Informe final* del Proyecto GU005
Reunión: 3rd World Lagomorph Conference

Responsable:	Dr. Fernando Alfredo Cervantes Reza
Institución:	Universidad Nacional Autónoma de México Instituto de Biología
Dirección:	Apartado Postal 70-153, Coyoacán, México, DF, 04510 , México
Correo electrónico:	fac@ibunam.ibiologia.unam.mx
Teléfono/Fax:	(999) 9428330 ext. 369

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Resumen:

La 3ª WLC reunirá a investigadores reconocidos de todo el mundo en México y brindará la oportunidad de compartir el conocimiento e intereses por el estudio y conservación de los lagomorfos en un espacio común con científicos y estudiantes y profesionistas interesados. La 3ª WLC será un foro para que los especialistas presenten sus investigaciones recientes en distintos temas y para forjar redes cooperativas que ayudarán a la conservación de este taxón de mamíferos y de su hábitat.

- * El presente documento no necesariamente contiene los principales resultados del proyecto correspondiente o la descripción de los mismos. Los proyectos apoyados por la CONABIO así como información adicional sobre ellos, pueden consultarse en www.conabio.gob.mx
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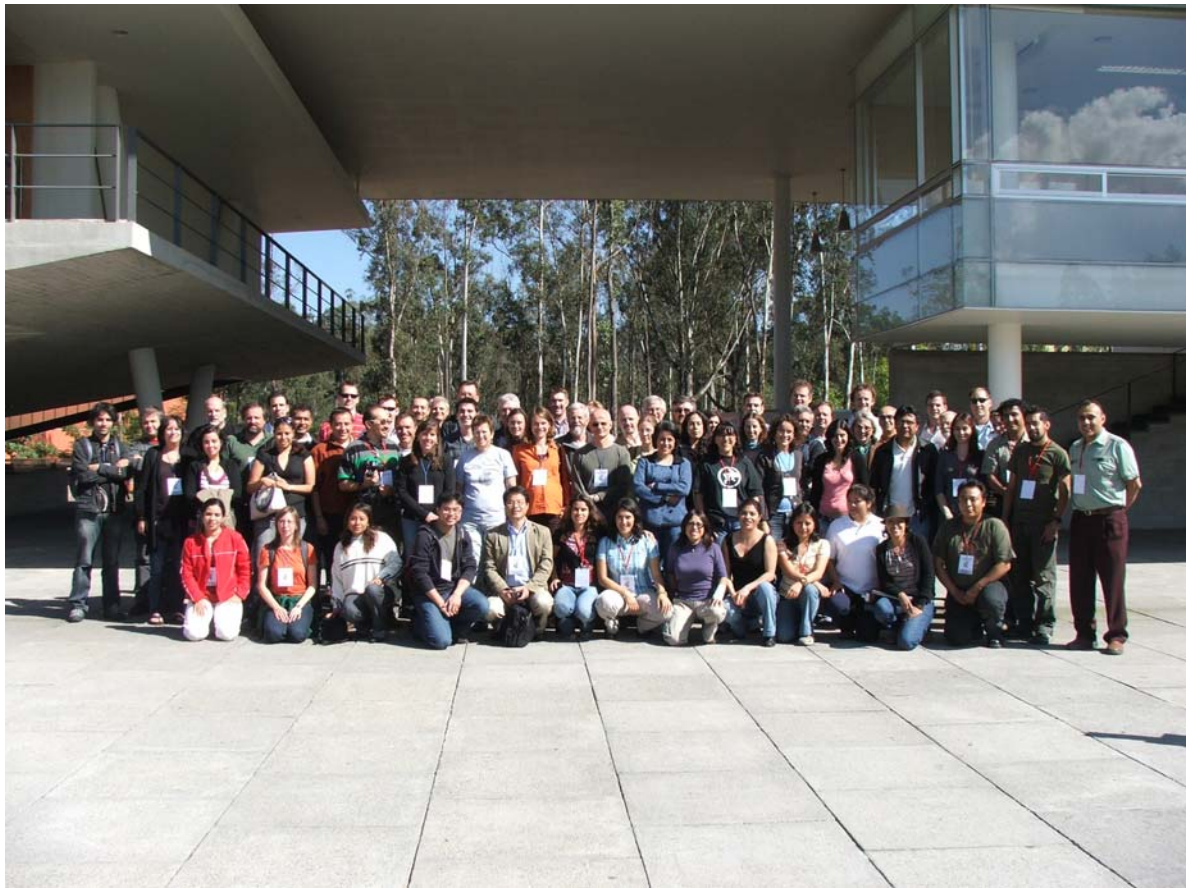
3rd World Lagomorph Conference



Asistentes a la Tercera Conferencia Mundial de Lagomorfos, 10-14 de Noviembre de 2008, UNAM Campus Morelia

Responsable del Proyecto:

Dr. Fernando Alfredo Cervantes Reza

Investigados Titular “B” T. C.

INSTITUTO DE BIOLOGÍA

UNIVERSIDAD NACIONAL AUTÓNOMA DE MÉXICO

Objetivos alcanzados:

La 3ª WLC reunió a investigadores reconocidos de todo el mundo en la sede para este evento (Morelia, Mich) y ofreció la oportunidad de compartir el conocimiento e interés por el estudio y conservación de los lagomorfos, en un espacio común con científicos, estudiantes y profesionistas interesados en el grupo. La 3ª WLC fue un foro para que los especialistas presentaran sus investigaciones recientes en distintos temas, y sin duda forjó redes cooperativas que ayudarán al estudio y conservación de estos mamíferos por medio de estudios presentes y futuros.

Todos los objetivos de esta importante reunión se cumplieron y se contó también con los principales organismos preocupados y dedicados a difundir el conocimiento de los lagomorfos en el mundo. Estos organismos son: Lagomorph Specialist Group (LSG) de IUCN/SSC, World Lagomorph Society (WLS) y AMCELA.

A través de la 3ª WLC estamos seguros de que se abrieron oportunidades para que los estudiantes mexicanos pudieran conocer y dialogar con investigadores nacionales e internacionales, lo cuales contagiaron el interés por las especies.

Cabe destacar el ambiente agradable y entusiasta que siempre mantuvieron tanto estudiantes como reconocidos investigadores que expresaron su gusto por haberse llevado a cabo la Tercera Reunión, además de que se contó con el honor de la visita de dos de los primeros exponentes en el estudio de los lagomorfos y asistentes también de la Primera Conferencia Mundial de Lagomorfos, en Canadá, en el año de 1979.

Programa científico:

El programa científico incluyó trabajos presentados por los participantes en las modalidades oral y de cartel, además de los talleres dirigidos a los problemas planteados por los grupos de trabajo que se formaron, lo cual propició discusiones interesantes sobre diferentes tópicos de importancia actual y las sesiones plenarias. Dentro del evento se realizó también la Asamblea General de la Sociedad Mundial de Lagomorfos (WLS), la reunión del Grupo Especialista de Lagomorfos (LSG) de la IUCN/SSC y de AMCELA con sus socios nacionales (Ver Programa Científico anexo).

Contar con la visita del Presidente de la Sociedad Mundial de Lagomorfos**,** **Dr. Paulo Célio Alves** del Centro de Investigación en Biodiversidad y Recursos Genéticos de la Facultad de Ciencias**,** Universidad de Porto, Vairão**,** Portugal, siempre fue un gusto y un honor, ya que cuenta con una amplia experiencia en el estudio de los lagomorfos y en su área de trabajo, además de ser una persona amable y siempre colaborativa con las actividades de la reunión.

Las aportaciones del Dr. Célio Alves fueron las siguientes:

Moderador del taller “Genética de Poblaciones y Filogeografía” y coautor de la conferencia “Molecular evidence of natural hybridization between the Iberian and brown hares in northern Iberian Peninsula”, impartida en dicho taller.

Coautor de dos conferencias en sesiones generales.

Ponente de la conferencia “Will *Lepus* successfully respond to global warming: A proposed rangewide research initiative”, en sesión general.

Moderador de la Asamblea General de la World Lagomorph Society (WLS)

Ponente de la Sesión Plenaria de Clausúra “Trends in Lagomorphs Research”

Pláticas informales con alumnos y miembros de AMCELA para el mutuo enriquecimiento de los trabajos que actualmente se realizan en México.

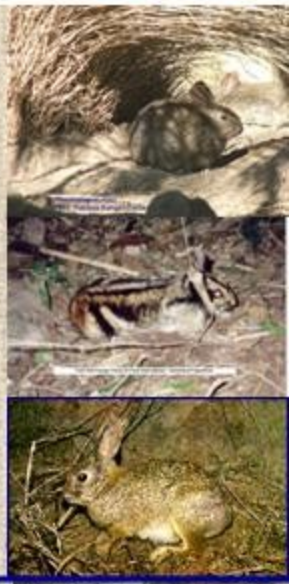
Instituciones participantes:
* Instituto de Biología, UNAM
* Asociación Mexicana para la Conservación y Estudio de Lagomorfos, A. C. (AMCELA)
* Centro de Investigaciones en Geografía Ambiental (CIGA) UNAM
* Grupo Especialista de Lagomorfos (LSG) de la IUCN/SSC
* Sociedad Mundial de Lagomorfos (WLS)
* Comisión Nacional para el Conocimiento y Uso de la Biodiversidad (CONABIO)
* Gobierno del Estado de Michoacán, México

3rd World Lagomorph Conference

10 – 13 November, 2008. Morelia, Mich. MEXICO

Organized by

Asociación Mexicana para la Conservación y Estudio de los Lagomorfos, A.C. (AMCELA)
Centro de Investigaciones en Geografía Ambiental (CIGA UNAM)
Instituto de Biología, UNAM
Universidad Autónoma de Tlaxcala
Gobierno del Estado de Michoacán



Plenaries

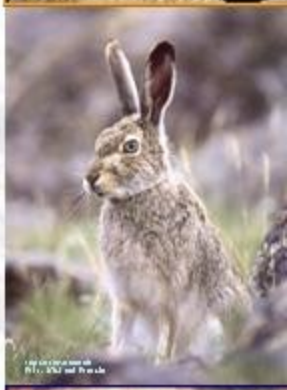
- Trends in lagomorph research.
- Conservation approaches using lagomorphs Mexican lagomorphs.
- Mexican lagomorphs.
- Epidemiological studies in European rabbits and hares: models for understanding diseases in other lagomorphs.
- The effects of climate change on lagomorph populations.
- Ecosystem services.

Oral and Poster sessions topics

Systematics, Taxonomy, Paleontology, Evolution and Genetics.

Phylogenetics and Biogeography, and Phylogeography.

Ecology and Population dynamics, Dispersal, Community ecology, Ecosystem dynamics, Population management and Conservation.



Lagomorph Specialist Group, SSC/ IUCN
General Assembly

World Lagomorph Society
General Assembly

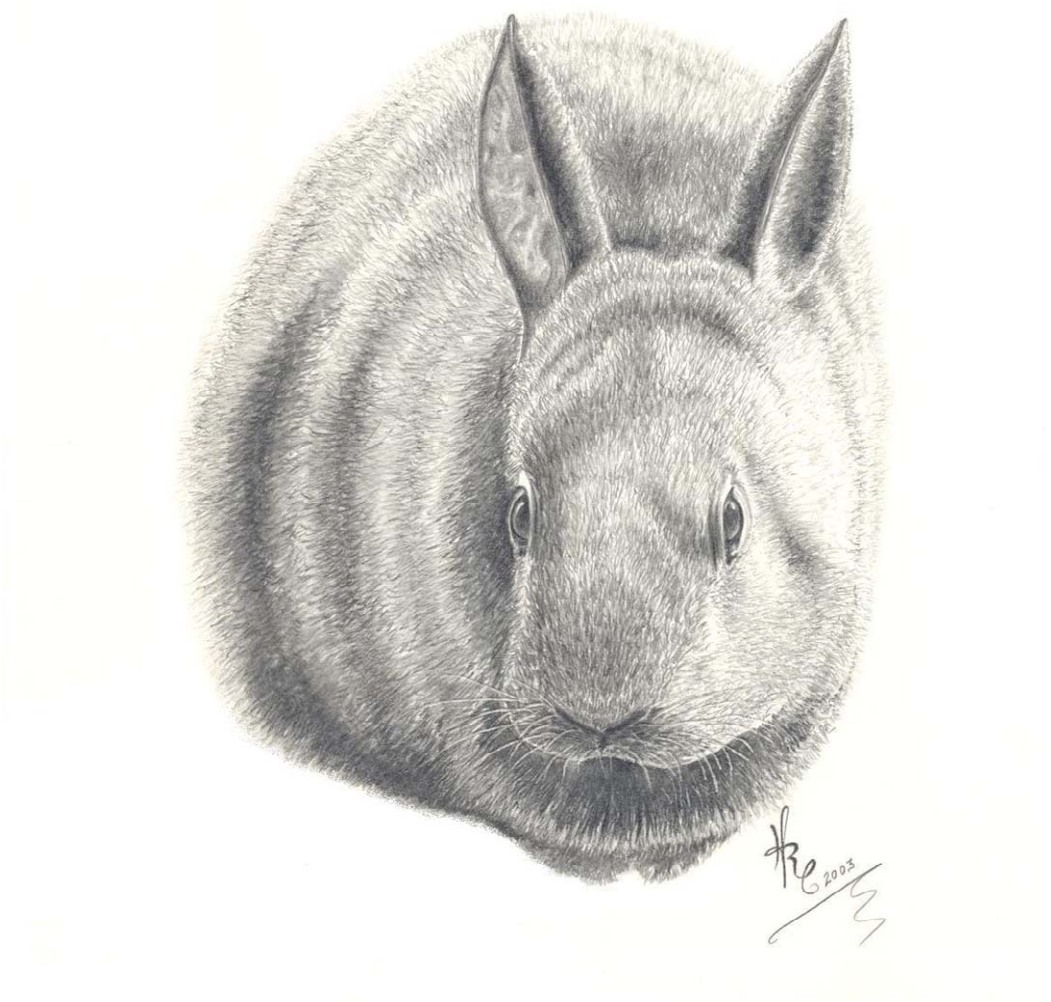
Mexican Association for the Conservation and Study of Lagomorphs
General Assembly

3rdwlc@gmail.com
www.ciga.unam.mx/docencia/lagomorfos/AMCELA-CIGA_v2.pdf

Rabbit relief on stone
Tepoztlán Museum. Morelos, MEXICO

3rd WORLD LAGOMORPH CONFERENCE

10-13 NOVEMBER 2008
MORELIA, MICHOACAN DE OCAMPO. MEXICO



ABSTRACT BOOK

3rd World Lagomorph Conference, Morelia, Michoacán de Ocampo, México, 10-13 November 2008. Abstract Book.

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Angélica Domínguez Pérez
Elizabeth Martínez-Villeda
Patricia Rangel Zarza
Héctor Rangel-Cordero
Verónica Farías González

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WELCOME

Most appreciated colleagues,

On behalf Mexican Association for the Conservation and Study of Lagomorphs and the Research Center on Environmental Geography we would like to welcome you all to the 3rd World Lagomorph Conference. This time, it our duty to hold this academic event that brings together all lagomorph specialists world wide. Four years ago we had the pleasure to see you all at the former meeting in Vairão, Portugal. It has been quite a challenge for us to organize this third world experience because AMCELA, in spite of his twenty anniversaries, is currently comprised of young students, and the CIGA is just a year old baby born institution. In our effort so far made, we would like to serve as steering group to drive through over 100 topics on one of the most enchanted icons of nature: indeed lagomorphs and related scientific issues derived from their study. We have made our best to keep the high academic standard experience in the previous meetings; in this regard, the combination of scientific experiences and the atmosphere provided by Michoacan of Ocampo and its magical context may help to learn from each other and bring us together as human beings.

Cordially,
Adriana Romero and Alejandro Velázquez
Morelia, November 2008

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DAILY PROGRAM SCHEDULE

	Monday 10th	Tuesday 11th	Wednesday 12th	Thursday 13th
09.00	*Opening*	Plenary Lecture	Plenary Lecture	Plenary Lecture
09.15	Plenary Lecture	Plenary Lecture	Plenary Lecture	Plenary Lecture
09.30	Plenary Lecture	Plenary Lecture	Plenary Lecture	Plenary Lecture
09.45	Plenary Lecture	GS2	GS4	*2008*
10.00	*Recess*	GS2	GS4	Meeting
10.15	GS1	GS2	GS4	Lagomorph
10.30	*Coffee*	*Coffee*	GS4	Specialist
10.45	*Coffee*	*Coffee*	*Coffee*	Group *(LSG)*
11.00	GS1	GS2	GS4	*Coffee*
11.15	GS1	GS2	GS4	*Coffee*
11.30	GS1	GS2	GS4	General
11.45	GS1	GS2	GS4	Assembly
12.00	GS1	GS2	GS4	Of
12.15	*Lunch*	GS2	GS4	*AMCELA*
12.30	*Lunch*	*Lunch*	GS4	*Lunch*
14.00	Plenary Lecture	*Lunch*	*Lunch*	*Lunch*
14.15	Plenary Lecture	*Lunch*	*Lunch*	*Lunch*
14.30	WS2	GS3	WS3, 4	Plenary Lecture
14.45	WS1, 2	GS3	WS3, 4	Plenary Lecture
15.00	WS1, 2	GS3	WS3, 4	Plenary Lecture
15.15	WS1, 2	GS3	WS3, 4	General
15.30	WS1, 2	GS3	WS3, 4	Assembly
15.45	WS1, 2	GS3	WS3, 4	World
16.00	WS1, 2	GS3	WS3, 4	Lagomorph
16.15	WS1, 2	GS3	WS3, 4	Society *(WLS)*
16.30	WS1, 2	*Coffe/Poster*	*Coffe/Poster*	*Coffee*
16.45	*Coffe/Poster*	*Coffe/Poster*	*Coffe/Poster*	*Coffee*
17.00	Coffe/Poster	Coffe/Poster	Coffe/Poster	Plenary Lecture
17.15	Coffe/Poster	Coffe/Poster	Coffe/Poster	Plenary Lecture
17.30	Coffe/Poster	Coffe/Poster	Coffe/Poster	Plenary Lecture
17.45	Coffe/Poster	Coffe/Poster	Coffe/Poster	*Closing*
18.00	Coffe/Poster	Coffe/Poster	Coffe/Poster	
18.15	Coffe/Poster	Coffe/Poster	Coffe/Poster	
18.30	Coffe/Poster	Coffe/Poster	*Book*	
18.45	Coffe/Poster	Coffe/Poster	*Presentation*	
19.00	*Welcome Toast*	*End*	*End*	*Banquet*

These issues are being studied closely, particularly in Europe, where rabbits have been reduced to fragmented populations following the arrival of rabbit haemorrhagic disease. It will be shown how ideas developed in studying epidemiology in a common species like *Oryctolagus* could provide useful background and skills for understanding the importance of disease in other less common lagomorphs. This could help not only with current conservation issues, such as maintaining populations of rare lagomorphs, but also provide useful information for assessing the risk of disease transfer between related species or better understanding the co-evolution of hosts and disease agents.

PLENARY LECTURES

Plenary lectures

The role of lagomorphs in ecosystems: keystones and engineers

Andrew Thomas Smith

School of Life Sciences, Arizona State University, Tempe, AZ 85287-4501 USA. E-mail: a.smith@asu.edu

Lagomorphs serve many positive functions in natural ecosystems. They may influence the abundance and variety of local plant communities, and they may serve as important prey for a variety of predators. As ecosystem engineers they may modify environments for the benefit of other species, affect nutrient cycling through soil disturbance and by changing plant nutrient content, and alter local hydrologic patterns. This review will give examples of the far-reaching influence of lagomorphs in natural ecosystems, concentrating on two species, the Plateau Pika (*Ochotona curzoniae*) and the European Rabbit (*Oryctolagus cunniculus*). The Plateau Pika lives in high density social family burrow systems on alpine meadow/steppe grassland habitat on the high elevations of the Tibetan Plateau. Its burrows are used frequently as breeding habitat by endemic birds and lizards. Being a non-hibernating species, it serves as the main food source for most mammalian and avian predators on the plateau. Its presence promotes increased plant species richness and nutrient cycling, and its burrows inhibit runoff of monsoonal rains, thus alleviating erosion and flooding. The European Rabbit is the main food source for two of Europe's most endangered animals, the Iberian Lynx (*Lynx pardinus*) and the Spanish Imperial Eagle (*Aquila adalberti*). It also exerts important impacts on plant communities, and rabbit burrows provide habitat for many animals. The lessons learned from these studies should be utilized by conservation biologists to argue for the incorporation of plans to protect natural ecosystems and the lagomorphs that occupy them.

Plenary lectures

Epidemiological studies in European rabbits and hares: models for understanding diseases in other lagomorphs

Brian Cooke

Invasive Animals Cooperative Research Centre, University of Canberra, Canberra ACT 2601, Australia.

European rabbits *Oryctolagus cuniculus* (L.) are common laboratory animals and have been widely used to test a wide range of disease causing agents. Wild rabbit populations are also affected by two diseases that cause high mortality, myxomatosis and rabbit haemorrhagic disease (RHD). These diseases cause great concern from a conservation perspective in Europe but are exploited for controlling rabbits in Australia and New Zealand. As a consequence a great deal is known about the field epidemiology of both diseases covering topics such as the behaviour of insect vectors, pathology and the interpretation of serological data from field collections. European brown hare syndrome virus (EBHSV) is another lagovirus which, as the name suggests, occurs in *Lepus europaeus,* and its epidemiology not only provides some interesting parallels with rabbit haemorrhagic disease but also provides insight into virus specificity. EBHSV also affects *Lepus timidus*, but only where both hare populations overlap, suggesting that *L. europaeus* is the primary host. Central to present day understanding of the epidemiology of rabbit haemorrhagic disease and myxomatosis has been the use of enzyme-linked immuno-sorbent assays (ELISAs) that quickly enable classification of the serological status of large numbers of rabbits repeatedly recaptured during live-trapping studies. This has not only enabled the disease history of individual rabbits to be followed but when coupled with survival rates on a population scale provides insight into seasonal disease patterns and changes in disease severity. However, there are also many other considerations in epidemiology such as meta-population structure that can be especially important in considering how rabbit populations recover following disease out-breaks.

Plenary lectures

Approaches and challenges of managing declining populations of lagomorphs

John A. Litvaitis

Department of Natural Resources and the Environment, University of New Hampshire, Durham, NH 03824, USA, john@unh.edu

Populations of more than a third of all lagomorphs are declining. A variety of causes for these declines have been identified including habitat loss, overexploitation, elevated populations of generalist predators, and disease. Because lagomorphs are essential members of many ecosystems, considerable activity is being directed to stabilize or reverse these declines. Common approaches have included restocking via trap-and-transfer, captive breeding, and habitat enhancement. Although these efforts have yielded some success, most have occurred at a limited spatial scale. Additionally, new threats are emerging (e.g., climate change and inbreeding depression) that may further lessen long-term survival of some populations. In response to these concerns, recent innovations for restoring threatened lagomorphs include working at several spatial scales. Emerging activities include an assessment of current levels of genetic diversity, identifying landscape features that facilitate connectivity among remnant and newly established populations, and establishing collaborative management networks that include public and private landowner partnerships. Perhaps the most important consideration to any effective restoration effort is to respond quickly to population declines.

Plenary lectures

Conservation approaches using Lagomorphs

Gerardo Ceballos

Instituto de Ecología, Universidad Nacional Autónoma de México.
gceballo@miranda.ecologia.unam.mx

Plenary lectures

Mexican Lagomorphs

Fernando A. Cervantes* and Adriana Romero-Palacios

Colección Nacional de Mamíferos, Departamento de Zoología, Instituto de Biología, Universidad Nacional Autónoma de México, Apartado Postal 70-153, 04510 México, D. F., acrp@ibiologia.unam.mx, fac@ibiologia.unam.mx

Mexico is one of the five countries with greater diversity of lagomorphs anywhere in the world. Account with 15 species, approximately 55% of the species that live in the American Continent, 10 of which they are rabbits (nine of the *Sylvilagus* species, one of the *Romerolagus* species) and 5 hares (*Lepus* species). On the other hand, Mexico has the greater number of endemic species in the American Continent, because 8 species are exclusive of this country. In addition it is possible to mention that 6 of these species are located in areas of distribution very restricted. Despite this abundant diversity of species and endemism, some of the wild populations of lagomorfos have been falling to an accelerated rate and its habitat is being aggravated day with day severely, reason why many species are catalogued like in danger of extinction or threatened. AMCELA is dedicated to conduct and to promote battle in favor of the conservation and the knowledge of this particular group.

Plenary lectures

Landscape-based conservation, a new paradigm or an state of mind

Alejandro Velázquez, Francisco J. Romero, Héctor Rangel-Cordero and Faustino López

Centro de Investigaciones en Geografía Ambiental, alex@ciga.unam.mx
Universidad Autónoma Metropilitana, Unidad Xochimilco, rmfj1302@correo.xoc.uam.mx,

Lagomorphs, as our main study object, have been approached from different scientific angles. Regardless the discipline, it is clear that this taxonomic group is been threatened by current human activities. In response, large efforts have been made to conserve them following convention methods, such as updating red book data bases, creating concern about their status and eventually establishing protected areas to safeguarded them. Conservation efforts directed at scattered areas and specific populations have not been sufficient to stop the enormous disappearance of habitats. Innovative approaches that incorporate a holistic ecosystem view and dynamic processes are needed to achieve effective conservation of species assemblages. In Mexico, most conservation efforts have adopted focal species approaches, with little concern for holistic ecological considerations. The current status of the lagomorphs is indicative of the inefficiency of these approaches. The main purpose of this talk will be to demonstrate that conservation has different connotations and that rabbits may play an important role to pursuit an emergent concept here denoted as landscape-based conservation. Over the last twenty years we have conducted a research program to investigate inclusive approaches that would achieve conservation in a broad sense. The volcano rabbit (*Romerolagus diazi*), a lagomorph restricted to high elevation in central Mexico, was chosen as the umbrella species to pursuit the autoecological approach. Then, we used data from over 6000 records of vascular plants and vertebrate species to identify and prioritize conservation communities (sinecological approach). A consecutive ecosystem approach was followed to depict critical areas and to compare them with current protected areas. The results were shared with local stakeholders and local authorities in order to construct a network of protected areas through a participatory approach.

