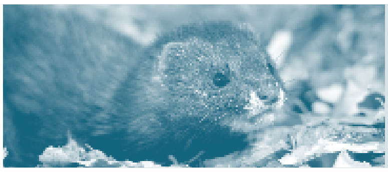


Today, after forty years of coexistence with the second most endangered carnivore in Europe, results could not be more devastating: 1- four atlases have been published, two of them exclusively on Bizkaia and the other two covering the whole of the Basque Country, in addition to a few more national atlases on the distribution of the species which include the previous information and some new data. 2- The only work done on the ecology and behaviour of the species arose from the work carried out in Urdaibai and some participations in other texts with data obtained here and there. 3- During all this time, specific funds have only been allocated twice —for the survey in Urdaibai and for the atlas on distribution of species in the Basque Country, all other paper published being private initiatives.

Despite everything and taking into account the limited resources available, information on the species in Bizkaia has been published in an acceptable form, thereby taking a step forward in the preservation of the species. However, we still need to make progress in our understanding of the measures that should be taken to preserve the species.

[CONCLUSIONES]

CONCLUSIONS



[Conclusiones]

Conclusions

1. ESTRATEGIAS DE CONSERVACIÓN "IN SITU"

- *El visón europeo ha sufrido una regresión en su área de distribución. Tenemos varias hipótesis de este declive (pérdida de hábitat favorable, invasión de visón americano, epizootias), sin embargo, no se han identificado explicaciones suficientemente claras.*
- *Se debe de destacar la importancia de la conservación del visón europeo a escala mundial, frente a otras especies consideradas "en peligro", pero de menor interés.*
- *Las autoridades deben incrementar su atención y recursos para la conservación del visón europeo. Ello es especialmente cierto para las poblaciones más pequeñas (p. ej. en Francia). Si no la especie desaparecerá pronto.*

Para evitar la extinción de Mustela lutreola es necesario:

- *"Monitorear" la distribución del visón europeo y el visón americano, especialmente en las áreas aledañas.*
- *Investigar con el objetivo final de comprender las causas concretas del declive de la especie, con especial atención a la suma de factores y posibles sinergias que pudieran estar actuando.*
- *Elevar a "en peligro de extinción" la situación legal de la especie, incluyéndola siempre en las evaluaciones de impacto ambiental.*
- *Evaluar y disminuir las amenazas y factores limitantes locales, tales como los atropellos, trampeos y capturas no intencionadas, molestias, depredación por animales domésticos y asilvestrados, escasez de alimento o refugios de cría y reposo, rodenticidas, etc. El hábitat del visón europeo*

1. "IN SITU" CONSERVATION STRATEGIES

European mink is declining worldwide within its natural range. We have some hypothesis of this decline (habitat loss, American mink, disseases, ...) but, however, no clear explanations have been identified.

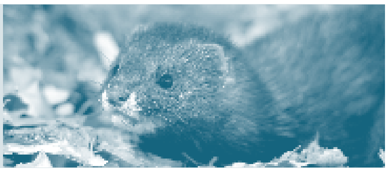
Status, ecology and conservation needs may vary through out Europe

The real importance of European mink conservation at a worldwide scale has to be pointed out, in front of other so called "endangered" species.

Authorities must increase attention and resources for European mink conservation. This is especially true in small population (for example in France). In other case the species will disappear soon.

To avoid the extinction of Mustela lutreola it is necessary:

- Monitoring the distribution of the E-mink and the A-mink, specially in adjacent areas
- Research with the final goal of understanding the concrete causes of declining for European mink populations, paying attention to the combination of factors (even for possible synergies).
- Increase the legal conservation status as "Endangered", including always the species within the Ecological Impact Assessment studies.
- Evaluate and reduce local threats and limiting factors for the E-minks such as road mortality, trapping and by-catch, disturbance by people, predation by domestic, feral or wild predators, food, shelter for breeding or resting, rodenticide, ...



E-mink habitat can be improved by the re-introductions or natural recovery of beaver.

- Habitat conservation is a necessary, even though not sufficient for securing survival of the species. The habitat must be managed or restored, in order to maintain the riperian ecosystems and to increase the prey (fish, amphibians, etc) and shelter availability for European mink. The watercourse management plans have to take into account the conservation requirements of the European mink.