To conclude, the role of the volcano rabbit as key species to regulate the dynamics of the alpine landscape has been reviewed. The results in conjunction with natural catastrophic events such as the outburst of the Popocatépetl volcano have been reckoned as the main forces to maintain current populations of volcano rabbits. Based upon the previous, we will recall the limits of the conventional conservation approaches and, to conclude, we will enhanced the outreach of a new cultural oriented, landscape-based conservation initiative to launch sound, long term conservation actions.

Plenary lectures

Trends on Lagomorph research

Paulo Célio Alves

CIBIO, Centro de Investigação em Biodiversidade e Recursos Genéticos & Faculdade de Ciências; Universidade do Porto, Campus Agrário de Vairão, 4485-661 Vairão, Portugal

Lagomorphs are present on all continents and include a great variety of species well adapted to completely different environments. Paleontological data show that lagomorphs are an ancient evolutionary group, and most likely had in the past an even greater ecological importance than today. Although the knowledge on the palaeontology and evolution has dramatically increased over the last few years, many questions remain open and unsolved, namely on the taxonomic classification within the group. However the explosion of genetic studies in the last years, significantly contributed to clarify some of these uncertainties. The molecular studies on the evolution of the European rabbit have been by far the major engine of such advances, of which the ongoing project on the sequencing of its complete genome is a clear example. This project will provide invaluable molecular tools and will certainly open the door to the development of more thorough research on lagomorph genetics and evolution, and will surely contribute to deepen our understanding of the dynamics of lagomorphs' populations. However, the progress on lagomorph research has touched more than the development of genetic tools, and big advances have been made on monitoring techniques, physiological studies, and on the understanding of some diseases. However, this is only the tip of the Iceberg on what we must explore in the future. Also, for a great number of species the scientific knowledge is still absent or very scarce. In this talk, a part of making an overview on the latest issues on lagomorph research, I will also highlight some future research pathways that may help us better understanding the fascinating world of rabbits, hares and pikas.

ORAL PRESENTATIONS

GS1 - Systematics, Evolution and Genetics

Molecular data pertinent to the systematics of South African cape hares (*Lepus capensis*)

F. Suchentrunk[1], H. B. Slimen[2] and U. Kryger[3]

[1]*Research Institute of Wildlife Ecology, University of Veterinary Medicine Vienna, Savoyenstr. 1, 1160 Vienna, Austria, e-mail: franz.suchentrunk@vu-wien.ac.at*
[2]*Laboratoire de Génétique Moléculaire, Immunologie et Biotechnologie, Faculté des Sciences de Tunis, Campus Universitaire El Manar, 2029 Tunis, Tunisia*
[3]*Department of Zoology and Entomology, University of Pretoria, Pretoria 0002, R.S.A.*

The conventional view that *Lepus capensis* is distributed across large parts of Africa has recently been questioned by several authorities. A very recent morphological study restricts cape hares tentatively to a small range in the Western Cape Region of South Africa and groups all other *L. capensis*-type hares from South Africa tentatively into a new species: *L. centralis* Palacios et al., 2008. Here, we studied molecular relationships among *L. capensis*-type hares from different regions throughout South Africa, encompassing six conventional subspecies, including *L. c. capensis* from the Western Cape Region. The hares matched phenotypically and morphologically the newly described *L. capensis* on the one hand or *L. centralis* on the other. The molecular data were used to examine whether those two new "morpho-species" were in accordance with the "Biological Species Concept" (BSC). We examined 66 hares for allelic variation at 13 microsatellite loci, and for sequence (463 bp) variation of the hypervariable segment 1 (mtHV1) of the mitochondrial control region. Neighbour joining (NJ) and maximum parsimony (MP) analyses of the currently obtained sequences together with all Lepus sequences downloaded from GenBank (337bp) resulted in a reasonably supported monophyly for all South African L. capensis-type sequences. The results of a NJ analysis, a MP, and a maximum likelihood analysis of all currently obtained 36 South African *L. capensis*-type mtHV1 haplotypes were

incongruent with the splitting into two morpho-species, and this was also confirmed by a median-joining network analysis. Moreover, both F-statistics, a Bayesian admixture structure model, as well as a principal coordinate analysis based on pair-wise Cavalli-Sforza-Edwards genetic distances between individuals as derived from the microsatellite data indicated close genetic relationships among all South African hares studied presently. A coalescence model-based migration analysis for the microsatellite genotypes indicated gene flow between most of the considered conventional subspecies, including *L. c. capensis* and *L. c. centralis*, sufficient to balance stochastic drift effects under an island model of population distribution. All our molecular results demonstrate that the examined hares from South Africa belong to a single species when accepting the BSC. Thus, (the morpho-species) *L. centralis* Palacios et al., 2008 has to be considered a synonym of *L. capensis* L., 1758. This study was financed by Wildlife Research – Franz Suchentrunk, Vienna, and the Research Institute of Wildlife Ecology, University of Veterinary Medicine Vienna, Austria.

GS1 - Systematics, Evolution and Genetics

Sharing of endogenous lentiviral gene fragments among leporid lineages separated for more than 12 million years (genera *Lepus, Sylvilagus, Bunolagus and Oryctolagus*)

P. J. Esteves[1,2*], J. Abrantes[1,3,4**] and W. van der Loo[1,3**]

[1]CIBIO-UP, Centro de Investigação em Biodiversidade e Recursos Genéticos – Universidade do Porto
[2]CITS, Centro de Investigação em Tecnologias da Saúde, ISPN, CESPU, Gandra, Portugal
[3]Departamento de Zoologia e Antropologia da Faculdade de Ciências da Universidade do Porto
[4]INSERM U601, Institut de Biologie, Nantes, France
*E-mail : *pjesteves@mail.icav.up.pt, **jabrantes@mail.icav.up.pt, ***wvdloo@mail.icav.up.pt*

Lentiviruses are retroviruses that can cause severe pathologies in a variety of mammals, including human and cattle (e.g. AIDS and different forms of lymphoma). The origin of this virus group is not completely understood. The hypothesis of a relatively recent emergence of the modern lentivirus subgroups was based on estimates of genetic distances among contemporary viruses, which is considered questionable. Although exogenous lentivirus has never been reported in leporids (rabbits and hares), in 2007, Katzourakis and co-workers discovered RELIK (Rabbit Endogenous LentIvirus type K) which appears to be the first reported endogenous lentivirus in the European rabbit (*Oryctolagus cuniculus*). Sequence comparisons among RELIK paralogs indicated a history of 7 million years. The authors suggested that a more exact estimate of RELIK persistence times might be obtained by searching for the occurrence of related lentiviral sequences in other lagomorph species. We have substantiated this inference by sequence data of the RELIK associated *gag* gene, which is among the more conserved gene regions of lentivirus. *Orytcolagus cuniculus algirus*, *Bunolagus monticularis*, *Lepus europaeus*, *Sylvilagus brasiliensis* revealed the presence of the *gag* gene, which indicates that RELIK is shared among Leporid lineages that

diverged more than 12 million years ago. RELIK was apparently absent from *Pronolagus crassicaudatus* and *Ochotona princeps*. Katzourakis's important discovery highlights the potentials of ongoing and future Whole Genome Projects. An understanding of the history of lentiviruses and their associated diseases might benefit from a better knowledge of (evolutionary) genetics of Leporids, including species other than *Oryctolagus*.

GS1 - Systematics, Evolution and Genetics

Pilot study to assess the MHC class I variability in European wild rabbits (*Oryctolagus cuniculus*) in north Rhine-Westphalia, Germany

J. Fickel[1,†], S. Desaga[1], T. Noventa[1], M. Putze[1] and W. Lutz[2]

[1] Dept. Evolutionary Genetics, Leibniz-Institute for Zoo and Wildlife Research, Alfred-Kowalke-Str. 17, D-10315 Berlin, Germany. [†]E-mail: Fickel@IZW-Berlin.de
[2] Wildlife Research Institute NRW, Pützchens Chaussee 228, D-53229 Bonn, Germany.

In Germany, one of the most severe diseases for wild rabbits (*Oryctolagus cuniculus*) is the rabbit haemorrhagic disease (RHD, *calicivirus)* which spread to western Europe around 1986 by imported Angora rabbits from China. In 2006 it was verified veterinarily in 9% (27% assumed) of all hunting districts in Germany. Viruses are tackled by MHC class I molecules (MHC I) of the immune system who then interact with $CD8^+$ (cytotoxic) T-cells to cause apoptosis of virus-infected cells. In this pilot study we investigated two separated (170km) small rabbit groups (pop1 & pop2, both n=13) for their MHC I allelic variability in order to later compare that variability among regions with and without disease outbreaks. First, we genotyped all 26 individuals at 10 microsatellite loci to ensure the presence of a Hardy-Weinberg equilibrium (HWE) at neutrally evolving loci. Both sampling groups were at HWE (pop1 H_O/H_E=0.638/0.652; pop2 H_O/H_E=0.537/0.634) and *R*-statistics showed no significant genetic group differentiation, neither by location (R_{ST}=0.0111, p=0.275) nor by gender (females/males n=13/13; R_{ST}=0.01583, p=0.208). Second, we devised primers to amplify the *Oryctolagus* MHC I exon3 (encoding the α2-domain) and to determine its variability. In contrast to microsatellite alleles, MHC alleles are of equal lengths but differ in their nucleotide sequence. Thus, the mixture of amplified exon3-PCR fragments (~180 bp) was cloned into a plasmid vector to be sequenced. On average we picked 40 clones per individual to capture all alleles of an animal. Until now we detected 41 different nucleotide sequences, corresponding to 29 different amino acid sequences (with 28 variable positions out of 59). The mean individual number of alleles/rabbit was 6.5, the highest number was 15, indicating an exon3 duplication (up to 8 copies). Pop1 and pop2 shared 30 out of 41 alleles, 6 alleles occurred in pop2 only, and 5 were only detected in pop1.

GS1 - Systematics, Evolution and Genetics

Biogeography and evolution of the cottontail genus *Sylvilagus* (Lagomorpha: Leporidae)

J. Salazar-Bravo[1] and L. Ruedas[2]

[1]Department of Biological Science; Texas Tech University; Box 43131; Lubbock, TX 79409-3131 E-mail: j.salazar-bravo@ttu.edu
[2]Museum of Vertebrate Biology and Department of Biology; Portland State University; Box 751; Portland, OR 97207–0751 E-mail: ruedas@pdx.edu

Rabbits of the genus *Sylvilagus* are distributed from North America to northern Argentina and 0 to 5000 meters. Most of the currently recognized species are Nearctic: only 2–3 range into South America. It is difficult to ascertain if this imbalance in species diversity is real or rather, an artifact of poor understanding of species limits in the Neotropical forms. The last revision of South American cottontails, over 50 years ago, resulted in numerous incongruous hypotheses of specific limits and geographic distribution. Here, we present results of phylogenetic analyses of nominal species of *Sylvilagus* based on analysis of sequence data. Our results indicate a substantial disconnect between current taxonomy and the phylogenetic relationships revealed by our analyses of the sequence data. Sequence divergence in the 12rRNA of the mtDNA gene ranges from 3–8%, or orders of magnitude higher that those found among species of *Sylvilagus* recognized in North America (as little as 0.8% in the same gene). The biogeography of the genus remains complex. We hypothesize that *Sylvilagus* originated primarily as a dry forest and xeric adapted genus, with the first excursion from this pattern being the Southeast North American sister taxa *S. aquaticus* and *S. palustris*. Most remaining cladogenic events in xeric areas: the Californian *S. bachmani*, the desert SW *S. audubonii*, and montane endemics of New Mexico. A major cladogenic event is the split between North and South American groups. Far from being a single species, we resolve minimally six South American species. Mesoamerica likewise is covered by species subsumed within *S. floridanus*, which is clearly a polytypic species complex. Resolution of the taxonomy of *S. floridanus* remains problematic and will require additional data and geographic and taxonomic coverage.

GS1 - Systematics, Evolution and Genetics

Taxonomy of the pikas (*Ochotona*) from a complex approach standpoint: actual advances

Andrey A. Lissovsky

Zoological Museum, Moscow State University, Bolshaya Nikitskaya 6, Moscow 125009, Russia. E-mail: andlis@zmmu.msu.ru

Taxonomy of the pikas approached the "genetic" stage of its development in a quite infantile condition. More than 100 names of Palaearctic taxa are distributed between species more or less by convention. The major part of these names corresponds to respective type sample only. The relations between such samples had never been strictly revised. Genetic studies aggravated the situation. The known diversity of mitochondrial gene sequences has no connection to the diversity of taxa described so far. One of the solutions of such kind of problem is a complex approach, which gave positive results in the study of alpina-hyperborea pikas. The latest progress of such approach will be reported in the presentation. Besides phylogeny and the variation pattern of palaearctic representatives of the subgenus Pika, the study has been conducting in various directions. Basal phylogenetic position of O. pusilla relative to other recent pikas is shown. This fact allows to obtain the high resolution of molecular trees, deduced from the mitochondrial gene sequences. A study of roylei-macrotis group have been started. The overall pattern of morphological variation of these pikas do not allow to recognize more than one taxon at the species level. Contrary, the morphological variation of cansus-tibetana group reveals quite complex geographical pattern. The overall pattern of morphological variation of palaearctic members of the genus *Ochotona* will be exposed and discussed.

GS1 - Systematics, Evolution and Genetics

Contrasting mitochondrial and nuclear DNA phylogenies reveal recurrent mtDNA introgressions among hares (*Lepus* spp)

J. Melo-Ferreira*[1,2,3], P. Boursot[3], P. J. Esteves[1] and P. C. Alves[1,2]

[1]CIBIO, Centro de Investigação em Biodiversidade e Recursos Genéticos, Universidade do Porto, Campus Agrário de Vairão, 4485-661 Vairão, Portugal.
[2]Departamento de Zoologia e Antropologia, Faculdade de Ciências da Universidade do Porto, 4099-002 Porto, Portugal.
[3]UMR 5554, Institut des Sciences de l'Evolution de Montpellier, Université Montpellier II, Case Courrier 063, 34095 Montpellier cedex 5, France.
[*]Email: jmeloferreira@mail.icav.up.pt

Low interspecific differentiation when compared to intraspecific polymorphism has hindered the emergence of a clear taxonomy of hares (genus *Lepus*). Phylogenetic inferences based on mtDNA alone have sometimes added to the confusion because of the multiple occurrences of hybridization among different species, inducing high mtDNA flow. The mtDNA clade of the mountain hare (*Lepus timidus*), an arctic/boreal species widespread in northern Eurasia, includes haplotypes from at least 10 other species, among which are *L. granatensis*, *L. europaeus*, *L. castroviejoi* and *L. corsicanus* from Europe, and *L. arcticus*, *L. othus* and *L. townsendii* from North America. Aiming at formally establishing whether the mtDNA resemblances of these species to *L. timidus* is due to sharing of ancestral polymorphism or to secondary introgression, we inferred the nuclear phylogeny of the species listed above and also *L. capensis*, *L. saxatilis*, *L. americanus* and *L. californicus* (12 species; 1 to 8 samples per species; 14 loci; 8189 bp). This phylogeny was then compared to that of the mtDNA (2 loci and 1113 bp). Our results suggest that *L. castroviejoi* was affected twice by mtDNA introgression of *L. timidus* origin during its history: first in an event also involving its sister taxon, *L. corsicanus*, and second, more recently, affecting all Iberian species. Also, both nuclear and mtDNA phylogenies confirmed that *L. arcticus* and *L. othus* are included in the *L. timidus* clade, suggesting the phylogenetic conspecificity of these taxa. However, the analyses were inconclusive in that respect regarding *L. townsendii*. Finally, the configuration of the estimated phylogenies supports the hypothesis of a rapid radiation of *Lepus*, most probably out of North America where the genus must have originated.

GS2 – Ecology, Population dynamics and Dispersal

A climate-based model defines the distribution of European rabbits *Oryctolagus cuniculus* (L.) in Australia

Brian Cooke

Invasive Animals Cooperative Research Centre, University of Canberra, Canberra ACT 2601, Australia.

A computer model, CLIMEX®, initially developed in Australia to predict the distributions of insects and plants can also be useful for predicting the distribution of some mammalian species. The european rabbit in Australia has proved to be a good candidate because its biology in different climatic regions (arid, alpine, subtropical and temperate) has been well studied and climatic constraints on its survival such as snow cover or aridity are reasonably well understood. The importance of green, growing herbage for successful rabbit reproduction and limits imposed by high temperatures on lactation and embryo implantation are also well understood in physiological terms and can be used to set parameters in the model. The final model, based mainly on average monthly rainfall and maximum and minimum monthly temperatures, reasonably reflects the distribution of rabbits in Australia. Apart from a few extreme areas such as alpine areas (above 2000 m) and extremely wet coastal areas of Tasmania, rabbits occur generally over the southern two-thirds of Australia. However, they are excluded from tropical summer rainfall areas presumably because the green food they need to reproduce successfully is available only during periods when high temperature and humidity combine to cause lactation failure and generally high reproductive stress. The model, initially developed using Australian data alone, has been tested by seeing how well it fits the known distribution of European rabbits in New Zealand, Europe, North Africa and Chile. Good agreement was obtained, suggesting the model could be used generally, and it has since been refined to give the best results as a 'world-wide' model. It may be possible to adapt CLIMEX to explain the potential distribution of other lagomorphs.

GS2 – Ecology, Population dynamics and Dispersal

Reproductive strategies at different altitudes: the mountain hare (*Lepus timidus varronis*) as a model species

K. Hackländer

Institute of Wildlife Biology and Game Management, University of Natural Resources and Applied Life Sciences, Gregor-Mendel-Str. 33, 1180 Vienna, Austria. E-mail: kaus.hacklaender@boku.ac.at

Many studies showed a positive correlation between litter size and latitude in hares (*Lepus* sp.). This phenomenon is mainly due to differences in climate at various latitudes. Consequently, hares produce fewer litters but larger litter sizes at higher latitudes. In this study I tested whether climate is also a strong evolutionary factor along various altitudes. For this, I analysed female fecundity of mountain hares by staining placental scars. Samples derived from hunted individuals shot between 1000 and 3000 m asl in Grisons (Switzerland). Females produced between three to 14 young in one to three litters per year. Corrected for age, body condition and other factors I found the following: Mountain hares produce fewer litters and larger litter sizes at higher altitudes. Therefore, altitude seems to be a similar environmental factor like latitude affecting reproductive strategies in hares. Altitudinal effects might be one explanation why exceptions of the linear relationship between litter size and latitude can be found. I thank Hannes Jenny and his colleagues from the Office of Game Management and Fisheries of Grisons for his support and the hunters for collecting hare samples. The help of Johanna Gander in the lab is highly appreciated.

GS2 – Ecology, Population dynamics and Dispersal

Worldwide variability in the reproduction of European wild rabbits and potential effects of climate change

Z. Tablado*, E. Revilla and F. Palomares

*Departamento de Biología de la Conservación, Estación Biológica de Doñana (EBD), Consejo Superior de Investigaciones Científicas (CSIC). *E-mail: zutal@ebd.csic.es*

European wild rabbits, *Oryctolagus cuniculus*, show highly different population dynamics and conservation status across its distribution range. In order to understand some of the causes of that variability we reviewed the information available on reproduction. We described the differences in rabbit breeding parameters across populations and identified the main factors that account for that variation at a global scale. While some reproductive traits (e. g. short sexual maturity age, duration of gestation, and post-partum oestrus) are similar in all populations, others vary substantially among regions and years resulting in highly different population productivities. Our results proved that the latter parameters (e.g. breeding season length, percentage of pregnancies, etc…) are mainly affected by environmental controls and individual properties (i.e. age and body weight). More specifically, breeding season length is mostly determined by local temperature, resource availability, and photoperiod. This allowed us to examine the potential effect of climate change on one of the main parameters driving rabbit population dynamics. We combined our results with data on monthly temperatures and precipitation provided by climate models for 1961-1990 and for 2071-2100 across Europe. We found that in all cases the reproductive period will tend to shorten and become more variable in Southern Europe, especially in the south of the Iberian Peninsula were the species is currently endangered. However, in North and East Europe the expected change will result in longer and less variable breeding seasons. These alterations of the length and stochasticity of the breeding period may have a substantial impact on the future population trends of such an opportunistic breeder as the European wild rabbit.

GS2 – Ecology, Population dynamics and Dispersal

Rabbit haemorrhagic disease and myxomatosis in the Netherlands

M. Drees[1], J. Dekker[1], A. Lavazza[2] and L. Capucci[2].

[1]Society for the study and conservation of Mammals, The Netherlands. E-mail: Jasja.dekker@vzz.nl
[2]Instituto Zooprofilattico Sperimentale della Lombardia e dell'Emilia Romagna' in Brescia, Italy, (IZSL).

Since 1990 the rabbit populations (*Oryctolagus cuniculus*) in The Netherlands showed a strong decline. This is probably a result of re-occurring epizootics of rabbit haemorrhagic disease (RHD). Research showed that not all populations recover well after RHD infection; some populations do recover, while others stay at low densities. We had the impression that recovering populations often experience a high mortality from myxomatosis, therefore we tested the following hypothesis: In low density rabbit populations the RHD and myxomatosis infections can not reach an endemic status. To get a better understanding why some populations do recover, while others do not, the immune status (immunoglobulin (Ig)) of five rabbit populations was assessed for RHD (IgG en IgM) and myxomatosis (IgG). It was found that animals from high density populations had a good immune status, with 11-27 % of the rabbit's even carrying sufficient concentrations of IgM, which indicates recurring RHD infections. From the low density populations all rabbits had sufficient concentrations of IgG and so a RHD epidemic has occurred recently. However, no IgM was found, so RHD is not endemic in these populations. In one low density population the rabbits had no immunity against myxomatosis. Hence, rabbits from populations with a low density are more susceptible to passing epizootics.

GS2 – Ecology, Population dynamics and Dispersal

Does the presence of a putative ecological trap explain an apparent hare population paradox?

N. Reid[1], R. McDonald[2] and I. Montgomery[1]

[1]*Quercus, School of Biological Sciences, Queen's University Belfast. Northern Ireland (UK). E-mail: neil.reid@qub.ac.uk*
[2]*Central Science Laboratory, York. England (UK).*

In common with other farmland species, hares are in widespread decline in agricultural landscapes. They are grazing, cursorial species that avoid predation by concealment, so their two basic needs are food and cover. Hare population declines are generally linked to agricultural intensification leading to a loss of habitat heterogeneity. Paradoxically, however, hares are often relatively abundant in intensive, homogeneous arable landscapes and less abundant in less intensive, more heterogeneous pastoral landscapes. The importance of habitat heterogeneity to Irish hares (*Lepus timidus hibernicus* Bell 1837) in a pastoral landscape was determined by radio-tracking during active nocturnal and inactive diurnal periods throughout one year. In autumn, winter and spring, hares occupied a heterogeneous combination of improved grassland, providing food, and *Juncus*-dominated rough pasture, providing refuge. In summer, however, hares favoured improved grassland only for both feeding and shelter. During summer, the long homogeneous sward of improved grassland, in common with growing arable crops, addresses the hares' heterogeneous need for feeding, cover and concealment of leverets. However, in contrast to cereal crops that are harvested during late summer or early autumn, improved grassland may be a risky habitat for hares as silage harvesting occurs during their peak birthing period of late spring and early summer. We draw a distinction between the heterogeneity of an individual's needs and the need for heterogeneous habitat *per se*. We reveal a potential ecological trap inherent to a homogeneous habitat that satisfies heterogeneous needs but presents risks at a critical time of year. In summer, hares satisfy their heterogeneous needs by occupying improved grasslands. However, this habitat may constitute an ecological trap because early silage harvesting coincides with leveret births. This may help explain the paradoxical success of hares in more intensive arable landscapes where harvest occurs well after peak birthing time. The development of 'hare-friendly' mowing regimes may help reduce the impact of this putative ecological trap in pastoral landscapes.

GS2 – Ecology, Population dynamics and Dispersal

Hunting statistics reveal influence of climatic oscillations and density dependence on Irish hare populations

N. Reid[1*], K. Dingerkus[1], I. Montgomery[1], F. Marnell[2], R. Jeffrey[2], D. Lynn[2], N. Kingston[2] and R. McDonald[3].

*[1]Quercus, School of Biological Sciences, Queen's University Belfast. Northern Ireland (UK) E-mail: *neil.reid@qub.ac.uk*
[2]National Parks and Wildlife Service, Dublin (Republic of Ireland)
[3]Central Science Laboratory, York. England (UK)

Game bag records for Irish hares (*Lepus timidus hibernicus* Bell 1837) from throughout Ireland for the period 1846-1970 were analysed to assess long-term historical trends. Prior to 1914, bag indices fluctuated markedly but there was no overall trend. Thereafter, the annual hare index declined markedly (-88%), consistent with declines in hare bags elsewhere in Europe, reflecting a major decline in the number of hares shot. Time-series analysis suggests that the Irish population exhibited periodicity both before and after the initiation of the population decline. Prior to 1914 a significant decadal anti-phase was detected. Further analysis suggests that population growth rate was regulated by both intrinsic delayed density dependence, principally determined by the abundance of hares in the previous year, and extrinsic climatic factors, specifically the weather in autumn, described by the Northern Atlantic Oscillation (NAO) index. The NAO also exhibits a decadal periodicity and we suggest that the interaction of density dependent processes and the autumn NAO gives rise to the significant decadal periodicity observed in the Irish hare population prior to the major population decline. After 1914, there was a reduction in the amplitude and frequency of periodicity and the relative importance of the long-term decline in accounting for variance in abundance increased markedly. There is no reason to discount the marked influence of climate and related periodicity in contemporary hare population dynamics but the decline of game shooting has removed one tool for detecting this influence.

GS2 – Ecology, Population dynamics and Dispersal

Plant productivity, predation and the abundance of black-tailed jackrabbits in the Chihuahuan Desert of Mexico

L. Hernández[1], J. Laundré[1], G. Portales[2], A. González-Romero[3], J. López-Portillo[3], K. Grajales[4], A. García[4] and J. Martínez[5]

[1]*Instituto de Ecología, A.C., Centro Regional Durango, Durango, 34100 México*
[2]*Facultad de Ciencias. UNAM, México D.F. 04530, México*
[3]*Instituto de Ecología, A.C., Xalapa, Veracruz, 91070, México*
[4]*Instituto de Ecología, A.C., Centro Regional Durango, Durango, 34100 México*
[5]*Universidad Autónoma de Ciudad Juárez, Ciudad Juárez, Chihuahua, 32310 México.*

The abundance of Black-tailed jackrabbits (*Lepus californicus*) can fluctuate dramatically in arid and semi-arid areas. Two hypothesis to explain these fluctuations are that predation (top-down) or food availability (bottom-up) limit and alternately release jackrabbit populations. We used an 11 year data sets to test which of these two hypotheses would best explain fluctuations of black-tailed jackrabbits. The study was conducted in the central part of the Chihuahuan Desert in Mexico where coyotes (*Canis latrans*) are the principal predator of jackrabbits. Specific predictions tested for the top-down hypothesis were: 1) the absolute mortality from coyotes is sufficient to limit, as opposed to slowing, jackrabbit population growth, 2) coyote abundance increased with increases in jackrabbit abundance, and 3) percent occurrence in the diets of coyotes increased with increasing jackrabbit abundance. Predictions for the bottom-up hypothesis were: 1) plant productivity will be directly related to precipitation levels, 2) jackrabbit abundance is positively related to precipitation and plant productivity, and 3) survival of jackrabbits from the beginning to the end of the reproductive season will be directly related to precipitation and plant productivity. For the predation hypothesis, we found jackrabbits were the principal food of coyotes during our study (67.8 % of the diet) but we found no evidence of either a numerical or functional response of coyote populations to jackrabbit abundance. We also demonstrate that predation by coyotes rarely accounts for > 50% of the mortality needed to maintain a stable jackrabbit population. For the plant productivity hypothesis, there was a significant relationship between forb productivity and annual precipitation levels (r^2 = 0.69, P = 0.002). Jackrabbit abundance (r^2 = 0.38, P = 0.002) and survival (r^2 = 0.73, P < 0.001) were significantly related to precipitation and forb and grass productivity. We conclude that in the extreme climate of the southern Chihuahuan Desert, precipitation levels and resulting plant productivity affect jackrabbit abundance more than predation levels.

GS2 – Ecology, Population dynamics and Dispersal

Survival rates and habitat use of juvenile brown hare (*Lepus europaeus*) – first results

U. Voigt

Institute of Wildlife Research, University of Veterinary Medicine Hannover, Foundation, 30173 Hannover, Germany; e-mail: ulrich.voigt@tiho-hannover.de

It has been suggested that abundance and fluctuations in hare populations are primarily generated by changes in the survival rates among juvenile European brown hares (Lepus europaeus). The environmental factors that appear to have the greatest effect on juvenile survival in the brown hare are diseases, agricultural practices and prior-ranking predation. This interdisciplinary investigation (2004-2010) evaluates the different causes for juvenile survival from birth to seventh week of live in two agricultural used areas in Lower Saxony. Densities of adult hares ranged between 30 and 60 ind./km² in spring. From 2004-2008 a total of 309 free-ranging individuals up to 35 days of age were traced at night using thermal imaging cameras. With this innovative technique is was possible to detect leverets in a range of approx. 120 m reliably. Fieldwork was conducted between February and May as well as August and September when vegetation is low or harvest had been done. Among health status (N=134) and energy balance (N=15) data on habitat and body metrics were collected. In total 41 leverets were monitored by radiotracking to estimate survival rates and causes of death. Examination of the habitat data revealed a heavily dependence on border lines like field tracks, drainage channels and unused strips with natural vegetation. Less than 3 % of all detections juveniles were found in the center of fields. Duration of tracking ranges from 5 to 42 days (mean 18d). In approx. 60 % of verified death the cause of mortality could be ascribed to predators (e.g. buzzard, martens and red fox), 29 % to assumed predation, 4 % to agricultural practices and 7 % others (diseases, undercooling or unknown). Survival seems to be much higher in summer than in early spring when vegetation cover is very low.

GS2 – Ecology, Population dynamics and Dispersal

GPS telemetry of European brown hare in central Italy: results of activity patterns

M. Zaccaroni[1*], N. Biliotti[1], S. Calieri[1], M. Ferretti[2], M. Genghini[2], F. Riga[2], Valter Trocchi[2] and F. Dessì-Fulgheri[1]

*[1] Department of Evolutionary Biology, University of Florence, Via Romana 17, 50124 Firenze, Italy. E-mail: *marco.zaccaroni@unifi.it*
[2] National Wildlife Institute (INFS), Via Ca' Fornacetta 9, I-40064 Ozzano dell'Emilia, Bologna, Italy

In this study, activity patterns of european brown hare (*Lepus europaeus*) were analyzed during winter season using global position system (GPS) collars (Tellus mini - Followit) on 27 hares in two study areas of Tuscany, Italy. We programmed the collars to make a location 12 times per day (1 location every 2 hours), for 98 days. Preliminary results show that in January hares were active during the dark phase, from February to April the activity decreased earlier in the morning, following the sunrise, but it didn't change in relation to the sunset, moreover in April the activity decreased in the middle of the night. The recent possibility to apply GPS collars on small mammals is a powerful instrument to study the eto-ecology of the hare, and suggest an appropriate territory and population management, aimed to the conservation of the hare.

GS3 - Behaviour, Sociobiology, Physiology, Toxicology and Diseases

Daily activity patterns of coyotes (*Canis latrans*) and lagomorphs (*Lepus californicus* and *Sylvilagus audobonii*) in the Chihuahuan Desert

I. Arias-Del Razo[1], L. Hernández[2], J. Laundré[2] and O. Myers[3]

[1]*Instituto de Ecología, A. C., Km. 2.5 carretera antigua a Coatepec 351, Congregación El Haya 91070, Xalapa, Veracruz. México. E-mail: itzel_arias@yahoo.com*
[2]*Instituto de Ecología, A. C. Centro Regional Durango, Boulevard del Guadiana 123, Los Remedios 34100, Victoria de Durango, Durango. México.*
[3] *University of New Mexico, MSC 10 5550, Albuquerque, NM 87131, U.S.A.*

Predation influences the behavior of prey species, with many prey responding to the activity patterns because of potential predation risk. However we know little about this interaction. Because of this we examined temporal patterns of predator/prey interactions of coyotes (*Canis latrans*) and their main prey hares (*Lepus californicus)* and rabbits (*Sylvilagus audoboni)* in the Chihuahuan desert. We tested the hypotheses that as a predator avoidance behavior there would be differences in the peaks of activity of predator and prey. During the dry fall/winter seasons in 2004-2006, 10 coyotes, 5 females and 5 males were tracked using GPS collars to identify areas of activity and to determine daily patterns of activity. Distances between consecutive locations were calculated from GPS coordinates and used to assess relative activity. Lagomorph feeding stations (n=30) were installed in coyote activity areas during the dry seasons of 2005–2007 to assess lagomorph activity patterns. Activity was recorded with digital game cameras set for 6-26 days. The number of photographs and time taken were used to determine activity of lagomorphs. Linear mixed model analyses were used to account for repeated activity measurements at feeding stations and from individual coyotes. Peaks of predator activity for both sexes occur between 8 to 10 h, and between 18 to 20h, however females moved more in the morning peak and males moving more in the evening peak ($P<0.001$). We also observed that male movements during the day were less than females. Relative activity was not constant over the day for cottontailed rabbits ($P<0.001$) and jackrabbits ($P<0.001$). Cottontailed and jackrabbits had different hourly patterns of activity ($P<0.001$). Morning and evening activity peaks were about the same for jackrabbits, but the relative activity of cottontailed was lower in the evening and higher in morning. We found an overlap in the evening activity but not in the morning activity between predators and prey.

GS3 - Behaviour, Sociobiology, Physiology, Toxicology and Diseases

Circadian rythmicity in newborn rabbits is entrained by nursing

I. Caldelas, R. Montúfar-Chaveznava and R. Hudson

Departamento de Biología Celular y Fisiología, Instituto de Investigaciones Biomédicas, Universidad Nacional Autónoma de México. División de Ingeniería, Instituto Tecnológico de Monterrey, Campus Santa Fe, México.

In early development the European rabbit (*Oryctolagus cuniculus*) exhibits prominent rhythmicity. The newborn pups in the isolated burrow are visited by the mother to be nursed once every 24 hours for about three minutes and under these environmentally constant conditions they anticipate the mother's visit by increasing their behavioral activity in the nest and with a rise in body temperature, both of which represent endogenous circadian rhythms. In order to determine if the suprachiasmatic nuclei (SCN) of the hypothalamus, the main circadian pacemaker in mammals, show endogenous 24-h rhythmicity in the expression of the clock genes Per1, Per2 and Bmal1, pups were nursed every 24-h from postnatal days 1 to 7 and fasted to day 9. This group showed the same rhythms of clock gene expression as normally nursed controls. To determine if these rhythms could be entrained by nursing, another group of pups was nursed from postnatal days 1 to 3 every 24-h, 30 minutes before light on. Three pups of each litter were sacrificed at different times and we observed the same rhythms in gene expression as for pups in the previous experiment. For the remaining littermates, on postnatal days 4 to 7 the nursing time was delayed six hours and this group showed a corresponding shift in the diurnal pattern of clock gene expression. Consistent with this, two groups of pups implanted with telemetric thermal sensors and nursed six hours apart had daily patterns in body temperature synchronized with the two different nursing times. We conclude that the expression of clock genes associated with the newborn rabbit's circadian system is entrained by nonphotic cues accompanying nursing, the exact nature of which now needs to be clarified. Supported by CONACyT 48504 and PAPIIT IN200203-3.

GS3 - Behaviour, Sociobiology, Physiology, Toxicology and Diseases

Ovarian dynamics in rabbits and brown hares in relation to seasonal variation

N. Lukac, P. Massanyi, J. Slamecka[1], R. Toman[2], R. Jurcik[1], J. Zitny[3], J. Rafay[1] and G. Formicki[4]

Slovak University of Agriculture, Faculty of Biotechnology and Food Sciences, Department of Animal Physiology, Trieda Andreja Hlinku 2, SK 94976 Nitra, Slovak Republic
[1]Slovak Agriculture Research Centre, Research Institute of Animal Production, Department for Small Farm Animals, Hlohovska 2, SK 94976, Nitra, Slovak Republic
[2]Slovak University of Agriculture, Faculty of Agrobiology and Food Resources, Department of Veterinary Disciplines, Trieda Andreja Hlinku 2, SK 94976, Nitra, Slovak Republic
[3]Slovak University of Agriculture, Faculty of Agrobiology and Food Resources, Department of Genetics and Animal Breeding, Trieda Andreja Hlinku 2, SK 94976, Nitra, Slovak Republic
[4]Pedagogical University, Faculty of Geography and Biology, Institute of Biology, Ulica Podbrzezie 3, PL 31054 Krakow, Poland

In this study quantification of the ovarian structure in relation to follicular growth in rabbits and in relation to season in brown hare is reported. In rabbits (n=10) an evaluation of relative volume of developmental stages of follicles revealed that the primary follicles (PF) form 84.8±8.5%, growing follicles (GF) without antrum formation 10.0±7.8%, antral follicles (AF) 3.9±4.3% and Graafian follicles (GF)1.3±2.5% of the relative volume of the ovary. In PF, the oocyte forms 72.8±2.3% and granulosa cells (GC) 27.2±2.3%. In GF with less than 2 layers of GC the relative volume of GC is 47.8±2.1% and that of oocyte 52.2±2.1%. In brown hares (n=37) seasonal variations in the structure of the ovary in spring (n=10), summer (n=7), autumn (n=14) and in winter (n=6), are reported. Evaluation of the relative volume of PF, GF and stroma in the hare ovary revealed a stable level of PF follicles during the year. The highest relative volume of GF was found in the autumn, with a similar value in winter. As the relative volume of GF increased, the amount of stroma decreased. The lowest relative volume of stroma was found in the autumn (90.1%) and the highest in the spring (97.3%). Any significant differences were found in the relative volumes of follicles and stroma in the ovary. The diameter of PF ranged from 30.8 to 35.9 μm during the year, with no significant seasonal difference. The diameter of GF ranged from 139 to 222 μm. This difference was significant in comparison with spring. Support: APVV 0299–06; VEGA 1/4347/07; VEGA 1/0696/08.

GS3 - Behaviour, Sociobiology, Physiology, Toxicology and Diseases

Comparisons of digestive function between two sympatric lagomorphs, the european hare (*Lepus europaeus*) and the european rabbit (*Oryctolagus cuniculus*)

P. Stott

Centre for Animal Science, The University of Adelaide, Roseworthy SA 5371, Australia. E-mail: philip.stott@adelaide.edu.au

The European hare *Lepus europaeus* and the European rabbit *Oryctolagus cuniculus* are medium-sized lagomorphs and sympatric trophic competitors. To elude predators, the hare uses sustained high-speed locomotion with erratic and rapid changes of direction, whereas the rabbit relies on short sprints to nearby cover. Therefore, I predicted that the hare would carry less ballast in the form of digestive organs and ingesta relative to body weight to maximise its locomotory performance, but at a cost to its digestive efficiency. I undertook several comparative tests of digestive function on samples of animals drawn from sympatric populations. I obtained the carcasses of 79 hares and 37 rabbits from shooters, and weighed the organs comprising the abdominal portion of the alimentary canal. I also maintained captive colonies of hares and wild-type rabbits, and used them to test the digestibility of a diet of lucerne (*Medicago sativa*) pellets. Although both species primarily feed on Gramineae, under extreme conditions in summer or winter, both species also feed on twigs; therefore I measured the rate of passage and the extent of trituration of particulate dietary markers intended to mimic those twigs. I found that both the stomach and the caecum formed a significantly smaller proportion of body weight in the hare, which would assist its power-weight ratio. Digestion of fibre was poor in both species, but digestibility of hemicelluloses was significantly greater in the rabbit. Although the digestive marker was rapidly passed by both species, passage was significantly faster in the hare. The rabbit more completely fragmented the markers using cutting and crushing actions, whereas the hare included a stripping action that would more efficiently access soluble carbohydrates stored in vascular rays. Other herbivores consumed lagomorph faeces, presumably because of the undigested plant fibre, and this should be taken into account in population surveys of lagomorphs.

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Heavy metals (lead, cadmium, mercury) in liver and kidney of brown hare (*Lepus europaeus*) and relation to blood plasma parameters

P. Massanyi, N. Lukac, J. Slamecka[1], F. Tataruch[2], R. Jurcik[1], R.Toman[3], J. Kovacik, M. Capcarova, A. Kolesarova, R.Stawarz[4]

Slovak University of Agriculture, Faculty of Biotechnology and Food Sciences, Department of Animal Physiology, Trieda Andreja Hlinku 2, SK 94976 Nitra, Slovak Republic
[1]Slovak Agriculture Research Centre, Research Institute of Animal Production, Department for Small Farm Animals, Hlohovska 2, SK 94976, Nitra, Slovak Republic
[2]University of Veterinary Medicine, Research Institute of Wildlife Ecology, Savoyenstrasse 1, 1160 Vienna, Austria
[3] Slovak University of Agriculture, Faculty of Agrobiology and Food Resources, Department of Veterinary Disciplines, Trieda Andreja Hlinku 2, SK 94976, Nitra, Slovak Republic
[4]Pedagogical University, Faculty of Geography and Biology, Institute of Biology, Ulica Podbrzezie 3, PL 31054 Krakow, Poland

The purpose of this study was to examine concentrations of selected heavy metals (lead, cadmium, mercury) in the liver and kidney of brown hares (*Lepus europaeus)* using AAS method. In addition, correlations between heavy metals and biochemical parameters in blood plasma were determined. The average concentrations of heavy metals (mg/kg) ± SD were as follows: liver: Pb 0.221±0.189, Cd 0.160±0.140, Hg 0.021±0.030, kidney: Pb 0.115±0.125, Cd 1.570±1.103, Hg 0.030±0.053. The average concentrations of biochemical parameters in the blood plasma were as follows: Ca 3.16 mmol/l, P 2.19 mmol/l, Mg 1.40 mmol/l, Na 148.71 mmol/l, K 8.12 mmol/l, glucose 6.56 mmol/l, total proteins 56.49 g/l, urea 5.00 mmol/l, total lipids 1.40 g/l, bilirubin 3.97 μmol/l, cholesterol 1.53 mmol/l, aspartate aminotransferase (AST) 6.06 μkat/l and alanine aminotransferase (ALT) 1.94 μkat/l. Average levels of hormones (ng/ml) were as follows: testosterone 2.94, androstendiol 0.13, estradiol 501.59, progesterone 6.63, oxytocin 328.60. Tissue analysis showed an accumulation of lead, cadmium and mercury in the liver and kidney of brown hares. There were no significant correlations between levels of heavy metals in liver, kidney, and biochemical parameters suggesting weak relation of detected metal on hare health status at these concentrations.Support: APVV 0299–06; VEGA 1/4347/07; VEGA 1/0696/08.

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Concentration of trace elements in rabbits semen and their correlations

R. Stawarz, P. Massanyi[1], N. Lukac[1], J. Slamecka[2], G. Formicki, I. Chlebec[2], J. Trandzik and A. Putala[3]

Pedagogical University, Faculty of Geography and Biology, Institute of Biology, Ulica Podbrzezie 3, PL 31054 Krakow, Poland
[1]Slovak University of Agriculture, Faculty of Biotechnology and Food Sciences, Department of Animal Physiology, Trieda Andreja Hlinku 2, SK 94976 Nitra, Slovak Republic
[2]Slovak Agriculture Research Centre, Research Institute of Animal Production, Department for Small Farm Animals, Hlohovska 2, SK 94976, Nitra, Slovak Republic
[3]Breeding Services of Slovak Republic, Genetic Laboratory, Hlohovska 5, SK 94976 Nitra, Slovak Republic

In this study concentration of selected elements in rabbit semen was determined. Semen was collected from adult (12 month old) male rabbits (n=28) of New Zealand breed. In rabbit semen using anodic stripping voltammetry (ASV) and atomic absorption spectrophotometry (AAS) these concentrations were found: Cd – 0.13±0.04 mg/kg; Pb – 0.72±0.35 mg/kg; Fe – 146.22±144.41 mg/kg; Cu – 1.10±0.32 mg/kg; Zn – 5.46±1.82 mg/kg; Ca – 127.47±30.68 mg/kg; Na – 450.43±114.32 mg/kg; K – 122.38±86.33 mg/kg and Mg 56.13±23.81 mg/kg. Correlation analysis detected element related relations. Positive correlations: strong: Fe – Zn; Fe – K; middle: Cd – Pb; Cd – Cu; Cd – Ca; Cd – Mg; Pb – Cu; Pb – Ca; Fe – Mg; Cu – Na; Cu – Mg; Ca – Na; Na – Mg; weak: Cd – Fe; Cd – Zn; Cd – Na; Pb – Na; Pb – Mg; Cu – Zn; Cu – Ca; Ca – Mg; Na – Zn; K – Mg; as well as negative correlations: strong: –; middle: Pb – Fe; Pb – K; Fe – Ca; Ca – Zn; Ca – K and weak: Cd – K; Zn – Pb; Fe – Cu; Fe – Na; Cu – K; Na – K have been detected suggesting various element related correlation in rabbit semen.
Support: APVV 0299–06; VEGA 1/4347/07; VEGA 1/0696/08.

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A shared unusual genetic change at the chemokine receptor type 5 between *Oryctolagus* and *Bunolagus*: can the accidental exposure to myxomatosis drive the critically endangered Riverine rabbit to extinction?

J. Abrantes[1,2,3*], C. R. Carmo[1,2,4**], C. A. Matthee[5***], W. van der Loo[1,2†] and P. J. Esteves[1,6††]

[1]CIBIO, Centro de Investigação em Biodiversidade e Recursos Genéticos, Campus Agrário de Vairão, Vairão, Portugal.
[2]Departamento de Zoologia e Antropologia, Faculdade de Ciências da Universidade do Porto, Porto, Portugal.
[3]INSERM U601 – Institut de Biologie, Nantes, France.
[4]Imperial College School of Medicine, Hammersmith Hospital Campus, Du Cane Road, London W12 0NN, United Kingdom.
[5]Evolutionary Genomics Group, Department of Botany and Zoology, Stellenbosch University, 7602, South Africa.
*[6]Centro de Investigação em Tecnologias da Saúde (CITS), ISPN, CESPU, Gandra, Portugal. E-mail: *jabrantes@mail.icav.up.pt^, **catarina_rc@yahoo.com, ***cam@sun.ac.za, †wvdloo@mail.icav.up.pt, ††pjesteves@mail.icav.up.pt*

Bunolagus monticularis, the Riverine rabbit of South Africa, included in the IUCN Red List as Critically Endangered, is heavily dependent of its natural habitat, the Karoo river ecosystems. Habitat loss and habitat fragmentation has severely reduced the species range during the past 40 to 50 years. Over the last 70 years, the population size has declined drastically and is now estimated to consist of fewer than 250 mature individuals. Myxoma virus (MV) is the causal agent of myxomatosis, a highly lethal disease in the European rabbit (*Oryctolagus cuniculus*), whereas other leporid species seem not to be affected. The chemokine receptor CCR5 plays an important role in infection by large DNA viruses by acting as a portal for viral entry into the host cells. Previous sequence comparisons of the CCR5 gene across several lagomorph species revealed a drastic change at the second extracellular loop, which was *unique* to the European rabbit. *Oryctolagus* and *Bunolagus* shared a common ancestor approximately 7-8 million years ago. In view of the monophyletic association between *Oryctolagus* and *Bunolagus*, the possibility of a potential threat of myxomatosis to the survival of the small extant populations of Riverine rabbit and the possible role of the CCR5 receptor in MV infectivity, we extended the previous sequence determinations of this gene to the monotypic genus *Bunolagus*. Here we report that the Riverine rabbit shares this particular mutation with *Oryctolagus*. Despite the lack of direct evidence, the reported finding would justify preemptive measures as it highlights the potential threat MV could have on the survival of *Bunolagus*.

GS3 - Behaviour, Sociobiology, Physiology, Toxicology and Diseases

Detection of positive selection in the major capsid protein VP60 of the rabbit haemorrhagic disease virus (RHDV)

P.J. Esteves[1,2*], J. Abrantes[1,3,4**], M. Carneiro[1,3***], A. Müller[5†], G. Thompson[5††] and W. van der Loo[1,3†††]

[1]CIBIO-UP, Centro de Investigação em Biodiversidade e Recursos Genéticos, Universidade do Porto, Campus Agrário de Vairão, Vairão, Portugal.
[2]CITS, Centro de Investigação em Tecnologias da Saúde, ISPN, CESPU, Gandra, Portugal.
[3]Departamento de Zoologia e Antropologia, Faculdade de Ciências da Universidade do Porto, Porto, Portugal.
[4]INSERM U601 - Institut de Biologie, Nantes, France.
[5]ICBAS/UMIB/UP, Instituto de Ciências Biomédicas de Abel Salazar, Porto, Portugal.
*E-mail: *pjesteves@mail.icav.up.pt, **jabrantes@mail.icav.up.pt,*
****miguel.carneiro@mail.icav.up.pt, †amuller@mail.icav.up.pt, ††gat1@mail.icav.up.pt,*
†††wvdloo@mail.icav.up.pt

Mutations were analysed in the major capsid protein VP60 of the rabbit haemorrhagic disease virus (RHDV), a calicivirus responsible for high mortality rates in both wild and domestic European rabbits (*Oryctolagus cuniculus*). We hypothesized that substitutions in this region, particularly sites under adaptive molecular evolution, might play a role in the ongoing genetic conflict between host and parasite Under neutrality, the expected ratio (ω) of non-synonymous (d_N) to synonymous (d_S) substitutions in a gene is one and significant deviations from this value can be interpreted as evidence of either positive ($\omega > 1$) or purifying selection ($\omega < 1$). Here, detection of positive selection was performed using PAML applied to 43 non-identical complete sequences of the major capsid protein. This maximum likelihood (ML) method instead of averaging ω across the gene uses codon-based models that allow heterogeneity in d_N/d_S among codons in a phylogenetic context, allowing detection of recurrent positive selection occurring only in small portion of a gene. Three codons showed signs of positive selection (with posterior probabilities over 95%), one of them is located in the region containing the major antigenic determinants (region E). The presence of positively selected codons (PSCs) in other regions may suggest the existence of other antigenic regions on the major capsid protein that stimulate protective immune responses. At all the 3 PSCs, variation contributes to putative N-glycosylation sites of the protein. An N-glycosylation site is deleted in the non-pathogenic strain RCV. Some of the substitutions at PSCs may alter the polarity and the charge of the protein with possible implications in the protein structure and host interaction. The detection of PSCs should allow a better understanding of the interaction between RHDV and the rabbit immune system.