- About pollution: (a) analyses have to be performed about the pollution levels in the river ecosystems and also in the European mink tissues; (b) water authorities must work to decrease pollution levels.

- Research on the main habitat features should be undertaken, specially for the more sensitive moments of the biological cycle (breeding, dispersal, ...). Habitat suitability models may help in conserving European mink habitat. Also research on biology, ecology and behaviour (between others) should be done.

- About scale problems: (a) we have to keep in mind area requirements for minimum viable population, (b) habitat fragmentation should be avoided, recovering connectivity of isolated patches, and (c) we must pay attention to the fact that the "European mink habitat" is only a little part of landscape, because of this semiaquatic lifestyle.

- About American mink control: research for new more efficient methodologies should be undertaken in next years. However, (a) trapping barriers should be create to prevent American mink invasion, (b) small American mink populations should be eradicated, and (c) even if it's impossible to eradicate American mink populations, efforts are encouraged for decreasing its abundance.

- Involvement of relevant stakeholders: water authorities, hunters, fishermen, landowners, fur farmers, country side people, and other.

puede ser mejorado mediante la reintroducción o recuperación natural de las poblaciones de castor.

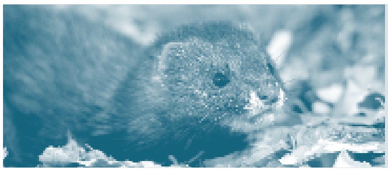
- *La conservación del hábitat es imprescindible, aunque no suficiente, para garantizar la conservación del visón europeo. El hábitat debe ser gestionado o restaurado para conservar los ecosistemas ribereños e incrementar la disponibilidad de recursos tróficos (peces, anfibios, cangrejos...) y refugio. Es necesario considerar los criterios de conservación del visón europeo a la hora de plantear cualquier obra pública o plan de gestión de los cursos de agua en su área de distribución.*

- *En lo referente a la contaminación: a) es necesario llevar a cabo investigación sobre los niveles de contaminantes en los ecosistemas y en los tejidos del visón europeo, así como sobre los umbrales que dan lugar a efectos letales y subletales (fallos reproductivos, inmunosupresión...). Como criterio general, los responsables de las políticas del agua deben trabajar para reducir los niveles de contaminación.*

- *Debe incrementarse la investigación sobre las características del hábitat del visón europeo, especialmente en los momentos más sensibles de su ciclo vital (reproducción, dispersión...). Los modelos de idoneidad de hábitat (HSM) pueden ayudar a conservar el hábitat del visón europeo. Asimismo, debería incrementarse la investigación sobre la ecología, biología y comportamiento de la especie.*

- *En relación con los problemas de escala: a) hay que tener presentes los requerimientos de superficie para mantener poblaciones mínimas viables de visón europeo, b) debe evitarse la fragmentación de los hábitats, recuperando la conexión entre fragmentos aislados cuando ocurra, y c) hay que conceder especial importancia al hecho de que el hábitat del visón europeo sea solamente una pequeña porción del entorno, dado su modo de vida semiacuático.*

- *En relación con el control del visón americano, en los próximos años deben buscarse metodologías*



de control más eficaces. No obstante, a) deben crearse barreras de trampeo para evitar la invasión del visón americano, b) deben erradicarse las poblaciones pequeñas de visón americano, y c) aun cuando sea imposible erradicar grandes poblaciones de visón americano, deben hacerse esfuerzos por reducir su abundancia.

- *Implicar a todos los actores relevantes: autoridades del agua (Confederaciones hidrográficas), cazadores, pescadores, propietarios, granjeros, lugareños, y otros.*
- *Conseguir una atención suficiente, a un nivel local y nacional, de las ONG y las OG, y a la sociedad, para conocer la importancia de la especie, los problemas asociados y para obtener recursos (humanos, económicos y materiales).*
- *Deben monitorizarse la enfermedad Aleutiana y otras patologías.*
- *Hay que evitar la disminución de la variabilidad genética, la aparición de la endogamia y el aislamiento poblacional.*
- *En relación con la reintroducción, a) debe crearse o recuperar al visón europeo en islas seguras (bajo un concepto amplio de isla), b) la realización debe tener en cuenta las experiencias previas con esta y otras especies similares, c) las necesidades financieras y socio-administrativas deben estar aseguradas para la totalidad del proyecto, y d) los programas de reintroducción deben ser monitorizados en lo que afecta a su efectividad y efectos en los ecosistemas.*
- *Se propone la creación de un Grupo Internacional de Trabajo sobre el visón europeo.*