GS4 - Population management and Conservation

The current distribution and the endangered status of lagomorphs in Asia

Royce To and K. Hackländer

Institute of Wildlife Biology and Game Management (IWJ), University of Natural Resources and Applied Life Sciences (BOKU) Gregor -Mendel-Straße 33, A-1180 Vienna, Austria. Email: royceto@gmail.com

The overall distribution and the endangered status of family Lagomorpha have not been reviewed since 1996. Based on the 1990 Lagomorph status report by IUCN/SSC Lagomorph Specialist Group and the current standard taxonomy, we reviewed 46 species that were reportedly presented in Asia. All information of each species was gathered from published literature in both Chinese and English since 1990's. We studied their current distribution, habitat, life history and threats. In addition, we evaluated their respective endangered status based on the latest IUCN Red List Categories and Criteria (version 3.1). Of the total 46 species, 14 species were evaluated as threatened species (Critically Endangered, Endangered or Vulnerable), 23 non-Threatened species and nine species with insufficient information. We further discussed the overall distribution of Asian Lagomorph and its endangered status, types of common threats such as hunting, pastoralism and climate change; and the current taxonomy. The stretch goal of this report is to provide suggestions for the renewal of the endangered status of Asian Lagomorph from version 2.1 to 3.1.

GS4 - Population management and Conservation

Space use, dispersal and connectivity among populations of pygmy rabbits in Idaho and Montana, USA

J. Rachlow, J. Witham, W. Estes-Zumpf, D. Sanchez, and L. Waits

Department of Fish and Wildlife Resources, POBox 441136, University of Idaho, Moscow, ID 83844-1136. (current address DMS: Oregon State University)

Pygmy rabbits (*Brachylagus idahoensis*), which occur patchily in the Great Basin of western USA, are closely associated with sagebrush vegetation and soils that support construction of burrows systems. Because of their small body size and habitat specializations, pygmy rabbits are expected to exhibit limited dispersal and movements. We examined patterns of space use, burrow use, and dispersal by both adult and juvenile pygmy rabbits using radio telemetry and genetic analyses across multiple spatial scales in Idaho and Montana, USA. At the local scale, both sex and season influenced space use. Males used larger home ranges and core areas, more burrow systems, and more widely dispersed burrow systems than females. We also documented significant differences in many movement parameters among study sites separated by <6 km, which suggested that local resource distribution also might influence how pygmy rabbits used space. Both telemetry and genetic data indicated high rates of natal dispersal and gene flow within and among populations. Dispersal by juvenile rabbits occurred between 6 and 12 weeks of age, and in some cases, distances markedly exceeded our expectations (up to 12 km). Genetic analyses based on 15 microsatellite loci revealed low to moderate levels of genetic differentiation among sample locations at a regional scale. Perennial streams and roads did not form barriers to movement of telemetered individuals or result in significant population structure. Landscape genetic analyses based on microsatellite and mitochondrial data from 19 populations across Idaho and southwestern Montana indicated that major rivers (Snake River), but not mountain ranges or the Continental Divide, served as barriers to gene flow. Annual censuses of burrow systems indicated that occupied areas were clumped and shifted across the landscape over time. Together, these data suggest that, despite their small body size, pygmy rabbits use resources across broad spatial extents.

GS4 - Population management and Conservation

The riparian brush rabbit (*Sylvilagus bachmani riparius*): fighting fire and flood on the road to recovery

P. Kelly*, M. Lloyd, L. Hamilton and D. Williams

*California State University, Stanislaus. Endangered Species Recovery Program. Department of Biological Sciences, Turlock, California 95382, USA. Phone: 00-1-559-453-1103 Web Site: http://esrp.csustan.edu. E-mail: *pkelly@esrp.csustan.edu*

The endangered riparian brush rabbit occupies old-growth riparian oak forest and riparian communities in the northern San Joaquin Valley of central California. The only known populations of riparian brush rabbits are confined to a small State park on the Stanislaus River (Caswell Memorial State Park) and the South Delta area of the Sacramento/San Joaquin Delta. Since both populations are under significant, proximate threats of extinction, a captive breeding and reintroduction program was initiated in 2002 to re-establish populations in suitable habitat throughout the historic range. Since July 2002, 771 riparian brush rabbits, which were all born and reared in captive but semi-wild conditions, have been released at the San Joaquin River National Wildlife Refuge (621) and adjacent lands (150). Reintroduced rabbits face significant individual challenges from natural and anthropogenic forces (e.g., predators, disease, radio-collar injuries, accidents) but the reintroduction program itself has to contend with broader more significant challenges, wildfire and flooding. In July 2004, a wildfire burned approximately 432 ha of the refuge (2004 ha), 27-33% of which was habitat used by the rabbits. The fire bypassed much of the best riparian habitat, where most of the radio-collared rabbits were located; 45 of 48 collared were emitting live signals two days after the fire started. Between March and June 2005, part of the refuge flooded, resulting in the deaths of 45% of collared rabbits (10/22). In April 2006, water management agencies drew down reservoirs in preparation for major runoff from a near-record snow pack in the Sierra Nevada, resulting in massive flooding at the refuge—the worst seen there since 1997—and 85% of collared rabbits (22/26) died or disappeared. The conservation strategy for the rabbit anticipated the challenges presented by flooding and wildfire, and the actual experience gained with both since 2004 have helped to refine the strategy.

GS4 - Population management and Conservation

The effects of climate change on lagomorph populations

Will *Lepus* successfully respond to global warming: A proposed rangewide research initiative

L. Scott Mills[1], Karen Hodges[2] and Paulo Alves*[3]

[1]*Wildlife Biology Program, University of Montana, Missoula, Montana, U.S.A.*
[2]*Biology Department, University of British Columbia Okanagan, Kelowna, BC, Canada*
[3]*Centro de Investigação em Biodiversidade e Recursos Geneticos*
Universidade do Porto, Portugal

One of the strongest fingerprints of global climate change in temperate regions is a reduction in the number of days that snow persists on the ground. For Lagomorph species that undergo seasonal molts in coat color to match their background, initiation of molt is thought to be driven by photoperiod, with temperature helping to determine the rate of change. A systematic mismatch between coat color and snow presence or absence is expected to carry high fitness costs via increased predation, translating into population-level effects. In order for these species to adapt in place to decreasing numbers of snow days in their environment, they will have to shift the timing of coat color change, but it is not known how or whether such a shift is possible. We do know that for several *Lepus* species (eg snowshoe hares (*L. americanus)* and mountain hares (*L. timidus*)) there is spatial variation in the extent and timing of coat color change, but it is not known whether that implies sufficient phenotypic plasticity or evolutionary potential to shift coat color in step with decreasing number of snow days. We are beginning a comprehensive set of studies on hares and jackrabbits in North America and Europe to evaluate the potential to adapt to climate change by shifting molt timing. Our project will elucidate the mechanism of coat color change, the fitness consequences of mismatch, and the potential for adaptive change, using a variety of field and laboratory approaches, including: a) determining genes and developmental pathways contributing to coat color change for various hare species; b) breeding studies to measure plasticity and heritability of coat color, and mechanistic pathways of color change; c) widespread field studies to collect genetic samples and to measure fitness consequences of mismatch to snow conditions; d) assays of historic samples to evaluate changes in frequencies of genetic markers linked to color change. We welcome ideas and hope to make this a widespread, collaborative project.

GS4 - Population management and Conservation

Is vaccination of juvenile wild rabbits against myxomatosis always effective if not systematic?

C. Ferreira[1,2]*, E. Ramirez[1], F. Castro[1], P. Alves[2], P. Ferreras[1] and R. Villafuerte[1]

*[1]Instituto de Investigación en Recursos Cinegéticos (CSIC-UCLM-JCCLM), Ronda de Toledo, s/n, 13071 Ciudad Real, España. E-mail: *catarinam.andrade@uclm.es*
[2]CIBIO, Centro de Investigação em Biodiversidade e Recursos Genéticos, Campus Agrário de Vairão, 4485-661 Vairão, Portugal e Departamento de Zoologia e Antropologia, Faculdade de Ciências da Universidade do Porto, 4099-002 Porto, Portugal

Wild rabbit populations have suffered a steadily decline in the Iberian Peninsula, as a consequence of several factors, namely viral diseases. One of the most popular management tools used to boost rabbit numbers include vaccination campaigns (mainly against Myxomatosis), although their success is inconclusive. Transmission rates, acquired immunity and length of the breeding season are known to play a crucial role in the differential impact of Myxomatosis on wild rabbit populations. However, some studies showed that although short-term negative effects of systematic vaccination campaigns may be reversible, in the field hunters use blind vaccination which may actually increase vulnerability to extinction through stochastic factors. Our experiment took place in Los Melonares, Sevilla Province, Spain in 4 breeding nucleus each with 18 warrens provided with a live-trapping system that allowed quick manipulation of rabbits. Our objective was to assess the efficacy of immunization of juvenile rabbits against Myxomatosis in wild populations. From April to October 2007 monthly captures were performed in each nucleus where half of the warrens were randomly selected to vaccinate against Myxomatosis (0.5ml POX-LAP, Ovejero) all susceptible rabbits (<900 g) captured inside. Simultaneously, all rabbits with the same weight trapped on the rest of the warrens (control) were injected with 0.5ml placebo. Additionally, 105 animals (vaccinated/control) were radio-collared to determine their survival. Our results suggest that systematic vaccination could be beneficial to rabbit populations by improving juvenile survival. Nevertheless, caution should be taken when making generalizations about the efficacy of vaccination campaigns, since the live-trapping system used in our study, which is little accessible to managers and hardly used by hunters, was determinant for the success of this measure. On the other hand, blind vaccination is highly dependent on the time of the disease outbreaks which is directly related to the proportion of juveniles available in the population.

GS4 - Population management and Conservation

Predictive model of a European wild rabbit (*Oryctolagus cuniculus*) enclosed population

A. Ferreira[1] and S. Pina

IMAR-CIC. Universidade de Coimbra, 3004-517 Coimbra, Portugal. E-mail: [1]ajf@zoo.uc.pt

Due to its importance in Mediterranean ecosystems and the strong decline of the *Oryctolagus cuniculus* (Linnaeus, 1758) in nature, the building of reproduction enclosures represents an important conservation tool for restocking programs and a beneficial location for future specie studies. The aim of this work was to build a Stochastic Population Model that works as a management tool for reproduction enclosures and helps to make these fenced areas more efficient and productive. The built model represents a rabbit population in the enclosure, age classes structured, with a discrete time variable. With the exception of the area, resources are considered to be unlimited. Several demographic parameters are consider for each age class, that make it possible to represent the biological interactions among animals and obtain some answers to important questions regarding enclosure management. This model was simulated and evaluated at least 50 times for this work, over a time span of several years with one month intervals. Simulations allow us to assess the effect of several management actions in the number of wild rabbits that can be produced in a year. For example, it demonstrated that the best way to maximize enclosure production is to remove a higher proportion of males and to maintain the preponderance of females in enclosure, since it is the females that mainly contribute to population increase.

GS4 - Population management and Conservation

Agri-evironment schemes: hare haven or pest paradise?

N. Reid[1*], R. McDonald[2] and I. Montgomery[1].

[1]*Quercus, School of Biological Sciences, Queen's University Belfast. Northern Ireland (UK).* E-mail: *neil.reid@qub.ac.uk
[2]*Central Science Laboratory, York. England (UK)*

The specific aims of Agri-environment schemes (AESs) do not always include the enhancement of species of conservation concern, however, associated conservation strategies such as the UK Biodiversity Action Plan often rest on the assumption that AESs enhance environmental conditions and thereby improve the conservation status of target species. To evaluate the effects of the Environmentally Sensitive Area (ESA) scheme, a widespread AES in the UK, a spotlight survey of the relative abundance of the Irish hare (*Lepus timidus hibernicus*), European rabbit (*Oryctolagus cuniculus*) and red fox (*Vulpes vulpes*) was conducted. The Irish hare is a conservation priority species and the focus of a Species Action Plan, while rabbits and foxes are commonly considered agricultural pests. The effects of ESA designation and habitat on each species were assessed at 150 ESA and 50 non-ESA sites, matched for landscape characteristics. The ESA scheme had no demonstrable effect on the abundance of Irish hares but rabbit and fox abundance was significantly greater within ESAs than in the wider countryside. Aside from the implications for farm economics, the proliferation of rabbit populations within conservation areas may raise issues concerning the grazing of important plant communities, whilst increases in fox populations may adversely affect other animal species of conservation concern.The abundance of rabbits and foxes corroborates recent work that suggests AESs may benefit common species but can not be relied upon to encourage rarer species. The Irish hare Species Action Plan relies on AESs to enhance the species' status and realise the target of increasing the hare population by 2010 by promoting suitable habitat. However, the ESA scheme is unlikely to help in achieving these objectives. Targeted and evidence-based agri-environment prescriptions are clearly required in order to ensure the realisation of species specific conservation targets.

GS4 - Population management and Conservation

Monitoring and population analysis of Amami rabbit *Pentalagus furnessi* based on pellet counting census and DNA extracted from pellets

F. Yamada[1]*, K. Sugimura[1], J. Nagata[1], S. Kobayashi[2], N. Ohnishi[1], T. Sakoda[3], Y. Nagai[3], M. Tatara[3] and S. Abe[3]

*[1]Forestry and Forest Products Research Institute. E-mail: *fumio@ffpri.affrc.go.jp*
[2]Kyoto University.
[3]Amami Wildlife Conservation Center of Ministry of the Environment

Amami rabbit *Pentalagus furnessi* is endemic to Amami-Ohshima Island (712 km2) and Tokuno-Shima Island (248 km2), which originally lacked predatory mammals, located in the subtropical zone in southern Japan. It has unique morphological characteristics, ecology and behavior that are thought to be expressions of adaptation to damp subtropical forests habitat. Whether we can conserve the rabbit from impacts of invasive species and human activities is one of most important issues now. For building a conservation program and assessment technique of the rabbit, we established a monitoring system by pellet counting census, and techniques for population genetic structure analysis and population size estimation using extracted DNA from pellets in Amami-Ohshima Island. Home range size of the rabbit (1.3 ha for males and 1.0 ha for females) was small, moving for feeding and dropping their pellets in open places, such as forest roads where food plants are rich, 100-200 m away from their burrows, which are usually located in small valleys covered by dense forests. For monitoring system by pellet counting census, we investigated at each census rout in nine areas including 24 valleys in total during 2005-2007. We did not find a clear increasing nor decreasing trends, in contrast with the 2002-2003 survey results that indicated a definite declining trend in the area where mongoose population density had increased rapidly. The result suggests a recovery of the rabbit population by mongoose eradication operations. We did not find large differences in genetic variation of mtDNA among populations in nine areas, though we found 12 haplotypes. For microsatellites analysis, we made the isolation and characterization of eight polymorphic and five monomorphic microsatellites. We suggest that these primers be used in future studies to monitor population size, determine dispersal patterns, and genetic diversity within and between populations of this and related species.

GS4 - Population management and Conservation

Landscape colonisation by rabbits: first results and perspectives of a spatially explicit simulation model

A. Lopez-Pintor[1] and W. Grant[2].

[1]Dpto. de Ecología, Fac. Biológicas, Univ. Complutense. C/ José Antonio Novais s/n, 28040-Madrid. Phone: +34 91 394 4421; FAX: +34 91 394 5081. E-mail: antonio.lopezpintor@bio.ucm.es.
[2]Dept. of Wildlife and Fisheries Sciences, Texas A&M University. College Station, TX 77843-2258, USA. Phone: +1 979-845-5702. E-mail: wegrant@tamu.edu

Many studies highlight the importance of considering ecological processes in their spatial context. Spatially explicit simulation models are a key tool in the management of both species and protected areas. The first aim of this work is to present initial results of a simulation model centered in the study of the spatial distribution of rabbit warrens in a landscape. Basic hypotheses regarding habitat choice are proposed, and performance of the model is evaluated based on expectations arising from these hypotheses. The second aim is to further explore the capabilities of the model by introducing more complex habitat preference rules that depend on vegetation types, habitat patchiness, neighbouring warrens, and habitat management practices. The model is based on the interaction between two components: one sedentary representing the landscape, and the other mobile representing warrens. Each component has different associated properties through which they interact. Initial properties of each landscape unit come from GIS-generated thematic layers. For the first aim of this work, factors considered (individually) responsible for the actual spatial distribution of warrens belong to three categories: abiotic factors (presence of physical obstacles for warren establishment; flooding risk); vegetation (minimum available woody or herbaceous cover, that is, availability of refuge site or forage), and rabbit behavior (dispersal distance; territorial exclusion). The spatial distribution of warrens generated by the model was clearly different from the actual one, as was expected: the decision of where to establish a warren is not based on a single factor but on a complex combination of many factors, which we call habitat preferences. This result confirms the appropriate performance of the model, and enables the introduction of new factors to make it more realistic. When more complex habitat preferences are used, the resemblance of simulation results to the actual warren spatial distribution is improved.

GS4 - Population management and Conservation

Effect of the climatic change in the spatial-temporal distribution of two lagomorphs in Mexico

E. Martínez-Villeda*‡ and E. Martínez-Meyer †

Laboratorio de Análisis Espaciales, Departamento de Zoología, Instituto de Biología, Universidad Nacional Autónoma de México. Circuito exterior s/n, Ciudad Universitaria, C. P. 04510, Apartado postal 70-153, México, D. F. E-mail: emv@ibiologia.unam.mx ‡, emm@ibiologia.unam.mx †

Species' geographic distributions are strongly driven by climate, thus current and future climatic changes are expected to impact them importantly. A key aspect in this topic is to understand climate change consequences on biodiversity, particularly in the direction and magnitude of species' ranges. Mexico holds an important diversity of lagomorphs (rabbits and hares), some with very unique ecological requirements; for instance, the almost-endemic white-sided jackrabbit (*Lepus callotis*) that inhabits natural grasslands of the northern deserts, and the endemic Mexican rabbit (*Sylvilagus cunicularius*), which lives mainly in the upper lands in Central Mexico. Previous studies regarding the potential responses of biodiversity to climate change make me hypothesize that these two species respond to it by shifting their current range differently. To test this hypothesis, I compiled and georeferenced record localities of the two species and I estimated the current distribution of the two species via modeling their ecological niches using the Genetic Algorithm for Rule-set Production (GARP), and field samplings were carried out to determine the predictive power of distribution models. Ecological niche models were then projected onto future climatic scenarios (2010 and 2050) to investigate the potential effects of climate change on both species under two contrasting dispersal scenarios (universal and no dispersion). Results indicate that potential effects of climate change are different for each species since *Lepus callotis* might observe an important range contraction, mainly towards the western portion; whereas *Sylvilagus cunicularius* is expected to suffer and upper shift of its distribution. This study presents a general view of the potential effects of climate change over the distribution of these species.

GS4 - Population management and Conservation

Latest tendencies of the European wild rabbit in Spain

J. Muñoz-Igualada[1] and S. Roig-Gómez[2]

[1]Wildlife Conservation Department. Tragsega (Tragsa Group). Julián Camarillo 6A 4A. 28037 Madrid (Spain). E-mail: jmunoz7@tragsa.es
[2]Centre of Forestry Research (CIFOR-INIA). Carretera de La Coruña km 7.5. 28040 Madrid (Spain). E-mail: sroig@inia.es

Wild rabbit Spanish populations have been decreasing since the arrival of the myxomatosis during the 1950s, with an special sharp drop during the nineties, just following the outbreak of the rabbit haemorrhagic disease. Currently, two different situations can be observed in the Spanish territory; meanwhile conservation projects continue developing actions aimed to recover wild rabbit as primary prey for endangered predators in several regions, farmers complains about wild rabbit damages on crops are becoming common in other areas of Spain. These complains have even provoke the local authorities permission for free hunting of this lagomorph in the more problematic areas. The objective of this work has been to obtain an updated overview of the situation along overall Spain. We contacted and interviewed the responsible managers for rabbit populations of every Spanish provinces. The inquiry included questions about rabbit situation and habitat, complains from farmers, hunting management (timing of the hunting authorisations, predator control operations, etc.) and diseases outbreaks. According to the collected information, wild rabbit populations seem to be recovering past status, and even showing increasing trends in agricultural environments of Central, Southeast and Northern Spain (i.e. *Ebro* river valley). Within some particular regions rabbits even cause important economical losses, specially in the cases of coincidence of high densities of rabbits with valuable crops like vineyard (i.e. *La Rioja*) or citrus fruits (i.e. Southeast Spain). However, this recovery is not reported in traditional rabbit habitats, such as Mediterranean scrubland biotopes of Central and Southwest Spain where the general low abundance of this species continues being the major conservation problem for its specialized endangered predators (Iberian lynx, imperial eagle,…). Periodical outbreaks of myxomatosis and RHD are observed in all areas although their timing and intensity seemed to change among the different regions. Finally, possible reasons of the reported patterns are discussed at the light of last ecological and epidemiological researches.

WORKSHOPS CONTRIBUTIONS

WS1 - Behaviour and physiology in rabbits: from the field to the lab and back again

Factors affecting vigilance in European rabbits

R. Monclús

Unidad de Zoología. Dpt. Biología. Universidad Autónoma de Madrid. 28049 Madrid, Spain. E-mail: raquel.monclus@uam.es

An animal's display of vigilance depends on various environmental factors such as predator presence or the proximity of conspecific competitors. In addition, several intrinsic traits may modify the frequency of vigilance displays. In an observational study on animals of an individually marked European rabbit (*Oryctolagus cuniculus*) population, we investigated the effects of sex, body condition, and social rank on vigilance in juveniles of both sexes and in adult females. Moreover, we considered pregnancy as a further factor that might affect vigilance in adult females. We found lower scanning rates in young rabbits than in adult females. Male and female juveniles did not differ. Moreover, vigilance of juveniles was correlated with their age-dependent body mass, whereas young rabbits with lower body condition scanned less. We suggest that juveniles in a low body condition were trading-off vigilance against feeding in order to maximize their growth. In contrast, we did not find a correlation between body mass and vigilance in adult females. However, females increased scanning rates during late pregnancy, which might reflect their lower capacity to escape predator attacks. In addition, low ranking females scanned more than high ranking individuals, most probably due to their higher risk of attacks by conspecifics. In summary, our results highlight various intrinsic traits modifying the display of vigilance behaviour in European rabbits. UATLX-EXB-149.

WS1 - Behaviour and physiology in rabbits: from the field to the lab and back again

Reproductive biology of the Mexican rabbit *Sylvilagus cunicularius*: field and lab aproaches

M. Martínez-Gómez[1,2] and J. Vázquez[1]

[1]*Centro Tlaxcala de Biología de la Conducta, Universidad Autónoma de Tlaxcala. E-mail: marmagabo@yahoo.com*
[2]*Instituto de Investigaciones Biomédicas, UNAM.*

The Mexican cottontail *Sylvilagus cunicularius* is one of the largest and most widely distributed endemic lagomorphs. Although is not considered endangered, it is increasingly threatened, and unfortunately, little is known about its general Biology. During the least years, our research group has been interested in this very common species at La Malinche National Park, Tlaxcala state; particularly, we want to set the bases to study its reproductive physiology and behavior. In order to capture these rabbits, we designed and used a net trap. Greater efficiency in capturing and recapturing was achieved with net traps than with tomahawk live capture traps. For seven years we caught and marked around 200 individuals with both devices, which enabled to observe that reproductive females are present throughout the year with a notable peak from March to October. Juveniles are also present throughout the year with a peak from September to December and adult males have scrotal testes all the year round with no seasonal change in testis length. During all study period, we have also been evaluating sings of cottontail rabbit health, including the intensity and prevalence of gut parasites and ectoparasites besides some hematological parameters such as leucocytes, haematocrit, and sedimentation rates. Furthermore, we have measured the concentrations of estradiol, progesterone and testosterone in blood serum of adult females and testosterone in adult males using the ELISA technique. Trying to find nests and using telemetry, we fitted radiocollar transmitters to two males and three females. These individuals were tracker for two months to estimate their home range. Early analyses show a home range of 5.1+2.8 ha for males while 3.6+1.1 ha for females. Finally, last year we established an enclosure of 530 square meters next to La Malinche Scientific Station where we got the reproduction of three females that gave birth to twelve pups. We are starting to analyze maternal behavior and pups´ development. We consider that this program was already contributed important introductory knowledge on the nearly unknown Biology of this species. Moreover, we think we are positive that this species promises future fruitful research as a model to answer behavioral, ecological, and eco-physiological questions. UATLX-EXB-149.

WS1 - Behaviour and physiology in rabbits: from the field to the lab and back again

Long-term maternal and sibling effects in the European rabbit: results from a study on a field enclosure population

H. Rödel and D. von Holst

Department of Animal Physiology, University of Bayreuth, Germany;
E-mail: heiko.roedel@uni-bayreuth.de

Environmental conditions during an animal's early life can have profound long-term consequences and affect its fitness. In particular, maternal and sibling effects, which can strongly influence the early growth and development of altricial animals may be important. We quantified the effects of litter size (i.e. number of litter siblings), age and social rank of the mother and date of birth on two fitness components of female European rabbits (*Oryctolagus cuniculus*) from a field enclosure population. Analyses were based on pup survival probabilities and on lifetime reproductive success (here: the number of recruited offspring over lifetime) of adult females from 10 years. Survival to maturity and lifetime reproductive success peaked in females from medium sized litters and were lower in females born to one-year-old than to older mothers. Additionally, lifetime reproductive success was decreased in females born to mothers older than 4 years. Survival to maturity and lifetime reproductive success were lower in animals born later in the breeding season, likely due to the seasonal environment. Our results emphasize that parameters of the early social environment do not only affect juvenile survival but have the potential to exert long-term influences on fitness components throughout life. UATLX-EXB-149.

WS1 - Behaviour and physiology in rabbits: from the field to the lab and back again

The unusual life of the newborn European rabbit: uniting studies from lab and field

R. Hudson[1] and A. Bautista[2]

[1]Departamento de Biología Celular y Fisiología, Instituto de Investigaciones Biomédicas, Universidad Nacional Autónoma de México. E-mail: rhudson@biomedicas,unam.mx
[2]Centro Tlaxcala de Biología de la Conducta, Universidad Autónoma de Tlaxcala

Life is hard for newborn European rabbits, and as outlined in the previous talk (Rödel & von Holst), early developmental conditions can have significant long-term consequences for individual survival and fitness. A first challenge for the altricial young is to survive a regimen of remarkably limited maternal care. Mothers leave their pups immediately after giving birth and only return to nurse them for about three minutes once every 24 hours. Furthermore, if mothers become pregnant as a result of the usual post partum estrus, they will stop nursing around postpartum day 26 in preparation for the next litter. The young are able to survive these harsh conditions due to several notable adaptations, four of which are: 1) a circadian system synchronized with the nursing rhythm of the mother, enabling pups to anticipate and prepare for her daily visits (Caldelas et al. this meeting), 2) stereotyped nipple-search behavior in response to pheromonal cues on the mother's ventrum, enabling pups to locate nipples in seconds and to drink up to 25% of their body weight at one nursing, 3) pups' ability to maintain close and dynamic contact with littermates, enabling them to sustain an adequate body temperature without maternal brooding, and 4) the ability to learn pre- and postnatally odors of the mother's diet in preparation for the transition to independent feeding. Nevertheless, up to 20% of pups do not survive the first postnatal week, mainly due to starvation. Competition for nipples is severe and the heaviest pups at birth generally show more mature motor control, obtain more milk, and are more likely to survive and to be the heaviest at weaning. Although this information has been obtained largely from domestic rabbits, studies of wild-type animals confirm that these are adaptive, species-typical patterns and are not simply the result of domestication. Supported by CONACyT 25889-N and PAPIIT IN229907. UATLX-EXB-149.

WS2 - Population Genetics and Phylogeography

Phylogeography and historical demography of North America's northmost ochotonid, the collared pika (*Ochotona collaris*)

H. Lanier[1,2,*] and L. E. Olson[1]

[1]University of Alaska Museum, 907 Yukon Drive, Fairbanks, AK 99775;
*[2]Department of Biology and Wildlife, 211 Irving 1, University of Alaska Fairbanks, Fairbanks, AK 99775. *E-mail: fthcl1@uaf.edu*

North American pikas are generally restricted to alpine talus and are considered to be poor dispersers, making them susceptible to population isolation and climatically-driven vicariance. Their evident restriction to 'sky islands' would lead one to suspect a high degree of phylogeographic structuring. In the American pika, *Ochotona princeps*, significant population differentiation is evident in morphology, allozymes, and mtDNA. Populations of the collared pika, *O. collaris*, found at higher altitudes in Alaska and northwestern Canada, have a much more recent history of colonization because many of their current localities were inaccessible during Pleistocene glaciations. Collared pikas are therefore expected to be less phylogeographically structured than their sister species, *O. princeps*, but more structured than other vagile or generalist arctic mammals. We use mtDNA sequences to analyze phylogeographic patterns within *O. collaris*, looking for evidence of refugia, range expansion, and population isolation. While *O. collaris* does show a strong signal of post-glacial range expansion, montane-driven population structuring is less evident than anticipated. We discuss several reasons for this unexpected pattern.

WS2 - Population Genetics and Phylogeography

Recombination and speciation: loci near centromeres are more differentiated than loci near telomeres between subspecies of the European rabbit (*Oryctolagus cuniculus*)

M. Carneiro[1], N. Ferrand[1] and M. Nachman[2]

[1]*CIBIO, Centro de Investigação em Biodiversidade e Recursos Genéticos, Campus Agrário de Vairão, 4485-661, Vairão, and Departamento de Zoologia e Antropología Faculdade de Ciências Universidade do Porto, 4099-002 Porto Portugal*
[2]*Department of Ecology and Evolutionary Biology, University of Arizona, Tucson, AZ, 85721*

Recent empirical and theoretical studies suggest that regions of restricted recombination play an important role in the formation of new species. To test this idea, we studied nucleotide variation in two parapatric subspecies of the European rabbit (*Oryctolagus cuniculus*). We surveyed five loci near centromeres, where recombination is expected to be suppressed, and five loci near telomeres, where recombination is expected to be higher. We analyzed this multilocus dataset using a divergence-with-gene flow framework and we report three main findings. First, we estimated that these subspecies diverged approximately 1.8 Mya and maintained large effective population sizes (*O. c. algirus* Ne ≈ 1,600,000 and *O. c. cuniculus* Ne ≈ 780,000). Second, we rejected a strict allopatric model of divergence without gene flow; instead, high rates of gene flow were inferred in both directions. Third, we found different patterns between loci near centromeres and loci near telomeres. Loci near centromeres exhibited higher levels of linkage disequilibrium than loci near telomeres. In addition, while all loci near telomeres showed little differentiation between subspecies, three of five loci near centromeres showed strong differentiation. These results support a view of speciation in which regions of low recombination can facilitate species divergence in the presence of gene flow.

WS2 - Population Genetics and Phylogeography

Molecular evidence of natural hybridization between the Iberian and brown hares in northern Iberian Peninsula

J. Melo-Ferreira*[1,2,3], H. Freitas[1], P. Boursot[3] and P. Alves[1,2]

[1]CIBIO, Centro de Investigação em Biodiversidade e Recursos Genéticos, Universidade do Porto, Campus Agrário de Vairão, 4485-661 Vairão, Portugal.
[2]Departamento de Zoologia e Antropologia, Faculdade de Ciências da Universidade do Porto, 4099-002 Porto, Portugal.
[3]UMR 5554, Institut des Sciences de l'Evolution de Montpellier, Université Montpellier II, Case Courrier 063, 34095 Montpellier cedex 5, France.
*Email: *jmeloferreira@mail.icav.up.pt*

Genome admixture through hybridization is an intriguing evolutionary phenomenon and genus *Lepus* appears as an ideal group to study such biological interactions. Presently, about 30 species of hares widely distributed around the world are recognized and many of them share extensive secondary contact zones. One of such contacts occurs between the Iberian hare, *Lepus granatensis*, and the brown hare, *L. europaeus*, in northern Iberian Peninsula. However, the possibility that these species hybridize in this area had not yet been thoroughly investigated. In order to clarify this question, we analyzed six microsatellites and one mitochondrial DNA marker in a total of 341 individuals of both *L. granatensis* and *L. europaeus*, including populations from the contact zone. Our analyses revealed several instances of introgression, which was found to be restricted to populations located near the contact zone. While the analysis of microsatellites suggested that genetic exchange may exclusively occur from *L. europaeus* to *L. granatensis*, transmission of mtDNA happens in both directions. These results clearly demonstrate the occurrence of hybridization between *L. granatensis* and *L. europaeus* in northern Iberia, and open new research questions on the dynamics of gene flow in this now recognized hybrid zone. It also adds up to the growing evidence that introgressive hybridization is a common phenomenon among hares.

WS3 - The Importance of Landscape Structure and Elements for Lagomorphs

Facilitation of rabbits by cattle

J. Dekker[1*], N. Somers[2], L. Bakker[3,4], L. Breukelen[5], S. Wieren[1], M. Hoffman[2] and H. Prins[1]

[1] *Resource Ecology Group, Dept. Environmental Sciences, Wageningen University. Bornsesteeg 69, 6708 PD, Wageningen, the Netherlands. *E-mail: jasja.dekker@vzz.nl*
[2] *Terrestrial Ecology Unit, Department of Biology, Ghent University, K. L. Ledeganckstraat 35 B-9000, Ghent, Belgium.*
[3] *Nature Conservation and Plant Ecology, Dept. Environmental Sciences, Wageningen University, The Netherlands.*
[4] *Centre for Limnology, NIOO-KNAW, Rijksstraatweg 6, 3631 AC Nieuwersluis, The Netherlands*
[5] *Waternet, Postbus 94370, 1090 GJ Amsterdam*

Mostly, research on community ecology is focussed on negative interactions, such as predation and food competition. However, interaction between herbivores also allows for positive interaction: facilitation. To facilitate means 'to make easier'. This is exactly what can occur between large and small herbivores. The general idea is that small herbivores are negatively affected by tall and old vegetation: they have trouble ingesting and digesting this, which results in low intake rates of food and digestible energy. Large herbivores can deal with this older vegetation much easier and can bring the old complex vegetation to a state in which it is easier to ingest and digest by rabbits, simply by grazing it short. This patch facilitation could result in an increase in small herbivore population i.e. population facilitation. In the Netherlands, a system in which facilitation could occur is that of grassy vegetation, rabbits and cattle. European rabbits often occur together with cattle, especially in nature areas where cattle are used as conservation management tools. More knowledge of the way these two species interact is important for nature conservation, as the rabbit has a large direct and indirect impact on local species diversity of flora and fauna, but has strongly decreased in number over the last decades. In our presentation, the sward-rabbit-cattle system is analysed for the presence of facilitative interactions, from the changes cattle bring about in swards to the food preferences and numerical response of rabbits. We do this by reviewing the literature and the experiments and field studies and mathematical modelling performed by the authors.

WS3 - The Importance of Landscape Structure and Elements for Lagomorphs

Landscape perspectives for wild rabbit (*Oryctolagus cuniculus* l.) in the south eastern Spain

D. Jiménez-García[1], J. E. Martínez-Pérez[2], V. Peiró[3], J. Arques[3], J. Palacio-Núñez [4] and A. Belda[3]

[1]Departamento de Agroecología y Ambiente-Instituto de Ciencias de la Benemérita Universidad Autónoma de Puebla. 14 Sur 1601. Col. San Manuel. C.P. 72570. Puebla, Puebla, México. E-mail: daniel.jimenez@icbuap.buap.mx.
[2]Unidad de Cartografía de los Recursos Natural. SIACI. Universidad de Alicante. Ap. 99-E03080. Alicante, Spain.
[3]Depto. Ecología. Universidad de Alicante. Ap. 99-E03080. Alicante, Spain.
[4]Colegio de Postgraduados, Campus SLP. Agustín de Iturbide # 73. Salinas de Hidalgo, S.L.P. C.P. 78622. México.

Landscape mosaic composition is a recurrent scope in the wildlife management however, only some works are strongly close to landscape perspectives and analysis. Our work was developed in the Alicante Province (South Eastern Spain), and try to describe the main landscape indices and mosaic composition influences on wild rabbit densities. Our work include abundances of game preserves (hunting bags: *n=33*) and transects (Ind/ha). Our result show strong relationships of wild rabbit abundances (hunting bags) with the landscape heterogeneity indices (Patch density) in two periods (1978: *B=14.558; p=0.009; r=0.772* and 2000: *B=8.33; p=0.011; r=0.448*). Some habitat characteristics are strongly correlated with the rabbit abundances: urbanization degree, clear zones and forage areas. By other hand, rabbit abundances (transects: *n=73*) are close related with landscape elements as forage areas and natural zones (*B=-0.304; p=0.012; r=0.304*). Wild rabbit prefer clear areas with a complex landscape heterogenity which include agricultural elements (dry vineyards: *B=0.267; p=0.000; r=0.545*) and natural structure. Landscape fragmenation and the anthropic presence are correlated with rabbit abundances. Disperse urban areas (*B=0.404; p=0.000; r=0.390*) and the increase of agricultural zones inside the shrublands areas, favour the wild rabbit abundances in the hunting areas of the Marina Alta Region (Alicante, Spain).

WS3 - The Importance of Landscape Structure and Elements for Lagomorphs

Adaptability of habitat preferences and spatial organization of rabbit warrens across the landscape in contrasting ecosystems

A. Lopez-Pintor

Dpto. de Ecología, Fac. Biológicas, Univ. Complutense. C/ José Antonio Novais s/n, 28040-Madrid. Phone: +34 91 394 4421; FAX: +34 91 394 5081. E-mail: antonio.lopezpintor@bio.ucm.es

The European rabbit (*Oryctolagus cuniculus*) is a lagomorph species native to the Mediterranean ecosystems of the Iberian Peninsula, and very well known mainly because of its negative effects when introduced into other regions of the world. In its native ecosystems rabbits constitute a key prey for a very diverse predator community, and recent works have focused on their role as key herbivore in Mediterranean ecosystems. The high adaptability of this species is held responsible for its capacity of successfully invading very different ecosystems of the world. Although the literature is abundant on its distribution, effects and control measures outside its native range, few works have focused on understanding the elements and factors that make up their habitat preferences, at different scales and in contrasting ecosystems, inside its native range. The aim of this work is to study the relative importance of factors affecting the spatial distribution of warrens in the landscape, in two contrasting ecosystems of central Spain. The first one was a dehesa, a mixture of woodland, shrub and pasture patches upon sandy soils. The second was an open landscape frequent on gypsum substrates, dominated by the perennial herb *Stipa tenacissima*, with few scattered individuals of some woody species. Rabbit warrens were mapped in the field, together with different variables regarding vegetation, soil, geomorphology and land use practices. ArcGIS was used to produce the appropriate thematic layers, and for the 40 m grid-based sampling. The statistical analyses showed, firstly, that the spatial organization of warrens greatly changed between ecosystems, in number and size. Secondly, the specific factors involved in habitat preferences are also quite different, although a useful generalization can be reached when element function is considered instead of identity.

WS3 - The Importance of Landscape Structure and Elements for Lagomorphs

Importance of landscape elements for rabbits and hares in semiarid environments in Mexico

D. Jiménez-García[1*], J. Palacio-Núñez[2], G. Olmos-Oropeza[2], O. Martínez[2], J. Martínez-Calderas[2], J. Cordero[3], S. Jiménez[3] and L.Victoria-García[3]

*[1]Departamento de Agroecología y Ambiente-Instituto de Ciencias de la Benemérita Universidad Autónoma de Puebla. 14 Sur 1601. Col. San Manuel. C.P. 72570. Puebla, Puebla, México. E-mail: *daniel.jimenez@icbuap.buap.mx.*
[2]Colegio de Postgraduados, Campus SLP. Agustín de Iturbide # 73. Salinas de Hidalgo, S.L.P. C.P. 78622. México.
[3]Escuela de Biología. Benemérita Universidad Autónoma de Puebla. Blvd. Valsequillo y Av. San Claudio. Edificio 76, Ciudad Universitaria, Col. Jardines de San Manuel. C. P. 72570.

Landscape composition is an important elemnt of habitat requeriments for a lot species in the semiarid regions. Lagomorphs have an important role in the ecology in a lot species. Lagomorphs are used as prey for canivorian species in arid and semiarid environments. Rabbits an hares are keyspecies in extreme environments because provide biomass to another species. Our work try to describe the importance of the landscape elements and composition in the rabbit and hare distribution in the central part of Mexico. We select the typical arid environment; compose by *Opuntia sp*. and another vegetation association as *Jatropha sp*, *Acacia* sp. and wild grass. We realise an Multicriterian Evaluation (GIS) to driscriminate the areas withouth elements which describe the arid environments. Potential surface to realise surveys is 6,800,000 ha, but we select 73 sampling points to determinate presence ausence of rabbits and hares associated to *Opuntia sp*. Transects have 100 m of lenght and was made in the matrices of landscape composition. Our results show strong relationships betwen the landscape composition (*Opuntia sp*) and hare frequency, whereas with the rabbit abundances, there are not relationships.

WS4 - Estimating Lagomorph Densities

European hare densities and pasture use: contrary results for a species of conservation concern in north east England

S. Petrovan[1,2]*, A. Ward[2] and P. Wheeler[1]

*[1]Centre for Environmental and Marine Studies, University of Hull, Scarborough Campus, UK. E-mail: *s.petrovan@hull.ac.uk*
[2]Central Science Laboratory, Sand Hutton, York, UK

The European hare (*Lepus europaeus*) has been declining throughout Europe, probably due to agricultural intensification. In the UK, hares have become rare in the pastural habitats of the west. Pastural landscapes are believed to have turned into suboptimal habitat for hares and proposed reasons include loss of habitat heterogeneity and increased precipitation, but the mechanisms governing pasture occupancy by hares is still poorly understood. We aimed to investigate pasture selection and population densities in pastures in the drier NE of England in order to quantify the major factors limiting hare populations in pastural habitats. We designed a broad scale survey in seven large pastural sites with a network of transects totalling 131km that we surveyed in both autumn 2007 and spring 2008. We developed a new method to survey hares in pastures using night-time line transect distance sampling. Fields were classified according to land management and information on sheep/cattle density, field size, sward height and numbers of foxes and rabbits were collected. Overall, hares had far higher densities than the national average for pastural sites, with a post-breeding (autumn) density of 27.3 hares $100ha^{-1}$ (95% CI=19-40) and a pre-breeding (spring) density of 20 hares $100ha^{-1}$ (95% CI=13-31). Abundances varied greatly between sites. During both seasons hares avoided fields with short sward height but selected sheep pastures when the vegetation was above 5cm. At the field scale hare abundance was negatively associated with rabbit abundance. Sites dominated by intensive sheep grazing produced the lowest hare densities, and in most cases were associated with high rabbit densities. We suggest that at our field sites, hares are more likely to be limited by habitat in terms of food rather than cover.

WS4 - Estimating Lagomorph Densities

Census techniques for European brown hare *Lepus europaeus* populations in an alpine environment: comparison and evaluation between spotlight count and faecal pellet count

P. Tizzani *, G. Ficetto, A. Dematteis and P. Meneguz

*Centro Ricerche sulla Gestione della Fauna Selvatica – Università degli Studi di Torino. E-mail: *paolo.tizzani@unito.it*

European Brown Hare populations have declined throughout Europe since the second half of XX century, but nowadays in hill and plain areas of Northern Italy the species has reached good population density due to efficacious management protocols. In the Alpine areas the situation is more complex due to the difficulties in obtaining effective estimations on the status of the species. In fact the monitoring of European Brown hare populations in Alpine environment results difficult due to: a) limited contactability of the species (small size and crepuscular habits); b) characteristics of Alpine environment (complex orography; difficult access to many areas); c) presence of woody areas along the roadside (poor visibility of the animals). The most common technique used in Italy to evaluate European hare density is the “spotlight count” performed by car. It is an effective method in a plain environment but does it represent a good choice in mountain areas? This work wants to: i) evaluate the applicability of spotlight count in order to obtain effective informations on hare density and distribution in mountain context; ii) suggest a different census method (Faecal Pellet Transect Count - FPTC) in mountain context. FPTC seems to be a more effective method, with better sensibility (23,6% underestimation vs 40,0%) and applicability in an area of more difficult access and in periods of the year when the spotlight count can’t be used (spring and summer: abundant vegetation cover). Our results agree with Parker (2001) that suggest FPTC as a tool suitable to every type of habitat and condition whereas spotlight count can be only used in area with poor vegetation and car accessibility. FPTC, based on more stable parameters as faeces stratification, isn’t influenced by stochastic factors as weather, animal disturb, moonlight. On opposite the method needs a hard work in the first phase (transect design and tracing) and can’t be used to monitor large areas. FPTC seems to be a suitable census method for long term population studies in Alpine areas.

WS4 - Estimating Lagomorph Densities

Towards a standardized index to estimate European rabbit abundance in Mediterranean habitats of central-southern Spain

J. Fernández de Simón[1*], F. Díaz[1], F. Cirilli[2], F. Sánchez[2], R. Villafuerte[1], M. Delibes-Mateos[1,3] and P. Ferreras[1]

*[1]Instituto de Investigación en Recursos Cinegéticos (IREC, CSIC-UCLM-JCCM) Ronda de Toledo s/n 13005 Ciudad Real (Spain). E-mail: *javier.fernandez@uclm.es*
[2]Departamento de Zoología, Universidad de Córdoba, Campus de Rabanales, ed. Darwin 14071 Córdoba (Spain).
[3]Departamento de Biología Animal, Universidad de Málaga 29071 Málaga (Spain).

European rabbits (*Oryctolagus cuniculus*) are a keystone species in the Iberian Mediterranean ecosystems. During the last decades, rabbits have drastically declined in the Iberian Peninsula. Since then, many studies have been performed to monitor rabbit population trends, as well as to analyze which factors are associated with rabbit abundances. However, most of these studies estimate rabbit abundances using different incomparable methods. From this perspective, it is very important to establish a standardized methodology to survey rabbit densities. Therefore, the aims of this study are (a) to compare several rabbit census methods employed in the literature, (b) to discuss the advantages and pitfalls of each one, (c) to propose common and comparable methodologies for assessing rabbit abundances according to the objectives and scale of each study. The study was carried out in the 2006 summer at eight localities of Central-Southern Spain. Several methods were used: a) latrines, b) warren entrances, c) rabbits seen and d) scrapes counted along 4 and 2 km walking transects, e) pellet counts in plots regularly distributed along walking transects f) standing crop counts and g) clearance plot counts at fixed sampling stations. We also considered h) the percentage of plots with pellets along transects and i) the proportion of 100 m transects with any latrine, as well as a rabbit density index (RDI) derived from a)-d) variables. The relationships between these indices were analyzed by means of a correlation matrix. Most methods were highly correlated (average correlation index 0.52-0.87). The most useful indices were pellet counts (both in clearance plot counts at fixed stations and standing crop counts along transects), warren entrances and RDI. The most appropriate method would depend on the objectives, the temporal and the spatial scale of each study, and must be carefully selected during the sampling design.

WS4 - Estimating Lagomorph Densities

Estimating lagomorph density: enhancing use and avoiding abuse of distance sampling

N. Reid[1*], K. Dingerkus[1], D. Borchers[2], T. Marques[2], I. Montgomery[1], F. Marnell[3], R. Jeffrey[3], D. Lynn[3], N. Kingston[3] and R. McDonald[4]

[1]*Quercus, School of Biological Sciences, Queen's University Belfast. Northern Ireland (UK).* E-mail: *neil.reid@qub.ac.uk
[2]*Centre for Research into Ecological and Environmental Modelling, University of St. Andrews. Scotland (UK)*
[3]*National Parks and Wildlife Service, Dublin (Republic of Ireland)*
[4]*Central Science Laboratory, York. England (UK)*

Distance-sampling has become a standard technique for estimating terrestrial animal population density with up to 50% of Distance users surveying mammals. However, successful implementation of this technique relies on a number of important assumptions, for example, that samplers are placed randomly with respect to the distribution of the surveyed population. Nevertheless, most published studies do not formally test whether their data met the assumptions of the analysis which if broken can result in severely bias density estimates. Being nocturnal lagomorphs are especially difficult to sample while some species may exhibit characteristic behaviours that inherently violate the assumptions of Distance-sampling. The Hare Survey of Ireland 2006/07 established the distribution and provided density estimates for the endemic Irish hare (*Lepus timidus hibernicus* Bell 1837). The aim of the survey was to provide a basis for the future monitoring of the species' conversation status. Almost 4000 point transects were surveyed at night using spotlights from minor roads throughout Ireland during winter during 2006 and 2007. Despite the potential bias of animals avoiding traffic and human contact, wildlife surveys often use tracks and roads are sampling transects. Furthermore, hares tend to avoid field boundaries, a further violation of Distance-sampling assumptions. We quantified the extent of potential bias arising from violated assumptions, then developed novel survey techniques to augment standard distance data to describe the avoidance of field boundaries and developed innovative statistical analysis for mitigating various sources of bias. The methods we developed will improve the application of distance-sampling techniques and aid future surveys of lagomorphs and other terrestrial mammals.