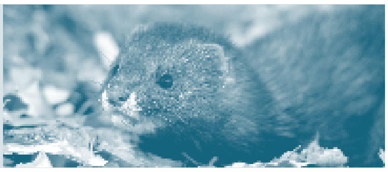
2. ESTRATEGIAS DE CONSERVACIÓN "EX SITU"

- *El objetivo general del programa de reproducción en cautividad se define como sigue: "Conservación de la diversidad genética de la especie". El programa Pan-europeo puede y debe consistir en programas nacionales y/o regionales*

- Get the necessary attention of local and national of GOs and NGOs, and society, to know the importance of the species, the problems associated and to receive resources (human, economic and material).
- Aleutian diseases and other pathologies must be monitored.
- Avoid the decrease in genetic variability, inbreeding and the population isolation.
- Re-introduction: (a) to create or recover European mink in safe islands (under a wide island concept), (b) their realisation should take in consideration the experiences from this and other similar species (financial and socio-administrative needs being ensured for the whole project).
- Monitoring of the introduced European mink populations in Asia.

2. EX SITU STRATEGIES FOR THE EUROPEAN MINK

- The general aim of the European captive breeding program has to be defined as follows:
- "Preservation of the genetic diversity of the species." The Pan-European program may and must consist of regional and/or national programs (eg. French, Spanish, Russian etc.) with different objectives depending upon of specific features of the regional requirements. Such objectives include a range of activities, including education, research, reintroduction, etc. The regional objectives must be in concordance with the general, international, aim.
- The ex situ and in situ tools have to be regarded as complementary to each other. Yet, considering the rapid decline of wild populations, the ex situ tools are of growing importance in securing the survival of the species.



- Along with the conservation breeding program(s), the development and use of new advanced technologies have to be promoted, such as assisted reproduction and development of a Genome Resource Bank.

- It is important to inform the stakeholders such as range states, regional zoo organizations (eg. EARAZA) and the European Commission on the growing importance of the ex situ tools in conservation of the European mink. It is important to realize that a conservation breeding operation involves a long-term commitment, not easily fitting into rapid project-based management approaches.

- The all-European conservation breeding program has to be organized around or into the already existing EEP Program with the involvement of presently participating organizations like, among others, Tallinn Zoo (Estonia), Euronerz (Germany), Pavlov (Check Republic), Thoiry Zoo (France), but also all new or planned effective conservation breeding initiatives in Spain, France, Russia (eg. the state breeding initiative in Tsernogolovka Field Station) and other countries.

- The conservation breeding initiatives have to be organized into a general European framework, while the establishment of regional subprograms is encouraged.

- The establishment of effective information exchange framework is of highest importance in this general action framework. The framework for all the breeding initiative has to be organized in the form of a species committee, with involvement of all active regional breeding initiatives.

- In regard of the question of the number of management units (ESU-s) the workshop has concluded the following:

  a) For the time being, and following the precautionary principle, the Spanish/French, eastern European, and Romanian populations have be regarded as separate management units.

  b) Under the eastern European management unit only animals from subspecies, Mustela lutreola novikovi, should be incorporated into the program.

(p.ej. Francia, España, Rusia, ...), con diferentes objetivos dependiendo de las características específicas de los requerimientos en cada lugar. Estos objetivos incluyen una serie de acciones (educación y sensibilización, investigación, reintroducción, etc.). Los objetivos locales deben estar de acuerdo con los del programa general internacional.