POSTER CONTRIBUTIONS

GS1 – Systematics, Evolution and Genetics

Genetic and morphological variation in Tunisian hares (*Lepus capensis*)

H. B. Slimen[1] and F. Suchentrunk[2]

[1]Laboratoire de Génétique Moléculaire, Immunologie et Biotechnologie, Faculté des Sciences de Tunis, Campus Universitaire El Manar, 2029 Tunis, Tunisia, e-mail: ben_slimen_hichem@yahoo.fr,
[2]Research Institute of Wildlife Ecology, University of Veterinary Medicine Vienna, Savoyenstr. 1, 1160 Vienna, Austria

To contribute to the understanding of the meaning of phenotypic and morphologic characters for the systematics of *Lepus capensis* sensu latu, we compared morphological variation with population genetic and phylogeographic data of *L. capensis*-type hares along a steep ecological gradient in Tunisia. We examined 139 hares from ten regional samples between the northern Mediterranean seaboard and the Sahara for fur colour, metric skull variables, allelic variation at 14 microsatellite loci, and sequence (462 bp) variation of the hypervariable segment 1 (HV1) of the mitochondrial (mt) control region. Coat colour varied between the typical yellowish pale in the Sahara and greyish brown in the north. Based on 27 metric transformed variables, skull shape could be characterized sufficiently by eight principal components (PCs), with complete exclusion of size. Skull shape varied across regions (MANCOVA of individual PC scores), when accounting for size (as we found static allometry), independent of a tendency for decreasing size towards the arid zone. Overall genetic differentiation among regional samples, as based on 169 alleles, was low (F_{ST}= 0.0377, p= 0.0001), and gene pool differentiation did not follow an isolation-by distance model (Mantel test). A Bayesian STRUCTURE analysis of microsatellites revealed a differentiation in k=4 most likely populations, of which one was dominated by hares with yellowish-pale and a second by hares with greyish-brown coat colour, whereas the other two populations contained a mixture of all four recognized colour categories. Haplotype diversity (0.966±0.007) was high for the 60 mtHV1 haplotypes found, but

nucleotide diversity (π= 0.0273 ± 0.0009) was low. There was no significant concordance of phylogenetic and geographical distribution of haplotypes, nor was coat colour associated with haplotypes or haplotype clusters. Moreover, there was no significant correlation between individual PC-scores for skull shape and individual dimension scores from a PCO-analysis of pair-wise mt distances. However, individual PC-scores for skull shape were correlated (r=0.851, p=0.004) with individual scores for the third among nine dimensions, that resulted from a PCO-analysis of pair-wise CSE-distances between individuals, as calculated from the microsatellites. In conclusion, we found high morphological and genetic variability in the Tunisian hares, with the latter indicating close phylogenetic relationship among hares from all regions; and there was only very little correspondence between morphological and molecular differentiation of individuals. This study was financed by Wildlife Research – Franz Suchentrunk, Vienna, and the Research Institute of Wildlife Ecology, University of Veterinary Medicine Vienna, Austria.

GS1 – Systematics, Evolution and Genetics

Oryctolagus giberti **n. sp. (Lagomorpha, mammalia) from the lower pleistocene of Cueva Victoria (Murcia, Spain)**

R. De Marfà.

Departament d'Estratigrafia, Paleontologia i Geociències Marines Universitat de Barcelona, C/ Marti i Franques, s/n, 08028 Barcelona (00 34) 93 402 13 79 e-mail : demarfa@ub.edu

A new species of leporid (Lagomorpha, Mammalia) is described based on the material from the lower Pleistocene of Cueva Victoria (Murcia, Spain). This species, named *Oryctolagus giberti* n. sp., presents several intermediate characters between the first known representative of the genus, *O. laynensis*, from the Middle Pliocene of Spain, and the modern European rabbit (*O. cuniculus*), specially at the level of the palate, the mandible, the third lower premolar, the ulna, the coxal and the femur. In this respect, *Oryctolagus giberti* n. sp. is a firm candidate to occupy the vacant phylogenetic place between these two species.

GS1 – Systematics, Evolution and Genetics

Success hints of a translocation program of wild European brown hares (*Lepus europeaus*)

C. Fischer and G. Yannic

University of applied sciences of Western Switzerland

These last decades, European brown hare (*Lepus europeaus*) populations experienced dramatic declines in many parts of Europe. As it is an appreciated game species, hunting associations regularly release captive reared individuals. Unfortunately, these releases are usually not sufficient to restock a population because of high mortality rates, and they have thus to be repeated regularly. In the canton of Geneva, Western Switzerland, brown hare populations are healthy with densities reaching up to 60 individuals per km^2. Under such densities, damages to cultivated crops are important and the local administration in charge of wildlife management is looking for solutions to reduce locally the hare's densities. As hunting is not allowed in this canton, translocation was proposed as an alternative solution. Four areas of low densities were chosen for release, one in Valais, Switzerland, and three in Haute-Savoie, France. We were given a mandate to follow the success of these translocations and to investigate how the released hares cope with their new environments, in order to determine if this management method is sustainable. After two years of survey, we have now indications about the success of this program.

GS1 – Systematics, Evolution and Genetics

Three methods for determining the geographic distribution area of species: a case study based on four species of lagomorphs in Mexico

E. Martínez-Villeda* and C. González-Salazar‡

*Laboratorio de Análisis Espaciales, Departamento de Zoología, Instituto de Biología, Universidad Nacional Autónoma de México. Circuito exterior s/n, Ciudad Universitaria, C. P. 04510, Apartado postal 70-153, México, D. F. E-mail: emv@ibiologia.unam.mx *, cgs@ibiologia.unam.mx‡*

Determining the limits and area for the geographic distribution of a species is a question of great relevance in studies of Biogeography and Ecology. Nevertheless, the criteria used for determining the limits of a distribution area are highly subjective. In this study we used three methods to compare and calculate the geographic distribution area of four species of lagomorphs in Mexico, the white-sided jackrabbit (*Lepus alleni*) and three cottontail rabbits (*Sylvilagus bachmani*, *S. brasiliensis* and *S. cunicularius*). One hundred eighteen localities of occurrence records were obtained from museum specimens in collections, and from published literature, and then georeferenced using a Geographic Information System (GIS). We used the minimum convex polygon method, the grid method with three cell sizes (25 x 25 km, 50 x 50 km, and 100 x 100 km), and we modeled the ecological niche using the Genetic for Algorithm Rule-Seth Prediction (GARP) system. Our results indicate that agglomeration or dispersion of localities had a significant influence in the estimation of shape and size of geographic distributions, and we discuss the advantages and disadvantages of the three methods in our case study.

GS1 – Systematics, Evolution and Genetics

From *Lepus tanaiticus* Gur. to *Lepus timidus* l. , the solution of that evolutional passage

Nocolay Ovodov

Institute of Archaeology and Ethnography, Russian Academy of Sciences, e-mail: ndovodov@mail.ru

In the Siberia the Pleistocene *Lepus tanaiticus* Gur. extinct with mammoths, bisons and horses in the geological understanding simultaneously. This hare was mainly herbivorous. The evidence of the this fact are the gentle outwards radius upper (16 - 20,5 - 25 mm; n=28 specimens) and down (27 - 34,5 - 44 mm; n = 42 specimens) incisors. Late Pleistocene hare be came the covered by snow food with the help by numerous tracks a feeding ungulates animals and mammoths. This species had pass on to the branch food in winter time after extinction mammoths and big ungulates. The radius of the incisors in the some populations of the *Lepus tanaiticus* was reduce according to this reason. The outwards radius of the upper incisor of the Holocene *Lepus timidus* make (10 -11, 04 -12 mm; n=12 specimens), down incisors (14 – 16,5 – 22 mm; n = 26 specimens). The Mountain Hare clear separated from the Late Pleistocene hare by this morphological peculiarity. The first species acquired more light skeleton for comfortable movement on the friable snow gradually. Among Early Holocene materials from Yeleneva Cave (Yenisey River, Krasnoyarsk, East Sayan) were discovered remains of the hares with transitional form of the incisors.Thus, *Lepus tanaiticus* evolved in the *Lepus timidus* during 2-3 millennia.

GS1 – Systematics, Evolution and Genetics

Molecular phylogeny of *Lepus* (Mammalia: Lagomorpha): a phylogenetic assessment including all the Mexican species

J. P. Ramírez-Silva[1], F. X. González-Cózatl[2], E. Vázquez-Domínguez[3] and F. A. Cervantes Reza[4]

[1]Programa de Biología, Universidad Autónoma de Nayarit, Ciudad de la Cultura "Amado Nervo". Tepic, Nayarit 63155, México. E-mail: pablor@nayar.uan.mx
[2]Centro de Educación Ambiental e Investigación Sierra de Huautla, UAEM, Av. Universidad 1001, Col. Chamilpa, Cuernavaca, Morelos, 62210, México. E-mail: xavier@buzon.uaem.mx
[3]Departamento de Ecología de la Biodiversidad, Instituto de Ecología, Universidad Nacional Autónoma de México, Ap. Postal 70-275, Ciudad Universitaria, México, DF., 04510, México. E-mail: evazquez@ecologia.unam.mx
[4]Departamento de Zoología, Instituto de Biología, Universidad Nacional Autónoma de México, Ap. Postal 70-153, México, DF, 04510, México. E-mail: fac@ibiologia.unam.mx

Lepus is the most diverse genus within the family Leporidae (Lagomorpha), with a worldwide distribution. The objective of this study was to evaluate the phylogenetic relationships and origin of hares and jackrabbits from the genus *Lepus*, and particularly in the Mexican species. We analyzed 51 complete cytochrome b sequences belonging to 23 *Lepus* species distributed across Asia, Africa, Europe and America. We performed phylogenetic tree reconstruction with Neighbor-joining, Maximum Parsimony and Maximum Likelihood. We also evaluated the genetic structure via nucleotide divergence and genetic distance and, for the Mexican species; a minimum spanning network and a Mantel test were done. We found five main phylogenetic groups that corresponded well with the geographical distribution of the species; one group included the American species, three other corresponded to Mexican, African and European species, and a last one grouped Asiatic and Artic species. Our study represents one of the most complete sampling of *Lepus*, in terms of number of species and geographical scope. We confirmed that the most plausible origin of *Lepus* was from North America (*Lepus americanus*). The Mexican species formed a monophyletic group, which showed geographical structuring and a rather high genetic differentiation.

GS1 – Systematics, Evolution and Genetics

Origin and present status of the Sardinian hare (*Lepus capensis*) assessed by morphometrical and molecular analyses

M. Scandura[1], A. Cossu[2], L. Lacolina[3], R. Foddai[4], N. Cappai[5], H. B. Slimen[6], F. Suchentrunk[7] and M. Apollonio[8]

[1,2,3,4,5]Department of Zoology and Evolutionary Genetics, University of Sassari Via Muroni 25, 07100 Sassari, Italy, e-mail: scandura@uniss.it
[6]Laboratory of Molecular Genetics, University of Tunis, Tunisia
[7]Research Institute of Wildlife Ecology, University of Veterinary Medicine Vienna, Austria
[8]Department of Zoology and Evolutionary Genetics, University of Sassari Via Muroni 25, 07100 Sassari, Italy

Hares are not part of the Pleistocene fauna of Sardinia but are likely to have been introduced from other regions of the Mediterranean basin during the Phoenician-Punic colonization. They are considered to belong to a taxon (*Lepus capensis*) which is not found elsewhere in Europe. In order to clarify the origin of the Sardinian population and to check for the effects of geographic isolation, we conducted a genetic and morphometric study. First, we performed a multivariate analysis of skull measurements to compare Sardinian hares (n = 26) with North African and European hares (n = 114, from several locations). Second, we sequenced a hypervariable portion of the mtDNA control region in 58 Sardinian hares and aligned them to >200 Old World hare sequences downloaded from GenBank. In both morphometrical and phylogenetic analyses the Sardinian sample clustered with North African hares. The 20 different mtDNA haplotypes observed in Sardinian hares are partitioned into two haplogroups, which are also found in Tunisian hares, but no haplotype is shared by the two populations. On the contrary, the divergence from hares inhabiting all other sampled circum-mediterranean populations is huge. As regards the recent worry raised by the suspect that introductions of continental brown hares (*L. europaeus*) into Sardinia might have polluted the island gene pool, no sign of introgression into the matriline was detected. Finally, we analysed seven autosomic microsatellites showing high levels of variability in the Sardinian population (H_e=0.706). Assignment tests performed on the obtained genotypes allowed to exclude any sign of hybridization with *L. europaeus* for almost all individuals (96%). These results demonstrate that Sardinian hares have a North-African origin, but seem to suggest a strong genetic drift since its introduction. In addition, the effect of recent human-mediated gene flow with continental populations, yet apparently low, can possibly affect the ongoing level of differentiation.

GS1 – Systematics, Evolution and Genetics

Is female brown hare (*Lepus europaeus*) reproductive success influenced by MHC and microsatellite variability?

S. Smith[1], J. G. de Bellocq[2], C. Zeitlhofer[3], K. Hackländer[4] and F. Suchentrunk[5]

[1]Research Institute of Wildlife Ecology, University of Veterinary Medicine Vienna, Savoyenstr. 1, 1160 Vienna, Austria,
[2]Research Institute of Wildlife Ecology, University of Veterinary Medicine Vienna, Savoyenstr. 1, 1160 Vienna, Austria,
[3]Institute of Wildlife Biology and Game Management, University of Natural Resources and Applied Life Sciences, Gregor-Mendel-Str. 33, 1180 Vienna, Austria,
[4]Institute of Wildlife Biology and Game Management, University of Natural Resources and Applied Life Sciences, Gregor-Mendel-Str. 33, 1180 Vienna, Austria,
[5]Research Institute of Wildlife Ecology, University of Veterinary Medicine Vienna, Savoyenstr. 1, 1160 Vienna, Austria

Diversity at MHC loci is thought to play an important role in individual and population fitness. In particular, increased heterozygosity is often suggested to confer a selective advantage by enhancing resistance to infections and improving the rate of implantation for successful reproduction (the heterozygote advantage hypothesis). In this study we examine female reproductive success as one component of fitness in two populations of European brown hares. We contrast this with variability at the DQA gene (a class II MHC locus) and eight presumably neutral microsatellite loci. Samples were collected from hunting grounds in eastern Austria and Belgium, representing continental and Atlantic climates, respectively. Reproductive success, as measured by the presence or absence of uterine placental scars, was significantly higher in the Austrian population (97.8% of adult females) compared to the Belgian population (81.8 %, p=0.037)). This difference was unrelated to body size and body condition and was not compensated for by a significant increase in the number of placental scars per individual. There were

seven DQA alleles and 15 different genotypes detected in the Austrian population compared to six alleles and eight genotypes in Belgium. There was no difference between the populations in terms of individual MHC heterozygosity. A trend towards an association between homozygosity at this locus and a failure to reproduce was observed for the Belgian population with 75% of non-reproductive adult females being homozygous. Heterozygosity at the DQA locus was not associated with average individual microsatellite heterozygosity for either population. The level of population subdivision as measured by F_{ST} was low (0.029), although still significant. Average expected heterozygosity for microsatellites was similar in the two populations (Austria=0.59±0.04, Belgium=0.61±0.06) indicating limited differences between the two populations in relation to population genetic factors. Our data cannot reject the hypothesis that female reproductive success is influenced by MHC variability and further analysis with increased sample sizes is expected to display this association more clearly. Funding was provided by the “Austrian Science Fund” (FWF) pr.-nr. P18534-B03 granted to F. Suchentrunk. JGB is currently a post-doctoral fellow with the Fund for Scientific Research-Flanders (FWO).

GS1 – Systematics, Evolution and Genetics

Microsatellite variation in brown hares (*Lepus europaeus*) from the mtDNA introgression zone in NE Greece and other Greek popoulations

F. Suchentrunk[1], H. B. Slimen[2], C. Stamatis[3] and Z. Mamuris[3]

[1]Research Institute of Wildlife Ecology, University of Veterinary Medicine Vienna, Savoyenstr.1, 1160 Vienna, Austria. E-mail : franz.suchentrunk@vu-wien.ac.at,
[2]Laboratoire de Génétique Moléculaire, Immunologie et Biotechnologie, Faculté des Sciences de Tunis, Campus Universitaire El Manar, 2029 Tunis, Tunisia
[3]Deptartment of Biochemistry and Biotechnology, University of Thessaly, 26 Ploutonos Str., 41221 Larissa, Greece

Brown hares from Thrace, NE Greece, carry mitochondrial HV1 haplotypes belonging to two major phylogenetic clades, the A-clade and the B-clade, which are estimated to have formed in allopatry 105.000-490.000 years BP. The former clade encompasses typical Anatolian lineages, whereas the latter represents lineages typical for Europe. The formation of an overlap zone in brown hares from Bulgaria and NE Greece (and probably also from Turkish Thrace) where lineages of both clades coexist is considered to have resulted from natural gene flow from Anatolia to the SE Balkans before the disintegration of the late-Pleistocene/ early-Holocene land bridge between Asian Minor and SE Europe. This inferred phylogeographical scenario suggests higher nuclear gene pool diversity in the overlap zone compared to regions where only B-clade lineages are found. Here, we studied the structuring of genetic diversity in 179 hares from seven regions in Greece by 13 highly variable microsatellite loci, with particular emphasis on NE Greece. We examined possible nuclear gene pool effects due to the inferred ancient introgression of typical Anatolian lineages in Thrace. Among all 140 alleles detected, 17.9 % were “private alleles”, i.e., present in only one population, respectively; but their frequencies were low (<10%). For NE Greece the number of private alleles (4) was well within the range revealed for the other populations with

only B-calde haplotypes (0-7). F-statistics indicated a low to moderate level of regional differentiation, with no particular separation of hares from NE Greece. Also, there was no significant genetic differentiation (F_{ST}) between hares with A- and B-clade mtDNA in Thrace. Similarly, based on two different Bayesian admixture models (STRUCTURE program), hares from Thrace could not be probabilistically assigned correctly to two different groups congruent with the A or B-clade haplogroups. However, a further Bayesian classification model (GENECLASS program) correctly assigned hares with European-type mtDNA (85.7%) and hares with Anatolian-type mtDNA (91.6%) from Thrace to their respective group. However, hares from other regions under study were correctly classified to their respective population in only 68.1%. Our results indicate high genetic diversity with some regional structuring in Greek hares. The Bayesian approaches partly suggested a little gene pool effect due to hares with introgressed Anatolian-type mtDNA in NE Greece, whereas private alleles and F-statistics failed to do so.

GS1 – Systematics, Evolution and Genetics

Variation of skull shape and size in cape hares (*Lepus capensis*) from three climatically different habitats in Kenya

F. Suchentrunk[1] and J. E.C. Flux[2]

[1]*Research Institute of Wildlife Ecology, University of Veterinary Medicine Vienna, Savoyenstr. 1, 1160 Vienna, Austria; e-mail: franz.suchentrunk@vu-wien.ac.at*
[2]*Margaret M. Flux, 230 Hill Road, Belmont, Lower Hutt, New Zealand*

To contribute to the understanding of the meaning of phenotypic and morphologic characters in *L. capensis* sensu latu and to help understanding morphological variation within this taxon in the ecological context, we examined skull shape and size of 165 adult-sized cape hares from a hot and dry habitat (Magadi, n=56; 29°C, 410mm annual rainfall), a cooler and humid habitat (Akira, n=52; 18°C, 772mm), and a climatically intermediate habitat (Olorgesailie, n=57; 24°C, 605mm) in the Rift Valley in Kenya. There were no major ecological or physiographic barriers hindering gene flow between those habitats. We performed a principal components analysis (PCA) based on the variance-covariance matrix of 27 appropriately transformed metric variables to describe skull shape, with fully excluding any size influence, and we used condylobasal length (CBL) to indicate skull size. CBL did not vary significantly ($p=0.264$) across the three habitats, and was not influenced by skull age category ($p=0.085$), but differed between the sexes ($p=0.001$; 3-way ANOVA). The PCA extracted eight principal components (PCs) with eigenvalues over 1.0 times mean eigenvalues, which explained 75.8% of the total shape variance. However, the morphological interpretation of the PCs, as resulting from correlations of individual PC scores and transformed values entered into the PCA, yielded quite complex shape components. Of these, two were negatively correlated with CBL, which indicated static allometry. A 3way-MANCOVA of individual PC scores of all eight PCs indicated significant ($p<0.0005$) variation across the three habitats as well as between sexes ($p=0.03$), and confirmed the dependence on CBL ($p<0.0005$). However, a closer examination of the variation of individual PC scores across the three habitats revealed variation only for PC2 ($p=0.002$) and PC4 ($p=0.004$), which together accounted for 23.4% of the total shape variance, and which did not represent particularly simple shape components. In conclusion, our eco-morphological study revealws comparatively little variation of the skull shape across the three ecologically different habitats and no size variation. The latter finding is in discordance with Bergmann´s rule. The small effect of the pronounced climatic differences between the three tropical habitats on the skull shape might reflect weak ecogenetic causation relative to phylogenetic causation of the encountered morphometric variation in the examined skulls.

GS1 – Systematics, Evolution and Genetics

Diversity and evolutionary history of the MHC DQA gene in leporids

A. Surridge[1,2], W. van der Loo[3,4], J. Abrantes[3,4], M. Carneiro[3,4], G. Hewitt[2] and P. J. Esteves[3,5]

[1] Department of Zoology, University of Cambridge, Downing Street, Cambridge CB2 3EJ, UK. E-mail: A. K. Surridge: aks59@cam.ac.uk
[2] School of Biological Sciences, University of East Anglia, Norwich NR4 7TJ, UK. E-mail: G. M. Hewitt: g.hewitt@uea.ac.uk
[3] CIBIO/UP, Centro de Investigação em Biodiversidade e Recursos Genéticos, Universidade do Porto, Campus Agrário de Vairão, R. Padre Armando Quintas – Crasto, 4485-661 Vairão, Portugal. E-mail: W. van der Loo: wvdloo@mail.icav.up.pt
[4] Departamento de Zoologia e Antropologia da Faculdade de Ciências da Universidade do Porto, Porto, Portugal. E-mail: M. Carneiro: miguel.carneiro@mail.icav.up.pt
[5] Centro de Investigação em Tecnologias da Saúde (CITS), ISPN, CESPU, Gandra, Portugal. E-mail: P.J. Esteves: pjesteves@mail.icav.up.pt

The European rabbit (*Oryctolagus cuniculus*) is used as a model for many human diseases, yet comparatively little is known of its genetics, particularly at important loci such as the major histocompatibility complex (MHC). The vertebrate MHC contains genes important for the immune response. Class I and class II gene products present antigens to T cells and typically show high levels of polymorphism. The class II region contains gene clusters (DR, DQ, DO, DN, DM and DP). Each gene cluster contains genes coding for an α chain and a β chain which are grouped together. The basic order of mammalian class II genes was probably established early in the divergence of the placental mammals and has been subject to some rearrangement. The rabbit has a single DQA gene in the DQ cluster. This study investigated genetic diversity and evolutionary history of the DQA gene in a range of leporid species by analysing coding sequence diversity of exon 2 and intron 2 in 53 individuals of 16 different species. Fifty leporid DQA alleles were detected, including 13 novel European rabbit alleles. In the rabbit, the highest levels of diversity were observed in wild rabbits from Portugal, with wild rabbits from England and domestic rabbits showing less diversity. Within the sample, several recombination events were detected and trans-specific evolution of alleles was evidenced, both being general characteristics of mammalian MHC genes. Positive selection is implicated as operating on six codons within exon 2, which are also subject to positive selection in other mammals. Some of these positions are putative antigen recognition sites and underline the importance of pathogen driven selection on these MHC genes.

GS1 – Systematics, Evolution and Genetics

Phylogeographical analysis of mountain hares (*Lepus timidus varronis*) from Eastern Switzerland: is there a genetic signature of postglacial immigration?

F. Zachos[1], M. Giacometti[2], K. Hackländer[3] and F. Suchentrunk[4]

[1]Zoological Institute, Christian-Albrechts-University, Olshausenstr. 40, 24118 Kiel, Germany, e-mail: fzachos@zoologie.uni-kiel.de
[2]WildVet Casa Piz Duan, Stampa, post box 2, 7605 Stampa, Switzerland,
[3]Institute of Wildlife Biology and Game Management, University of Natural Resources and Applied Life Sciences, Gregor-Mendel-Str. 33, 1180 Vienna, Austria,
[4]Research Institute of Wildlife Ecology, University of Veterinary Medicine Vienna, Savoyenstr. 1, 1160 Vienna, Austria

Postglacial immigration of mountain hares into their present range in the Alps may have occurred from evolutionarily diverse sources north and south of the Alps, where they had roamed during the Late Glacial Maximum (LGM), when most of the Alps were covered by ice. Here, we studied whether mountain hares currently roaming the eastern Swiss Alps showed a significant phylogeographic signature concordant with such a likely postglacial immigration scenario. We screened a total of 100 specimens from different locations across the cantons of Grisons and Glarus for allelic variability at 31 isozyme loci and sequenced a 443 bp long fragment (HV1) of the mitochondrial control region. All nine polymorphic enzyme loci showed similar allele frequencies in the four regional populations considered, with not significant values of relative genetic differentiation (F_{ST}) in pair-wise comparisons. Accordingly, both a spatial autocorrelation analysis and a STRUCTURE analysis (admixture model with correlated alleles) based on the nine polymorphic loci indicated no significant spatial-genetic structuring of the samples. The 17 HV1 haplotypes revealed showed relative shallow phylogenetic differentiation as indicated by both tree-building procedures (neighbor joining and maximum parsimony analyses) and a network analysis. However, a spatial

autocorrelation analysis revealed a significant shallow geographic structure in the haplotype distribution, congruent with the interpretation of slightly restricted mtDNA dispersal. All findings indicate high gene flow among the mountain hares in eastern Switzerland as well as almost panmictic population structure. They also suggest that postglacial immigration into the study area, which is right in the centre of the Alpine arch, has most likely occurred from source populations with relatively little evolutionary divergence. This is in accordance with earlier allozyme, mtHV1 sequence, and partly also microsatellite data of mountain hares, which showed little gene pool differentiation across large parts of Europe. We thank Peider Ratti and Hannes Jenny and their colleagues from the Office of Game Management and Fisheries of Grisons as well as Ch. Rühlé from the Game Mamagement office of Glarus for their support and the hunters for collecting hare samples.