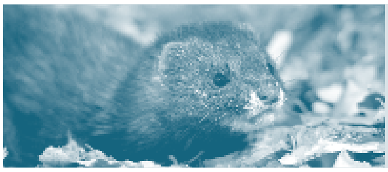
- *Las herramientas de conservación "ex situ" e "in situ" deben considerarse complementarias. Sin embargo, teniendo en cuenta el rápido declive de las poblaciones salvajes, la conservación "ex situ" adquiere una importancia creciente para garantizar la supervivencia de la especie.*

- *Junto al programa(s) de reproducción para la conservación, debe promoverse el desarrollo y uso de nuevas tecnologías avanzadas tales como la reproducción asistida y la creación de un Banco de Recursos Genéticos.*

- *Es importante informar a los actores tales como los diversos estados, las organizaciones regionales de zoos (p. ej. EARAZA) y la Comisión Europea sobre la importancia de la conservación "ex situ" para el visón europeo. Debe tenerse en cuenta que los programas de reproducción para la conservación representan un compromiso a largo plazo que no es fácil ajustar a las aproximaciones de manejo basadas en proyectos.*

- *El Programa Pan-europeo de reproducción para la conservación tiene que organizarse alrededor o dentro del programa ya existente EEP con la implicación de las organizaciones que participan en la actualidad, como, entre otros el Zoo de Tallin (Estonia), Euronerz (Alemania), Pavlov (República Checa), Thoiry Zoo (Francia), y también con todos las nuevas iniciativas planeadas en España, Francia, Rusia (p. ej. la iniciativa estatal de la estación de campo de Tsernogolova) y otros países.*

- *Las iniciativas de reproducción para la conservación deben de organizarse en un marco general europeo, animándose además al establecimiento de programas a nivel regional y nacional.*



- *El establecimiento de un marco efectivo de intercambio de información es de la mayor importancia en el contexto de esta propuesta de actuación general. El marco para todas las iniciativas de reproducción tiene que organizarse en forma de un comité de especies con implicación de todas las iniciativas de reproducción activas a nivel regional y nacional.*
- *Con respecto a la cuestión del número de unidades de manejo y conservación (ESUs), se ha concluido lo siguiente:*
  - *a) Por el momento y de acuerdo con el principio de precaución, las poblaciones de España-Francia, el este de Europa y Rumania deben de ser consideradas como unidades de manejo distintas.*
  - *b) La unidad de manejo del este de Europa, solamente animales de la subespecie Mustela lutreola novikovi, deberían de incorporarse al programa.*
  - *c) Durante los próximos 3-5 años deberían de llevarse a cabo los estudios más detallados posibles para resolver los siguientes puntos:*
    - *Desarrollar nuevos métodos para identificar más loci polimórficos (los disponibles no son lo suficientemente sensibles).*
    - *Llevar a cabo estudios de morfología comparada.*
    - *Llevar a cabo estudios de etología comparada.*
    - *Estudiar las diferencias potenciales de hábitats entre subespecies (incluyendo el papel del visón en los ecosistemas ribereños).*
    - *Considerar los posibles efectos de depresión exogámica entre poblaciones.*
  - *d) Tras estos estudios el Comité de especies debe de tomar la decisión sobre el número futuro de ESUs en las operaciones de reproducción.*

3. ASPECTOS LEGALES, ADMINISTRATIVOS Y DE MANEJO DEL VISÓN EUROPEO

- *Reclasificar al visón europeo como especie prioritaria en la Directiva Hábitats y en todos los países, declarándola como especie en peligro.*
- *Incrementar la representatividad en la lista de Lugares de Interés Comunitario (LIC) (Natura*

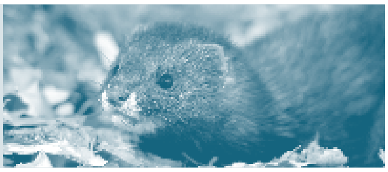
c) During the next 3-5 years the more thorough detailed studies have to be conducted in order to resolve the following points:

- Develop new methods to determine more polymorphic loci (present ones are not sensitive enough).
- Conduct comparative morphology studies.
- Study on comparative ethology.
- Study on potential habitat differences (including the species role in riparian ecosystem) between subspecies.
- Look for indications of inbreeding depression in the Western and Romanian populations (Workshop I).
- Look for possible effect of outbreeding between the populations.

d) After these studies the decision has to be made by the species committee on the future number of management units in breeding operations.

3. LEGAL, ADMINISTRATIVE AND MANAGEMENT ASPECTS OF THE E MINK

- Reclassify the European Mink as a priority species in the Habitats Directive and in all the countries, declare the populations as an endangered species.
- Increase the scope of the Sites of Community Interest (Natura 2000). Management Plans experts Bern Convention incorporation
- Ensure the effective implementation of Community Legislation throughout the EU.
- Within the framework of the Bern Convention, draft and implement national conservation programmes which are realistic and achievable in those countries which have signed it.



· In those countries where the public water systems are controlled by regional and national water authorities, make a clear distinction of the areas of responsibility regarding conservation of the habitats and the species, especially those authorities responsible for water use.

· Make clear that the priority is the conservation of the habitat of the European Mink. This implies that the water quality, water courses, woods and other riparian vegetation must be protected and preserved. In this sense, the concept of biological corridors will be promoted as a means of protecting the habitat for the Natura 2000 network.

· Draw up co-ordinated international programmes between all the countries with populations , or potential habitats of the E-mink and seek funding for the implementation of these plans.

· About American mink farms: (a) to establish more efective requirements to avoid escapes, (b) to forbid the establishment of new mink farms within the European mink range, (c) to encourage the already existing farms to substitute mink whith other animals, and (d) to remove as soon as possible mink from massive releases.

· To encourage the establishment of an international European mink Working Group and information exchange network.

2000). Incorporación en los planes de manejo del Convenio de Berna.

· *Asegurar la transposición efectiva de la legislación comunitaria en la UE,*

· *En el marco del Convenio de Berna, elaborar borradores e implementar programas de conservación nacional realistas y posibles en todos los países signatarios.*

· *En todos los países en los que los sistemas acuáticos son públicos (dominio público hidráulico) y están controlados por las agencias del agua nacionales o regionales, deslindar claramente estos terrenos bajo el prisma de la conservación de los hábitat y de las especies.*

· *La calidad del agua, los cursos de agua, los bosques y otra vegetación riparia debe ser protegida y preservada. En este sentido, el concepto de corredores biológicos ha de ser promovido como forma de protección del hábitat para Natura 2000.*

· *Acerca de las granjas de visón americano: a) establecer requerimientos más efectivos para evitar los escapes, b) prohibir el establecimiento de nuevas granjas dentro del área de distribución del visón europeo, c) estimular la sustitución de las granjas actualmente en actividad por otro tipo de explotación y d) eliminar lo antes posible los visones resultantes de sueltas masivas.*

· *Preparar programas internacionales coordinados entre todos los países con poblaciones o hábitat potencial del visón europeo, y buscar financiación para estos planes.*

· *Promover el establecimiento de un Grupo de Trabajo Internacional sobre el visón europeo y una red de intercambio de información.*

[ANEXO]

LISTA DE ASISTENTES AL CONGRESO

PEOPLE PRESENT

[ANEXO. Lista de asistentes al Congreso]

People present

Alarcia Alejos, Olga Esther. Junta de Castilla y León. Burgos. ESPAÑA.

Álvarez de Arcaya Fdez. de Landa, Idoia. Vitoria-Gasteiz. Álava. ESPAÑA.

Amstislavsky, Sergei. Academia Rusa de Ciencias. Instituto de Citología y genética. Siberia. RUSIA.

Asensio Carricondo, Victoria. TRAGSA. El Pont de Suert. Lérida. ESPAÑA.

Baquero Herce, Ana. Diputación Gral. De Aragón. Casa Forestal de Sigüés. Sigües. Zaragoza. ESPAÑA.

Batet Trias, Antonio. Generalitat Catalunya. Girona. ESPAÑA.

Belamendia Cotorruelo, Gorka. Museo de Ciencias Naturales de Álava. Vitoria-Gasteiz. Álava. ESPAÑA.

Bernat Ortells, Yasmina. DGA Servicio Provincial de Aragón. Dpto. Medio Ambiente. Zaragoza. ESPAÑA.

Bravo Villa, Carlos. El Espinar. Segovia. ESPAÑA.

Brizuela González, Sara. Junta de Castilla y León. Burgos. ESPAÑA

Cabria Garrido, Maite. Universidad Pais Vasco. Fac. Farmacia. Dpto. de Zoología. Vitoria. Álava. ESPAÑA.

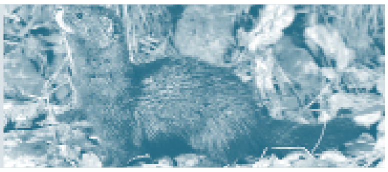
Calvo Simón, Francisco Javier. Junta Castilla y León. Soria. ESPAÑA.