GS1 – Systematics, Evolution and Genetics

Dental enamel comparison of the molariforms of Mexican hares (Leporidae: *Lepus*)

A. Romero-Palacios and F. A. Cervantes

Colección Nacional de Mamíferos, Departamento de Zoología, Instituto de Biología, Universidad Nacional Autónoma de México, Apartado Postal 70-153, 04510 México, D. F., acrp@ibiologia.unam.mx, fac@ibiologia.unam.mx

There are controversy about the relationships of Mexican hares and exists hypothesis with different tools that they leave from morphology, genetics and molecular biology. Unfortunately, none approaches at the same time to the five species from Mexico (*Lepus flavigularis, L. callotis, L. alleni, L. californicus* and *L. insularis*). Today there are not hypothesis of this relationships based on the comparison of dental enamel of molariforms, which are informative elements for systematic ends and with people have been able to described fossil and current species.The patterns of enamel of this Mexican hares were described using the P^2, P^3 and P_3 premolars of mature specimens. The data were included in a matrix to carry out tests in PAUP 4.0 for Macintosh, to obtain phylogenetic trees following the approach of parsimony that gave us sample of the relationships among the species. It was found that the most variable molariforms were the P_3 and P^2 premolars. As a results we have that *L. insularis* is more similar to *L. californicus* since presents a simple dental enamel pattern that any other one, while *L. alleni* presents a particularly complex pattern as for the number of pleats and forms of the enamel, but more similar to the group of *L. callotis* and *L. flavigularis* that to the first ones. We concluded that this characters allow to distinguish the pattern of the dental enamel, which shows little variation inside the species, although more significant among species. The results indicate a good characters that we could be used like support for later studies about the phylogenetic relationships of leporid species.

GS2 – Ecology, Population dynamics and Dispersal

Dispersal of the European hare (*Lepus europaeus*) in South America

N. Bonino[1], D. Cossios[2] and J. Menegheti[3]

[1] National Institute of Agricultural Technology, Department of Natural Resources, P.O. Box 277, 8400 Bariloche (RN), Argentina. E-mail: nbonino@bariloche.inta.gov.ar
[2] Montreal University, Department of Biological Sciences, C.P. 6126, Montréal QC. H3C 3J7, Canada. E-mail: dcossios@yahoo.com
[3] Federal University of Rio Grande do Sul, Institute of Biosciences, Av. Bento Gonçalves 9500, Porto Alegre (RS), Brazil. E-mail: meneghet@vortex.ufrgs.br

The first introduction of the European hare in South America occurred around 1880, into several regions of Argentina. From these points the species spread and invaded neighboring countries. In 1983, the status and geographic distribution of this exotic species was determined and shown to behave like an invasive alien species. The objectives of this study were to update the geographic distribution of the European hare in Argentina, Chile, Peru, Bolivia, Paraguay, Brazil, and Uruguay and to estimate the dispersal rate of this invasive species in South America. Data were collected in three ways: bibliographical compilation, informal interviews and direct observations. All of the information was georeferenced into a digitalized map in order to determine the current geographic distribution and the dispersal velocity of this invasive species. According to our results the current geographic distribution of the European hare covers practically all of Argentina and Chile, southeastern Peru, southwestern Bolivia, southeastern Paraguay, the central part of southern Brazil, and all of Uruguay. During the process of invading new areas, the hare has occupied very dissimilar environments, from the bushy steppes and Andean deserts of Bolivia and Peru to the dry and humid forests and wooded savannahs of Paraguay and Brazil. This could explain the dispersal rates that varied between 10 and 37 km/year in different places.

GS2 – Ecology, Population dynamics and Dispersal

The role of *Juniperus deppeana* seed dispersal by *Sylvilagus floridanus* in a semiarid region of Mexico

J. Campos J. and A. J. Martínez C.

Instituto de Neuroetología, Universidad Veracruzana. E-mail: kelly_cj@hotmail.com and armartinez@uv.mx

Lagomorphs have been considered as specialized secondary dispersers, but there is limited research on the topic. Nevertheless, it is clear that latrine formation favors seed dissemination and distance from parental crowns. The aim of the present study was therefore to evaluate the role of *Sylvilagus floridanus* as a potential spatio-temporal dispersal agent of *J. deppeana* var. *deppeana* seeds in a disturbed fragment of the semiarid zone of Veracruz-Puebla, Mexico. For this purpose, the following microhabitat factors were identified on a 14.5 hectare area: latrines, male and female *Juniperus* trees, and control sites. On five recording dates, all fresh cottontail rabbit pellets were collected on a $4m^2$ surface in each microhabitat. We recorded a total of 74 latrines, 33 male and18 female trees, and 74 control points, at which we collected a total of 20926 pellets. From these, 59% were deposited in latrines, 21% under female tree crowns, 14% under male trees crown, and 6% at control sites. From the total number of pellets collected, only 8% (1618 pellets) had *J. deppeana* var. *deppeana* seeds. However, during a repeated collection, a temporary variation in the average number of pellets and dispersed seeds was obtained for these microhabitats. On average, far more pellets and seeds were deposited under tree crowns than at latrines. Therefore, we conclude that *J. deppeana* var. *deppeana* seed distribution by *S. floridanus* depends on microhabitat preference use, which possibly is influenced by foraging behavior and fruit availability in fragmented habitats.

GS2 – Ecology, Population dynamics and Dispersal

Resting and feeding sites of the Tehuantepec jackrabbit, an endangered lagomorph: conservation implications

A. Carrillo-Reyes[1], C. Lorenzo[2], E. Naranjo[3], M. Pando[4] and T. Rioja[5]

[1,2,3,5]El Colegio de la Frontera Sur, Departamento de Ecología y Sistemática Terrestres, Carretera Panamericana y Periférico Sur s/n. C.P. 29290, San Cristóbal de Las Casas, Chiapas, México. Tel. +52 (967) 6749000, ext.1309. E-mail: acarrillo@oikos.org.mx[1]; clorenzo@ecosur.mx[2]; enaranjo@ecosur.mx[3]; trioja@oikos.org.mx[5]
[4]Facultad de Ciencias Forestales, Universidad Autónoma de Nuevo León. Carretera Panamericana km 145 s/n, Linares, N. L. México. E-mail: mpando@fcf.uanl.mx[4]

The Tehuantepec Jackrabbit, an endangered mammal, is the *Lepus* species with the southernmost distribution in America, and there was no previous information on its feeding and resting sites characteristics. Between June 2006 and January 2008, 60 adult radio-collared jackrabbits were monitored in Santa Maria del Mar, Oaxaca, Mexico. We register 171 resting sites (RS), of which 24 % was characterized, and 168 feeding sites (FS), of which 26.19 % was characterized. Twenty variables was measured in every site; a principal components analysis (PCA) were used to identify the most important variables. RS has a high coverage of herbaceous and high values of visual obstruction, probably owed to that the vegetation structure provides protection from predators and environmental adverse conditions. Jackrabbit prefers RS far away from the principal town, this variable is related to the presence of feral and domestic dogs; these were identified as the principal predator of the Tehuantepec hare in Santa Maria of Mar. FS shows a low visual obstruction, probably because jackrabbits can reach a very wide visual field, which will facilitate it to observe predators at large distances and to increase its possibilities of escape. As with the RS, we found that FS was far away from the principal town, probably due to the same reason quoted previously. Our results highlight the need to preserve the structure of the grassland ecosystem to assure that the Tehuantepec jackrabbit should find suitable places to rest and feed. Also highlight the urgent need to control the increasing population of feral and domestic dogs in Santa Maria of Mar. This information will be fundamental to development of programs of management and conservation of this species.

GS2 – Ecology, Population dynamics and Dispersal

Home range and habitat selection of free-ranging Iberian hares (*Lepus granatensis*) in Doñana National Park (SW Iberian Peninsula)

F. Carro[1], R. C. Soriguer[1], J. F. Beltrán[2] and A. C. Andreu[1]

[1]Estación Biológica de Doñana (C. S. I. C.); Avenida María Luisa, s. n.; Pabellón del Perú; 41013, Sevilla, Spain. pcarro@ebd.csic.es; soriguer@ebd.csic.es;; acandreu@ebd.csic.es
[2]Department of Physiology and Zoology, University of Seville, Avda. Reina Mercedes, 41012 Sevilla, Spain. jfbeltran@us.es

The Iberian hare is a common and abundant species throughout most of Iberian Peninsula. However, studies documenting its ecology are very rare. This prompted us to carry out a study using radiotagged individuals in two areas of the Doñana National Park, SW Spain: ecotone and marshland which differences in habitat quality. Hares were captured using vertical nets during the years 1996 and 1997. A total of 66 hares were captured, 21 adult hares (13 females and 8 males) were tagged with radio-collars. Between August 1996 and September 1997, hares were located by triangulation on a daily basis at least once a week. The average home range size in the ecotone was 28 ha for males and 24 ha for females. No significant differences were observed neither between sexes nor seasons (summer vs. winter). In the marshland area the average of male home ranges (44 ha) were larger than those of females (11 ha), although this difference was not significant.
Habitat use was estimated using a geographical information system (GIS). Nine habitat types were recognized. The availability percentage was taken as the relative presence of each habitat within the total surface area. Habitat selection was established by means of Ivlev's Index. In the ecotone zone, significant differences were observed in habitat in scrub areas and in dry pastures. During the dry and wet seasons males and females were most often located in the pastures of ecotone, rush stands and scrub. On the other hand, the stands of *Pteridium aquilinum* and *Scirpus maritimus* were avoided. These results are the first on the spatial ecology of this species in their native habitat and provide a basic reference for the ecology of this endemic species to the Iberian Peninsula.

GS2 – Ecology, Population dynamics and Dispersal

The rabbit's ecosystem: a review of the multifunctional key role of European rabbits (*Oryctolagus cuniculus*) in Mediterranean South-Western Europe

M. Delibes-Mateos[1,2*], M. Delibes[3], J. Fernández de Simón[2], P. Ferreras[2] and R. Villafuerte[2]

*[1]Departamento de Biología Animal, Universidad de Málaga 29071 Málaga (Spain). *E-mail: mdelibesmateos@gmail.com*
[2]Instituto de Investigación en Recursos Cinegéticos (IREC, CSIC-UCLM-JCCM) Ronda de Toledo s/n 13005 Ciudad Real (Spain)
[3]CSIC, Dept Applied Biology, Estación Biológica de Doñana, ES-41013 Seville, (Spain)

Mediterranean areas are considered to be important centres of biodiversity. To conserve these hotspots it is necessary to preserve the main functions and processes regulating their dynamics. Among other considerations, this relies on identification of species having a special role in the ecological relationships of the system (termed keystone species). We reviewed the role of European rabbits (*Oryctolagus cuniculus*) as a multifunctional keystone species in the Iberian Peninsula portion of the Mediterranean Basin hotspot. Rabbits serve as prey for > 40 predators, including the critically endangered Iberian lynx (*Lynx pardinus*) and Spanish imperial eagle (*Aquila adalberti*). Moreover, they conspicuously alter plant species composition and vegetation structure through grazing and seed dispersal, creating open areas and preserving plant species diversity. Rabbit burrows additionally provide nest sites and shelter for vertebrates and invertebrates. Finally, rabbit latrines have a demonstrable effect on soil chemical fertility and plant growth, and also provide new feeding resources for many invertebrate species. Thus, rabbits affect major ecosystem processes and consequently biodiversity conservation in the Mediterranean scrubland ecosystem of the Iberian Peninsula. The role of rabbits is so important in this area that it should be termed "the rabbit's ecosystem". Rabbit populations have drastically declined on the Iberian Peninsula during recent decades, and this could have important cascading effects on the functioning of the Iberian Mediterranean ecosystem, with serious ecological and economic consequences. From this perspective, rabbit recovery is one of the biggest challenges for nature conservation in this biodiversity hotspot.

GS2 – Ecology, Population dynamics and Dispersal

Desert lagomorphs and hunting strategies of their mammalian carnivore predators

C. Elizalde-Arellano[1]*, J. C. López-Vidal[1], L. Hernández[2] and J. W. Laundré[2].

[1]Laboratorio de Cordados Terrestres, Departamento de Zoología, Escuela Nacional de Ciencias Biológicas, IPN. Carpio y Plan de Ayala s/n. Santo Tomás, México D. F. 11340, México. E-mail: thiadeno@hotmail.com; jclvidal@hotmail.com
[2]Instituto de Ecología A.C., Centro Regional Durango, km 5 Carretera Durango-Mazatlán 34100, Durango, México. E-mail: hernluci@hotmail.com; launjohn@hotmail.com

Lagomorphs are the most common prey in bobcats (*Lynx rufus*) and coyotes (*Canis latrans*) diets in many areas where they coexist. Is widely acepted that bobcats and coyotes have different hunting styles: bobcats stalk their prey and coyotes pursue them, while their lagomorph prey have different motility styles, jackrabbits travel longer distances than rabbits and spend more time in areas without vegetation, while rabbits stay near bushes. These traits represent two prey species with different motiliy abilities for predators with different hunting strategies then, we expect that bobcats and coyotes will eat different proportion of jackrabbits and rabbits as response of these traits. Our objective was to analyze the diet of bobcats and coyotes to know if such differences can be evident. Bobcat and coyotes scats were colected in flat and rocky areas in Mapimi Biosphere Reserve in Chihuahuan Desert, Durango, Mexico from 2005 to 2006, where the diet of these predators is based on lagomorphs, black-tailed jack-rabbits (*Lepus californicus*) and cottontail rabbits (*Sylvilagus audubonii*). Scats were dried and disgregated by hand, their contents were separated, analized and compared with reference collections. We colected 50 bobcat scats and 102 coyotes scats. Mammals show highest proportion in diet of both predators: bobcats (proportion prey: mammals 84.7, plants 6.9, insects 2.8, reptiles 1.4, other 4.2) and coyotes (mammals 65.2, plants 26.6, insects 3.8, reptiles 2.7, other 1.6). Rodents show higher proportions than lagomorphs for both carnivores: bobcats (Lagomorphs 37.5, rodents 45.8, plants 6.9, other 9.7), coyotes (lagomorphs 24.5, rodents 40.8, plants 26.6, other 8.2). Rabbits and jackrabbits were in similar proportions in the diet of bobcats (*Lepus* 15.3, *Sylvilagus* 15.3) and coyotes (*Lepus* 10.9, *Sylvilagus* 10.3). Bobcats and coyotes ate more rodents than lagomorphs (although more samples analysis is needed), there was no difference between them eating *Lepus* or *Sylvilagus* prey.

GS2 – Ecology, Population dynamics and Dispersal

Habitat Use of Volcano and Cottontail Rabbits in Pelado Volcano, México

Y. García Feria and V. Farías

Lab. Análisis Espaciales, Depto. Zoología, Instituto de Biología, Universidad Nacional Autónoma de México. 3er Circuito Exterior s/n, Ciudad Universitaria 04510 Coyoacán, México D.F., México.
Email: bioyagf@yahoo.com.mx, vfarias@ibiologia.unam.mx

Studies about habitat use patterns of sympatric rabbits are pioneering in México. For conservation purposes, it is necessary to determine habitat requirements for less tolerant leporid species that may be displaced by leporid species tolerant to human activities and disturbances. The volcano rabbit (*Romerolagus diazi*) or zacatuche is particularly sensible to the effects of habitat loss and fragmentation due to its poor tolerance to perturbation and to its restricted geographic distribution. Zacatuches are habitat specialists and their populations survival is closely linked to conservation of its habitat in template forests and high altitude grasslands. The ecological study and conservation of the volcano rabbit are priorities due to the unique biological characteristics of this endemic species of México which is critically endangered with extinction. Zacatuche populations occur in the central region of the Trans-Mexican volcanic belt between altitudes of 2800 and 4250 m, and are sympatric with Mexican cottontails (*Sylvilagus cunicularius*) and eastern cottontails (*Sylvilagus floridanus*). We aim to determine and compare habitat selection between sympatric volcano and cottontail rabbits in the locality known as Paraje La Rosa, in Pelado Volcano, México. Habitat use patterns and relative abundances of sympatric volcano and cottontail rabbits will be evaluated by pellet counts in the study area, throughout a year. In addition, we plan to radiotrack volcano and cottontail rabbits of different age and sex; individuals will be fitted with VHF transmitters. Capture efforts started with the use of Tomahawk traps, and a net trap (developed by Jorge Vázquez, Centro Tlaxcala de Biología de la Conducta, UNAM - UAT). (Supported by DGAPA-PAPIIT Project IN221208, and IDEAWILD).

GS2 – Ecology, Population dynamics and Dispersal

Characteristics of latrines and habitat use in *Lepus callotis* and *Sylvilagus floridanus*, sympatric species of the Trans-Volcanic Belt of Central Mexico

José Luis González Gálvez[1], Armando J. Martínez Chacón[1], José G. García-Franco [2], Laura Teresa Hernández Salazar[1] and Ariadna I. Santa Anna Aguayo [1]

[1]Instituto de Neuroetología, Universidad Veracruzana, Veracruz, México. E-mail: galvezj@hotmail.com, armartinez@uv.mx, arisabelle@hotmail.com, herlats@yahoo.com
[2]Instituto de Ecología A.C. Veracruz, México. E-mail: jose.garcia.franco@inecol.edu.mx

In heterogeneous environments, lagomorphs can choose between different types of habitat and levels of plant cover, although they must make trade-offs on the basis of how they perceive the landscape. Lagomorph latrines are an unequivocal sign of habitat preference and use; structural characteristics of vegetation and predator-induced pressure can affect the behavior and use of these sites. In this study we evaluated spatial-temporal habitat use based on the deposition of *Lepus callotis* and *Sylvilagus floridanus* pellets on latrines. Comparison was made of dunghills in a xeric scrubland environment (malpaís) to a woodland (ecotone) with arboreal species of pine forest within the Oriental Basin Valley of the Trans-volcanic belt. We quantified lagomoph pellets deposition between climatic seasons, as well as their relation with the plant microhabitat structure; furthermore, we measured the distance between latrines and vegetation to evaluate the level of visual obstruction for leporids. There were significant differences in the amount of pellets deposited by hares and rabbits in their latrines, which season play an important role. Also, we described how plant structure influences habitat use decisions and latrine size, since in the ecotone zone is an abundant plant cover and also more hare and rabbit pellet deposition. This differs from the most arid zone, where latrine size is smaller and distance from plant cover is less. This indicates that differential habitat use by hares and rabbits is in synergy with plant structure and predator-related pressure, and seems to define coexistence patterns.

GS2 – Ecology, Population dynamics and Dispersal

Monitoring the brown hare (*Lepus europaeus*) in Germany

A. Grauer[1], E. Straußß[1], B. Heyen[2], R. Klein[2], L. Wenzelides[2], G. Greiser[3], A. Muchin[3], A. Winter[4] and U. Voigt[1]

[1] *Institute of Wildlife Research, University of Veterinary Medicine Hannover, Foundation, Bischofsholer Damm 15, 30173 Hannover, Germany. E-mail: andreas.grauer@tiho-hannover.de*
[2] *Deptartment of Biogeography, University of Trier, 54286 Trier, Germany*
[3] *Forschungsstelle für Wildökologie und Jagdwirtschaft, Landesforstanstalt Eberswalde, 16225 Eberswalde, Germany*
[4] *Deutscher Jagdschutz-Verband.e.V., 53113 Bonn, Germany*

The brown hare is one of the most important small game species in Germany. Due to the fact that hunting is not restricted and a decline in population densities can be assumed for the 1980s/90s the German hunting associations focus on assessing the brown hare population in Germany within the German Wildlife Information System monitoring program (WILD). The data serve as a base for further research, recommendations on sustainable utilisation and for decision making in conservation policy. Since 2002 Brown hares´densities are counting by spotlight in 510-706 reference areas in both spring and autumn each year. Hence, a net rate of increase can be estimated by comparing the spring and autumn densities (mean spotlight area=2,5 km²). To analyse the data, the reference areas are split up into clusters, the differing landscapes in Germany and the federal states. The population densities of Brown hare in Germany vary at local and regional level between <1 and 130 hares/km² and was on average 13 hares/km² (Median) in spring 2007. Significant differences between the brown hare abundances can be proved for the *landscapes North-eastern German lowlands* and *North-western German lowlands*. Whilst in the *North-eastern German lowlands* the average density was about 5 hares/km² and abundances of more than 15 hares/km² were rare; the average density in the *North-western German lowlands* was 23 hares/km², and most of the reference areas had abundances of >15 hares/km². Since spring 2002 stable average spring abundance can be assumed for Germany. This is proved in both the analysis of the data subset a) *all hunting grounds participating in a single year* and the data subset b) *hunting grounds participating continuously since 2002*, indicating that only the increase in subset a) from 11 (2002) to 15 hares/km² (2006) was significant. The net rate of increase, as a result of reproduction, mortality and migration, varies between 0 and 25 % (Median) all over Germany since 2002. The high net rates of increase in 2003 (20 %) and 2007 (25 %) correspond with high spring and autumn temperatures respectively high summer temperatures in those years.

GS2 – Ecology, Population dynamics and Dispersal

Preliminary data on habitat preferences in *Lepus corsicanus* and *L. europaeus* in Latium region (Central Italy)

S. Guglielmi, S. Properzi, F. Riga, A. Sorace and V. Trocchi

Istituto Superiore Protezione e Ricerca Ambientale (ISPRA). E-mail: leprecoturnice@yahoo.it, Scalisi, M. Agenzia Regionale Parchi (ARP). E-mail: scalisi.arp@parchilazio.it

The Italian Hare *Lepus corsicanus* is an endemic species of southern-central Italy and Sicily and the knowledge on its status and ecology is very scarce. Actually, the continental populations are considered *critically endangered* according to IUCN criteria. The aim of our survey is to compare habitat use of *L. corsicanus* and *L. europaeus*, in order to plan appropriate measures for the conservation of the Italian Hare. In fact, the European Hare is restocked for hunting purposes also in distributional area of *L. c.* and this could promote the occurrence of interspecific competition. Since July 2007 to July 2008, spot light census was carried out in 105 transects (on average 4.25 km ± 0.34 SE): 68 transects in protected areas (PA) (total length: 292.0 km; mean: 4.3 km ± 0.5) and 37 transects in non protected areas (NPA) (total length: 153.8 km; mean: 4.2 km ± 0.4). We observed 53 *L. corsicanus*, 88 *L. europaeus* and 20 unrecognized individuals. The frequency of the observations was higher between 3rd and 5th hour after sunset for *L. corsicanus*, whereas for *L. europeaus* was constant between 2nd and 6th hour. A 300-m buffer was drawn around each sighting location, using GIS software and land use map. Percentage cover of natural areas (woods, meadows, pastures, bushes) around the locations of *L. corsicanus* was higher than in *L. europaeus* (98.1% vs. 62.9%) whereas agricultural areas were more represented around the locations of *L. europaeus* (37.1% vs. 1.8%). Mean altitude of the observations of *L. corsicanus* (467.1 m a.s.l. ± 57.6; range: 26-1365 m a.s.l.) was lower than in *L. europaeus* (840.3 m a.s.l. ± 45.3; range: 55-1858 m a.s.l.). Abundance of *L. corsicanus* and *L. europaeus* was similar (0.20 ind./km ± 0.09 and 0.26 ind./km ± 0.06, respectively). *L. corsicanus* was more abundant in PA than in NPA (PA: 1.36 ind/km ± 0.86, min = 0 e max = 8.91; NPA: 0.52 ind./km ± 0.95, min = 0 max = 1,14). Similar abundances were observed for *L. europaeus* (PA: 0.73 ind./km ± 0.11, min = 0 max = 2.23; NPA: 0.73 ind/km ± 0.27, min = 0 max = 2.96). The results indicate that *L. corsicanus* inhabit areas closer to natural environments and placed at lower altitude as compared to *L. europaeus*.

GS2 – Ecology, Population dynamics and Dispersal

Factors associated with survival of reintroduced riparian brush rabbits in California

L. P. Hamilton[1,2], D. A. Kelt[2], H. U. Wittmer[2], P. A. Kelly[1] and D. F. Williams[1]

[1]California State University, Stanislaus Endangered Species Recovery Program Department of Biological Sciences Turlock, California 95382, USA. Phone: 00-1-209-667-3550 Email: lphamilton@ucdavis.edu Web Site: http://esrp.csustan.edu
[2]University of California, Davis Department of Wildlife, Fish, & Conservation Biology One Shields Avenue, Davis, CA 95616, USA

The riparian brush rabbit (*Sylvilagus bachmani riparius*) is an endangered species found in dense, brushy habitat in the Central Valley of California. We implemented a reintroduction program to bolster populations at a federal wildlife refuge and to assess factors influencing release mortality and subsequent survival. Between July 2002 and July 2005, we reintroduced 344 captive-bred individuals to unoccupied habitat within their historic range using a soft-release strategy (rabbits were partially acclimated by temporary detention in fenced enclosures at the release sites), and monitored their survival with radiotelemetry. Rabbits were most susceptible to post-release mortality during the first four weeks following reintroduction. Both body mass and length of time in the soft-release enclosure influenced this relationship. When we controlled for release mortality during this acclimation period, subsequent survival was most strongly influenced by release year (year 1 vs. years 2 and 3), a catastrophic flooding event, animal mass, and length of time in the soft-release enclosure. Longer time in soft-release pens resulted in increased survival, but this relationship was not steep (e.g., survival increased from ca. 89% to ca. 93% when time in pens increased from 1 to 10 days) and further work should assess the costs associated with raising additional rabbits vs. that associated with building and maintaining release pens. Cause of mortality was unknown for the majority of deaths (61.9%), but predation (including presumptive predation) was the greatest known cause of death in translocated rabbits (26.4%). Flood history and available refugia must be considered when evaluating parcels for rabbit reintroduction in frequently inundated locations. Additionally, riparian brush rabbit release sites should have sufficient high ground to provide refugia in the event of flooding.