Calvo Tomás, Alfonso. Confederación Hidrográfica del Ebro. Zaragoza. ESPAÑA.

Camiña Cardenal, Álvaro. Biólogo/Investigador. Viniegra de Arriba. La Rioja. ESPAÑA.

Campion Ventura, David. Gestión Ambiental de Navarra. Pamplona. Navarra. ESPAÑA.

Carnero Fuente, Estela. Dirección Gral. Calidad Ambiental. Logroño. La Rioja. ESPAÑA.



Carreras de Bergaretxe, Joseba. Servicio Conservación de la Naturaleza. Diputación Foral de Álava. Vitoria-Gasteiz. Álava. ESPAÑA

Centenera Martín, Soledad. TRAGSA- Area de Medio Ambiente. Leganés. Madrid. ESPAÑA.

Ceña Martínez, Alfonso. Logroño. La Rioja. ESPAÑA.

Ceña Martínez, Juan Carlos (Conferenciante). Investigador Proyectos Life. Logroño. La Rioja. ESPAÑA.

Christian, Seebass. Euronerz E.V. Osnabrück. Niedersachsen. ALEMANIA.

De Leonardo Catalán, Iovanka. Sirasa (Sociedad de Infraestructuras Rurales Agrarias). Teruel. ESPAÑA.

Del Villar Marzo, Joseba. Fundación Urdaibai. Bilbao. Bizkaia. ESPAÑA.

Delibes de Castro (Moderador), Miguel. Estación Biológica de Doñana. Sevilla. ESPAÑA.

Dick, Klees. Studio Wolverine. Chaam. PAÍSES BAJOS.

Elisabeth, Peters. University of Osnabrüch. Niedersachsen. ALEMANIA

Elorza Knörr, Laura. PAGOA Consultores Ambientales S. C. Vitoria-Gasteiz. Álava. ESPAÑA.

Encinas Escribano, Ascensión. Universidad Europea Madrid. Villaviciosa de Odón. Madrid. ESPAÑA.

Fernández García, José María. IKI, S.A.. Arkaute. Álava. ESPAÑA.

Ferreira Sebastián, Jorge. Vitoria-Gasteiz. Álava. ESPAÑA.

Ferrer Javares, Mirenka. TRAGSA- Área de Medio Ambiente. Leganés. Madrid. ESPAÑA.

Ferrer-Bergua Leese, Nicolás. Centro Recepción Fauna Silvestre. “El Planizar”. Teruel. ESPAÑA.

Fournier, Christine. GREGE. Groupe de Recherche et d’etudes p.i. Gestion de l’environnement. Villandraut. FRANCIA.

Fournier, Pascal (Conferenciante) GREGE. Groupe de Recherche et d’etudes p.i. Gestion de l’environnement. Villandraut. FRANCIA.

García de la Fuente, Jorge. AVAFES-León. Gijón. Asturias. ESPAÑA.

Gómez Gayubo, Mª Asunción. Aranda de Duero. Burgos. ESPAÑA.

Gómez Moliner, Benjamín. Universidad Pais Vasco. Fac. Farmacia. Dpto. de Zoología. Vitoria. Álava. ESPAÑA.

González Esteban, Jorge. Santesteban. Navarra. ESPAÑA.

Gutiérrez Teira, Alfonso. MECOMAT/ ATECHA. Villalba de Guadarrama. Madrid. ESPAÑA.

Harmer, James Henry. Uk Small Carnivore. Herts. REINO UNIDO.

Harmer, Lesley Patricia. Uk Small Carnivore. Herts. REINO UNIDO.

Jiménez Fernández, Francisco José. Junta de Castilla y León. Valladolid. ESPAÑA.

Johan, Michaux. University of Liege. Liege. BÉLGICA

Karling, Marita. Ecosystems. Nature Link Int. Bruselas. BÉLGICA

Katchanovsky, Vladimir. Central Forest State Nature Biosphere Reserve. Tver Region. RUSIA.

Kiss, Botond J. Danube Delta National nstitute for Research-Development. Tulcea. RUMANÍA.

Kranz, Andreas. (Conferenciante). University of Agricultural Science - BOKU. Institute of wildlife biology and wildlife management. Graz. AUSTRIA.

Lindeberg, Heli. Universidad de Kuopio. P.O. Kuopio. FINLANDIA

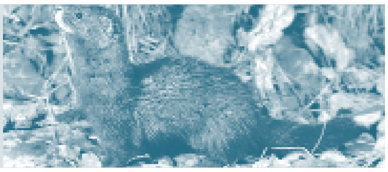
Lizarraga Armentia, Patricia. Centro de recuperación de fauna de Mártioda. Mártioda. Álava. ESPAÑA.

Lobo Urrutia, Luis. Centro de Estudios Ambientales. Vitoria-Gasteiz. Álava. ESPAÑA.

López de Luzuriaga García, Javier. Vitoria-Gazteiz. Álava. ESPAÑA.

Lopo Carramiñana, Luis (Moderador). D.G. Medio Natural - Gobierno de La Rioja. Logroño. La Rioja. ESPAÑA.

Maizeret, Christian (Conferenciante). Direction de l'Environnement. Mont de Marsan. FRANCIA



Maksudov, Georgy. Moscow Zoo Scientific Department. B. Moscow. Russia

Mañas Prieto, Sisco. Departamento de Medio Ambiente. Generalitat de Catalunya. Barcelona. ESPAÑA.

Maran, Tiit (Conferenciante). Fundación Lutreola. Tallin. ESTONIA.

Mariano González, Luis (Moderador). Dirección Gral. de Conservación de la Naturaleza. MIMAM. Madrid. ESPAÑA.

Mariño Fernández, Fernando José. Ingeniería y Ciencia Ambiental, S.L.. Madrid. ESPAÑA.

Marsol Farrero, Rosa. Departamento de Medio Ambiente de la Generalitat de Catalunya. Centro de Nutrias. El Pont de Suert. Lérida. ESPAÑA

Martínez Alonso, Laura. Universidad Europea Madrid. Villaviciosa de Odón. Madrid. ESPAÑA

Melero Cavero, Yolanda. Universidad de Barcelona. Departamento Biología Animal. Barcelona. ESPAÑA.

Mendiola Gómez, Iñigo. Diputación Foral de Gipuzkoa. Dpto. Medio Rural. Dirección de Montes y Conservación de la Naturaleza. Donostia - San Sebastián. ESPAÑA.

Meneses Canalejo, José Manuel. Junta de Castilla y León. Soria. ESPAÑA.

Mengod Alcalá, Joaquín. SIRASA. Teruel. ESPAÑA.

Miquel Colome, Jordi. Universitat de Barcelona. Facultad de Farmacia. Barcelona. ESPAÑA.

Monika, Blanke. Ethologie, Univ. Osnabruck. Niedersachsen. ALEMANIA

Olalla Tárraga, Miguel Ángel. Universidad Autónoma de Madrid. Dpto de Ecología. Tres Cantos. Madrid. ESPAÑA.

Onrubia Baticón, Alejandro. Taravero. Burgos. ESPAÑA.

Palazón Miñano, Santiago (Moderador). Departamento de Medio Ambiente. Generalitat de Catallunya. Barcelona. ESPAÑA.

Pallarés López, Marta. D.G. Medio Natural - Gobierno de La Rioja. Logroño. La Rioja. ESPAÑA.

Palomo Muñoz, L. Javier. Universidad Málaga. Dpto. Biología Animal. Málaga. ESPAÑA.

Pérez Acín, Ana Isabel. Gernika. Vizcaya. ESPAÑA.

Philippa, Joost. Institute of Virology. Erasmus University. Rotterdam Zoo. Rotterdam. PAÍSES BAJOS.

Pinedo Ruiz, Francisco Javier. Logroño. La Rioja. ESPAÑA.

Pödra, Madis. Hiiumaa Protected Areas Administration. Kardla. Hiiumaa. ESTONIA

Polma, Merje. Tallinn. ESTONIA

Rafart Plaza, Elena. Universidad de Barcelona. Dpto. de biología animal. Barcelona. ESPAÑA.

Rodríguez Comte, Mónica. Fundación Naturaleza y Hombre. Matienzo de Ruesga. Cantabria. ESPAÑA.

Rodríguez Sanz, Julia. POC Medio Ambiente. La Puebla de Arganzón. Burgos. ESPAÑA.

Romero Martín, Esther. SIRASA. Teruel. ESPAÑA.

Rozhnov, Viarcheslav. A.N. Severtsov Institute of Ecology and Evolution. Moscú. RUSIA

Rubines García, Jonathan. Universidad Pais Vasco. Fac. Farmacia. Dpto. de Zoología. Vitoria. Álava. ESPAÑA.

Ruiz de Azúa, Nerea. EKOS Estudios Ambientales. Lasarte. Guipuzcoa. ESPAÑA.

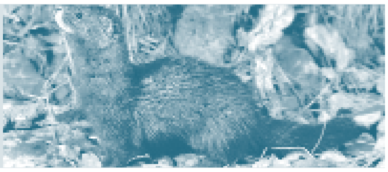
Ruiz-Olmo, Jordi (Moderador). Departamento de Medio Ambiente de la Generalitat de Catalunya. Barcelona. ESPAÑA.

Sánchez Migallón, David. Santo Domingo de la Calzada. La Rioja. ESPAÑA.

Saveljev, Alexander. Russian Research Institute of Game Management and Fur Farming. Kirov. RUSIA.

Sidorovich, Vazdim (conferenciante). Institute of Zoology NASB. Minsk. BIELORRUSIA.

Siguero Sánchez, Isacio. Euronerz e.v.. Hamburgo. ALEMANIA.



Skumatov, Dimitry Valentinovich. Russian Research Institute of Game Management and Fur Farming. Kirov. RUSIA

Soto del Río, Mónica. Diputación Foral de Álava. Dpto. Agricultura y Md. Ambiente. Vitoria. Álava. ESPAÑA.

Temiño Fernández, Consuelo. Junta de Castilla y León. Burgos. ESPAÑA.

Ternovskaya, Julia. Instituto de Zootaxy y Ecología. Novobbirsk . RUSIA

Toman, Ales. Agency for Nature Conservation of Czech Rep. Leded. REPÚBLICA CHECA.

Torres Martínez, Jordi. Universitat de Barcelona. Fac. de Farmacia. Barcelona. ESPAÑA.

Tumanov, Igor (Conferenciante). Instituto Ártico y Antártico del Centro de Investigaciones Científicas de la Federación Rusa. Saint Petersburgo. RUSIA.

Unanue Goikoetxea, Araitz. Vitoria-Gasteiz. Álava - Araba. ESPAÑA.

Urra Maya, Fermín. Gestión Ambiental de Navarra. Pamplona. Navarra. ESPAÑA.

Vargas, Astrid (Moderadora). Servicio de Pesca y Vida Silvestre. Torremolinos. Málaga. ESPAÑA.

Wolfgang, Festl. Euronerz E.V. niedersachsen. ALEMANIA

Zabala Albizua, Francisco Javier. Arrigorriaga. Bizkaia. ESPAÑA.

Zaldívar Ezquerro, Carlos. D.G. de Medio Natural - Gobierno de La Rioja. Logroño, La Rioja. ESPAÑA.

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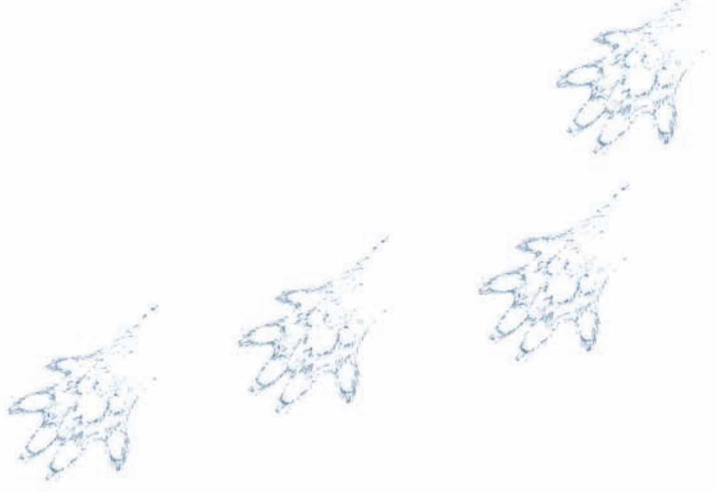

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