GS2 – Ecology, Population dynamics and Dispersal

Spatial ecology and habitat selection of a translocated population of riparian brush rabbits

L. P. Hamilton[1,2], D. A. Kelt[2], P. A. Kelly[1] and D. F. Williams[1]

[1]California State University, Stanislaus Endangered Species Recovery Program Department of Biological Sciences Turlock, California 95382, USA. Phone: 00-1-209-667-3550 E-mail: lphamilton@ucdavis.edu
[2]University of California, Davis Department of Wildlife, Fish, & Conservation Biology One Shields Avenue, Davis, CA 95616, USA. Web Site: http://esrp.csustan.edu

The endangered riparian brush rabbit, *Sylvilagus bachmani riparius,* occupies areas of dense, brushy cover along streamside communities in the San Joaquin Valley of central California. The recovery plan for this subspecies requires the establishment of three additional self-sustaining, wild populations within its historical range. To achieve this objective, more than 600 captive-born rabbits have been released at the San Joaquin River National Wildlife Refuge since July 2002. To gather location information, a subset of translocated rabbits was monitored via radio-telemetry at least twice weekly. Analysis of the movements of 101 individuals indicated that males had larger home ranges and core areas than females regardless of the season. However, in contrast to studies of brush rabbits in other regions, the home ranges of female riparian brush rabbits were larger during the breeding season than at any other time of the year. The maximum dispersal distance was 1.1 km for females, and 2.5 km for males. Mean dispersal distances were 578 m (*se* +/- 109 m) for females, and 897 (*se* +/- 181 m) for males, but did not differ significantly by gender (p = 0.079). No individuals were observed returning to the release enclosures after dispersing. Furthermore, analysis revealed that riparian brush rabbits do not establish home ranges and core areas randomly, but instead select areas consisting of thick understory cover.

GS2 – Ecology, Population dynamics and Dispersal

Food habits of the cotton *Sylvilagus floridanus* from Puebla, Mexico

J. Martínez V.[1], R. M. González M.[2] and L. Martínez O.[3]

[1,2,3]Benemérita Universidad Autónoma de Puebla. Edif. 76 C.U. Puebla, Puebla, México. E-mail: [1]jesusmartinez90@hotmail.com, [2]rosagonzalezm@hotmail.com

The object of this study is to know the composition diet of the cottontail rabbit in three areas: low forest and oak forest in the state of Puebla. Fecal pellets of *Sylvilagus floridanus* were collected each month during twelve months from a three permanents plot in Huehuetlán El Grande, Molcaxac and Amozoc, Puebla. Fecal pellets were oven-dried for three days at 60-70 °C and crumbled to prepare microscope slides following standard procedures. Microscopic analysis of epidermal fragments in feces is a helpful tool in assessing the diet of cottontail rabbit in all areas. Number of occurrences and percent frequency of occurrence were determined for each food item. Species of the plant belonging in Huehuetlán El Grande (low forest) were twenty five families of flowering plant identified in the fecal pellets of *Sylvilagus floridanus*, the families Poaceae, Compositae and Acanthaceae were the most frequently found in pellets. Leaves and stems of the grass *Cathestecum brevifolium* (64.64%), *Santivalia fructicosa* (52.27%) and leaves of the *Justicia mexicana* (39.31%) were by far the most common in fecal samples. In Molcaxac (low forest) consume eighteen families of flowering plant, the principal families. Poaceae, Acanthaceae and Compositae were the most common found in pellets. Leaves of the *Bouteloa friana* (66.34%), *Beloperone comosa* (20.14%) and *Perymonium mendezii* (16.92%) most frequently found in fecal pellets. Finally, in Amozoc (Oak forest) consummation sixteen families of flowering plant identified in the fecal pellets of *Sylvilagus floridanus* were Poaceae, Lythraceae and Euphorbiaceae. Leaves of the three grasses: *Jumus tenius* (43.58%), *Digilaria bicomis* (28.48%) and *Brachiaria convexum* (27.24%) were most in pellets. Then, we conclude that grass is a staple food of *Sylvilagus floridanus* through the twelve months in all areas examined.

GS2 – Ecology, Population dynamics and Dispersal

Fire effects on volcano rabbit population (*Romerolagus diazi*), in alpine grassland, central Mexico

H. Rangel-Cordero

Facultad de Ciencias, Universidad Nacional Autónoma de México, Ciudad Universitaria s/n. Distrito Federal, México. E-mail: hrc@fciencias.unam.mx

Many small and medium-sized mammals and other animal species of the tropical-alpine dry grasslands depend on grasses for food and cover. In Mexico man-made grass-fires, which are used to promote grass regrowth for livestock, usually result in a strong impact on natural vegetation and wild animals. The study considered the impact of man-made uncontrolled fires and its effects on the persistence, therefore survival, of the endangered volcano rabbit population (*Romerolagus diazi*) in patches of post-fire tropical-alpine dry grasslands. Considering only grasslands I supposed that exist a linkage between rabbit densities and grass density increase, but during the study I found zacatuches in recent burned grasses (±1 year grassland recovery stage). It could be due to the presence of the annual plant *Lupinus montanus*, which offered enough shelter cover to the rabbits. Data showed an important rabbit density in places with 60 to 90% of vegetation cover (grasses or *Lupinus*). The X^2 Test analysis showed a different value regarding to the *G* Test (X^2= 10.6 **>** *G*=2.334). It means I could rejected the null hypothesis: the presence of zacatuche doesn't depend on the condition of vegetation density (low, medium and/or high). On the other hand, the *Kruskal-Wallis* Test was also used to compare abundance rabbit averages between patches. The analysis showed that, there were no significative differences between abundance of rabbits *vs.* post-fire grassland recovery stage, and also *vs.* vegetation density (P= 0.392 and P= 0.416 respectively). Values were lower than the ones in the statistic tables: 3<7.81 for P= 0.05 and 3<11.34 for P= 0.01, for the relation zacatuche abundance *vs.* post-fire grassland recovery stage. And 5<11.07 for P= 0.05 and 5 <15.09 for P=

0.01, for the relation rabbit abundance *vs.* vegetation density. Results should be analyzed for those single populations, but it must be considered that there exist large potential patches, actually without rabbit occurrence. This situation could be explained by the fact that there exists a high fragmentation in its population structure. In some cases, Metapopulation theory could be an important tool to help in trying to explain situations where fragmentation took place on animal distribution. Local extinction, dispersal and other movements could be explained by the theory. In the case of the zacatuche, and analyzing the collected data concerning the places where zacatuche occurred, besides the high fragmented distribution, I could see a separated occupied patches by long distances. Landscape structure plays here an important role in determining fire spread, and vegetation dynamics, including the plant *Lupinus montanus*. The zacatuche rabbit persist because some kind of operative mechanism into the landscape dynamics, fires are an important trigger in determining its survival, but as long as we have large dynamic patches supporting rabbit populations, they can survive the impacts that take place in these high places above the timberline.

GS2 – Ecology, Population dynamics and Dispersal

Life history strategies in European hares (*Lepus europaeus*): comparing Atlantic and Continental climate

C. Zeitlhofer[1], F. Suchentrunk[2] and K. Hackländer[1]

[1]Institute of Wildlife Biology and Game Management, University of Natural Resources and Applied Life Sciences Vienna, Gregor-Mendel-Str. 33, 1180 Vienna, Austria, Email: klaus.hacklaender@boku.ac.at,
[2]Research Institute of Wildlife Ecology, University of Veterinary Medicine Vienna, Savoyenstr. 1, 1160 Vienna, Austria

Within the genus *Lepus* reproductive pattern varies between species and depends on climatic conditions. In line with this, litter size increases and number of litters within this genus decreases with increasing latitude. We hypothesized that life history strategies within a species should also vary between latitudes and/or with different climatic conditions and compared two female European hare populations in Belgium (atlantic) and Austria (continental) with respect to age at first reproduction, reproductive output and body weight. Differences in climatic conditions were determined using the continentality index of Gorczynski. Age was determined using dried eye-lens weights. Reproductive output was measured by counting stained placental scars. As expected, European hares in both study sites did not differ in reproductive output, but females in Belgium started reproduction earlier in life and thus with a lower body weight. We concluded that the allocation of available energy varied between the two study sites due to differences in winter harshness, leading to heavier individuals in Austria and younger does in Belgium. This study was supported by FWF (Austrian Science Fund) project P18534-B03 granted to F. Suchentrunk.

GS3 – Behaviour, Sociobiology, Physiology, Toxicology and Diseases

Serum concentrations of gonadal hormones in Mexican cottontail *Sylvilagus cunicularius* at the Malinche National Park, Tlaxcala

Fernando Aguilar*[1], Leticia Nicolás[2], Luisa Rodríguez-Martínez[2], Jorge Vázquez[2], Laura García[3], Humberto Pérez-Roldán[1] and Margarita Martínez-Gómez[2,3.]

*[1]Maestría en Ciencias Biológicas. E-mail: *gazapo100@yahoo.com.mx*
[2]Centro Tlaxcala de Biología de la Conducta, UAT
[3]Instituto de Investigaciones Biomédicas, UNAM

The reproductive processes in lagomorphs are under hormone influence. The main gonadal hormones (GSH) are progesterone (P_4), testosterone (T) and estradiol (E_2). The concentrations of these hormones have been related to reproductive condition in adult animals. Reports on gonadal level hormones in cottontails are lacking. In American rabbits group (*Sylvilagus floridanus*) only steroid hormones related to stress (costicosterone and cortisol) have been quantified. In Tlaxcala we are studying an endemic wild rabbit (*Sylvilagus cunicularius*) population to learn about basic aspects of its reproductive biology. The aims of this work were to identify the reproductive condition and to determine the GSH concentrations of adult *S. cunicularius* males and females at La Malinche National Park, Tlaxcala by using ELISA test. Since February 2005 until now, 24 females and 32 males have been captured and collected blood samples. Adult females were categorized on the basis of liveweight and reproductive condition into four groups as follows: two pregnant (P), three lactating (L), seven pregnant and lactating at the same time (PL) and 12 neither pregnant nor lactating (NPL). Adult males (all with testis in scrotum) showed upper T concentration compared than those of females ($p<0.001$ U Mann-Whitney). There were differences on T levels among female groups according to Kruskal-Wallis test, $p< 0.05$. But, hormonal levels either P_4 or E_2 were similar among female groups, probably because the precise stage of pregnancy or lactation was difficult to define. The GSH values ranges in both sexes were lower than those reported on European rabbits (*Oryctolagus cuniculus*). Nevertheless, female T and E_2 levels follow the same trend than that of *O. cuniculus*. This is the first report on GSH quantifications in this species and even on cottontails in general. CUPIA2007 UATLX-CA-191 y 27; UATLX-EXB-156.

GS3 – Behaviour, Sociobiology, Physiology, Toxicology and Diseases

Chemical restraint of the zacatuche rabbit (*Romerolagus diazi*) at Chapultepec Zoo, Mexico City

R. Campos-Morales

Chapultepec Zoo, Mexico City/ Dirección General de Zoológicos y Vida Silvestre/ Secretaría del Medio Ambiente de la Ciudad de México. E-mail: rogercamx@yahoo.com.mx

Chemical restraint of captive zacatuche rabbits is useful for medical procedures (as surgery) or in some special procedures (*e.g.,* biopsy sampling, radiology, etc.). In order to reduce physical restraint stress on field conditions, chemical restraint could be necessary even for simpler procedures (e.g., blood sampling) mainly if it is planned to colect a set of samples. Furthermore, the zacatuche rabbit is considered as an easy stressful animal. Ketamine alone (20 - 50 mg/kg, IM) can be used for short time procedures (15 to 20 minutes), redosing (if necesary) with full initial dose (IM) or alf initial dose (IV). The combination of ketamine (10 - 30 mg/kg) and xilazine (1 mg/kg) is very useful for longer procedures (30 to 45 min.), but it is not recommended to increase or redose the xilazine due to respiratory depression risk; for this combination, xilazine antagonists can be used, such as yohimbine (0.1 - 0.2 mg/kg), tolazoline (2 - 4 mg/kg), or atipamezole (1 mcg/kg), any of them IV, IM, or IP. Xilazine alone (0.5 - 1 mg/kg, IM) has a limited use as a tranquilizer, better results have been observed if used as a nasal spray solution. Combination of ketamine (44 mg/kg) with acepromacine (5 mg/kg) or ketamine (15 - 20 mg/kg) with propionilpromacine (0.5 - 1 mg/kg) have been satisfactory (respiratory depression is not observed and recovery time is short). Volatile anaesthetics (*e.g.*, halothane, isoflurane, fluotane) are the most recommended if performing surgical or painful procedures. Vital signs recorded during chemical restraint of zacatuche rabbit at the Chapultepec Zoo: Oxygen saturation (80 - 97%), Pulse (180 – 321/min.), Respiratory Rate (39 – 80/min.) and Temperature (35.2 - 36 °C). Similar to other small species, special attention must be given to body temperature monitoring in long anaesthetics procedures (hypothermia and excessive intestinal gas production risk).

GS3 – Behaviour, Sociobiology, Physiology, Toxicology and Diseases

Somatometry of adult zacatuche rabbit (*Romerolagus diazi*) in captivity at Chapultepec Zoo, Mexico City

R. Campos-Morales[1,2], G. Mendoza Martínez[2], J. Ojeda Chavez[1], J. A. García Martínez[2] and F. X. Plata Pérez[2].

[1]Chapultepec Zoo, Mexico City/ Dirección General de Zoológicos y Vida Silvestre/ Secretaría del Medio Ambiente de la Ciudad de México. E-mail: jav_ojeda@hotmail.com ;
[2]Master´s Division on Agricultural Sciences/ Universidad Autónoma Metropolitana-Xochimilco, Ciudad de México. E-mail: rogercamx@yahoo.com.mx ; gmendoza@correo.xoc.uam.mx ; jamgar@correo.xoc.uam.mx ; fplata_61@yahoo.com

There are few reports on the somatometry of zacatuche rabbit, most of them have been carried out on small samples of rabbits of unknown age, and reporting only few variables. Using data collected at the Chapultepec Zoo colony (in 2007), we estimated the following parameters for the adults (over 6 months age, N = 85, 19 males and 66 females): Body Weight (BW, grams), Ear Length (EL, mm), Rear Leg Length (RLL, mm), and Body Length (BL, mm). Pregnant females were not included for BW measurement. For the variable EL (mean 45 mm) only 3 data were available for females (no data for males). Results for males (mean ± SD) were: BW 514 ± 38.4, RLL 45.9 ± 1.2 and BL 319 ± 14.6; and for females: BW 651 ± 68, EL 45 ±1.7, RLL 46.7 ± 1.3 and BL 342 ± 17. There were significant differences (P<0.000) by sex. Regarding to body weight, the means for both sex were obviously higher (about 100 grams each one) for the Zoo´s zacatuches than the data reported by other authors. The averages for EL and RLL were quite similar to other reports. Captivity diet (with greater nutritional content that zacatuche rabbit's diet in wildlife) and captivity time of the colony (24 years, probably conducing to genetic or selection changes) seem to be possible factors affecting the variable BW on this colony. Furthermore, individual longevity (age) could be also affecting the BW average significantly, mainly in females with an average age (at time of sampling) of 19.5 months (maximum: 53 months) *versus* 9.3 months in males (maximum: 21 months). It is necesary further investigation to determine the origen of the higher weight in the Zoo´s zacatuches.

GS3 – Behaviour, Sociobiology, Physiology, Toxicology and Diseases

Zacatuche´s (*Romerolagus diazi*) hypoglycemic and wasting syndrome in captivity

R. Campos-Morales*, O. López-Díaz** and A. Pintado-Escamilla

*Chapultepec Zoo, Mexico City/ Dirección General de Zoológicos y Vida Silvestre/ Secretaría del Medio Ambiente de la Ciudad de México. E-mail: *rogercamx@yahoo.com.mx; **voxis@hotmail.com*

This syndrome can be described as a not infectious disease of the zacatuche rabbit, producing weight loss (fat tissue loss mainly), hypoglycemia, and death. Usually, it has been observed as acute and self-limiting episodic disease with low to moderate incidence (1 - 4%, when predisposing factors were corrected rapidly), but high mortality (almost 100%). It is thought that chronic stress and perhaps chronic fiber deficiency could have important roles in this syndrome. Additionally, an immunosuppressive effect seems to predispose the onset of collateral infectious diseases (in the respiratory and digestive systems mainly), which may hinder the identification of the syndrome. Among the isolated pathogenic agents found: *E. coli, Klebsiella sp., Citrobacter fruendii, Staphylococcus aureus, Corynebacterium spp., Salmonella enteritidis, Enterobacter sp., Pseudomonas sp., Eimeria spp.* and *Trichomona sp.* At the Chapultepec Zoo, just one section has been affected each time (the zacatuches enclosure is subdivided in 5 sections), and particularly those rabbits in the individual cages section. The disease has been more common in adults but has been diagnosed in the younger too (since 2 months old). Becouse of the acute course of the disease it is difficult to see signs (stupor, tachypnea, mydriasis, lateral decubitus, opisthotonus and seizures). Some macroscopic lesions: weight loss (10 - 30%), fat tissue reduction, gastric ulcers, adrenomegaly (with congestion or hemorrhage). Microscopically no pattern of lesion has been established yet. Hypoglycemia has been diagnosed by signs mainly and confirmed by laboratory in some cases (blood glucose as low as 35 mg/dl). In this species, the apparent scarce fat reserves may be a physiological predisposing factor, which limits the response to stressful chronic events, so depletion of fat reserves finally triggers the syndrome. A similar disease has been described (shock disease) in American hares (*Lepus americanus*).

GS3 – Behaviour, Sociobiology, Physiology, Toxicology and Diseases

Morphometry of the third lower premolar of modern leporids from Western Mediterranean

R. De Marfà[1], C. Callou[2], M. Baylac [3], and R. Cornette[3]

[1] Departament d'Estratigrafia, Paleontologia i Geociències Marines, Universitat de Barcelona. C/ Marti i Franques, s/n; 08028 Barcelona (Spain). E-mail: demarfa@ub.edu
[2] "Archéozoologie, Histoire des sociétés humaines et des peuplements animaux" (UMR 5197-USM 303), Muséum national d'Histoire naturelle (Paris, France).
[3] "Plate-forme de morphométrie" (CNRS IFR 101, UMR 5202, GDR 2474), Muséum national d'Histoire naturelle (Paris, France).

In this work we have done a morphometric study of the third lower premolar of Current Leporids *Oryctolagus cuniculus*, *Lepus europaeus* and *Lepus capensis* from Western Mediterranean. Two approaches are applied: analysis of landmarks and elliptic Fourier analysis. The results of the Principal Components Analysis (PCA) and of the Discriminant Analysis allowed to separate clearly the genus *Oryctolagus* and *Lepus*, as well as the forms A and B of European rabbits, and the species *Lepus europaeus* and *Lepus capensis*. These results could be very useful for the determination of fossil remains.

GS3 – Behaviour, Sociobiology, Physiology, Toxicology and Diseases

Fertility and leveret survival of the European hare *Lepus europaeus* in north-eastern Italy

A. De Marinis[1], V.Trocchi[1], G. Nadalin[2], R. Petrucco and L. Masselli[1]

[1] Istituto Superiore Protezione e Ricerca Ambientale (ISPRA), Via Cà Fornacetta 9, Ozzano dell'Emilia, 40064 Italy
[2] Regione Autonoma Friuli Venezia Giulia, Direzione Centrale Risorse Agricole, Naturali, Forestali e Montagna, Ufficio Studi Faunistici, Via Oberdan, 18, I-33170 Pordenone, Italy.
annamaria.demarinis@infs.it

The breeding success is an important factor affecting the dynamics of European hare populations (*Lepus europaeus*). This demographic parameter is highly variable in time and space and is determined by the interaction between fertility and leveret survival. We collected 163 hares (74 males and 89 females) in North-Eastern Italy during 2003 hunting season (October and November). We aged them by dry weight of eye lens. The reproductive status of 65 females was assessed by staining of placental scars. Leveret survival was estimated by comparing the age structure in the bag to fertility data. The number of young per adult and the sex ratio are 1.29 and 1.15, respectively (coming out from natality, mortality and dispersal). Most of adult females (84%) showed placental scars and 19.4% presented pathological signs in the reproductive apparatus, while only 12.5% of young females were fertile and any of them had diseases. The mean number of pregnancies per young breeding female was 2 ± 0.82; while the mean number of placental scars per pregnancy was 2.08 ± 0.95. The mean number of pregnancies per adult breeding female was 4.23 ± 1.36; while the mean number of placental scars per pregnancy was 3 ± 1.26. Fertility of young breeding females was 3.25 ± 1.26 whereas breeding adults showed 10 ± 3.73. The leveret survival was very low (24%). In conclusion we recorded a percentage of adult breeding females and an average fertility according to literature data. The high prevalence of reproductive pathologies and above all the very low survival of leverets seem to negatively influence the breeding success of the population. Therefore further studies are necessary to identify the ecological factors and / or management criteria affecting the reproductive and demographic parameters and to achieve a sustainable harvesting of this population as other hare populations.

GS3 – Behaviour, Sociobiology, Physiology, Toxicology and Diseases

Maternal care in the European rabbit, *Oryctolagus cuniculus*

M. Drees[1], I. Mol (pictures) and S. Broekhuizen (film)

[1]Community and Conservation Ecology, University of Groningen, The Netherlands. E-mail: marijke.drees@kpnplanet.nl

European rabbit kits are born naked and blind in underground burrows. The mother makes a nest chamber in the burrow system and lines it with hay and hair from her belly just prior to parturition. Mothers do not stay with the new born young. They generally visit the burrow only once in 24 hours to suckle the kits and attract as little attention as possible during this time. Sometimes low-ranking females who are not tolerated in the main burrow system make elsewhere a so-called “stop”: a separate pipe with a chamber at the end. Stops provide an opportunity to make observations on mother rabbits while visiting their young. In the first weeks post-parturition the mother opens and closes the stop carefully. As the kits grow older they start waiting for her near the entrance of the stop. The mother will suckle the kits at the entrance of the stop and will leave them without closing the stop behind her. If the kittens have left the stop in the days before weaning, they still assemble at the place of the stop after sundown to meet their mother. We present observations of mother rabbits using stops in this poster and on a supplementary film.

GS3 – Behaviour, Sociobiology, Physiology, Toxicology and Diseases

Illustrations of hare and rabbit behaviour in New Zealand

J. Flux

E-mail: flux@paradise.net.nz

Hares (*Lepus europaeus*) and rabbits (*Oryctolagus cuniculus*) were introduced into New Zealand from Britain about 1860 and became widespread. Small numbers of both species live in a 200 ha field opposite our house and can be photographed undisturbed using a 12X zoom digital camera. They graze within a metre of each other without interaction, but rabbits burrowed in a hares' dusting place, and in a form. Some rabbits spent the whole day in open forms like hares; even in sight of hares. Hares in forms allowed people to approach to 20 m, horses sheep and cattle to 3 m, and paid little attention to magpies and smaller birds within 1-2 m. One hare jumped up and down on its hind feet for 10 m on seeing a cat (the fox signal response). In the breeding season, dominant male hares guarded females and fought off other males. Females avoided unwanted male attention by striking with the forepaws (the rebuff), or by lying flat on their sides as when dust-bathing. Males sometimes lay down alongside. Mating was seen only once. Guarding males usually grazed within 1 m of the female, and spent the day as close to her form. Hares in forms paid no attention to the author working in the garden 20 m away, even with noisy machinery; but rabbits were far more timid and ran at 30-50 m. No hares ever entered our 0.5 ha garden, but a young one settled in a residential area 300 m away, feeding on lawns 3 m from a house. One hare when approached in the open down-sun sat erect and used an ear as a sun shield. Young rabbits were often seen, but no young hares less than three-quarters adult size, although our cat brought in four leverets a week old.

GS3 – Behaviour, Sociobiology, Physiology, Toxicology and Diseases

The landscape of fear for jackrabbits (*Lepus californicus)* related to bobcats (*Lynx rufus*) at the Chihuahuan desert

J. C. López-Vidal[1], C. Elizalde-Arellano[1], J. W. Laundré[2] and L. Hernández García[2]

[1]Escuela Nacional de Ciencias Biológicas, I. P. N., Carpio y Plan de Ayala S/N_Col. Casco de Santo Tomás, México D. F. CP 11340, México D. F., Tel. 57296000 ext. 62421; and Instituto de Ecología, UNAM. E-mail: jclvidal@hotmail.com, jvidal@ipn.mx, thiadeno@hotmail.com
[2]Instituto de Ecología A. C., Unidad Durango. Km 5 Carretera Mazatlán esquina Boulevard Los Remedios, CP 34100, Victoria de Durango, Dgo. E-mail: hernluci@hotmail.com, launjohn@hotmail.com

The landscape of fear Theory is based on Optimal Foraging Theory and proposes that animals can perceive different levels of predation risk, and consequently, levels of fear, that are associated with physic, vegetation and geologic environmental traits, resulting in a LANDSCAPE OF FEAR. In this landscape any animal foraging optimally has to consider habitat use of their predators (in the case of prey) and of their prey (in the case of predators). Both prey and predator behaviors show a response in a two players game. If bobcats are foraging optimally, we predict they will use rocky areas or/and densely vegetated “islands” which occur in the desert, because in those areas they hunt more efficiently. With the Landscape of Fear theory as framework, and considering the risk of predation and the fear as the response to predator lethality, we further predicted that bobcat’s main prey (jackrabbits - *Lepus californicus*) will use these dangerous islands less than surrounding areas. From 2005 to 2008, the areas of high and low use by bobcats, were determinated by GPS telemetry and the jackrabbit density was estimated by pellets counts in those areas. Jackrabbit´s density was higher in bobcat’s low use areas and was lower in bobcat’s high use areas. Habitat is different in bobcat’s low and high use areas, vegetal cover and density is higher and visibility is lower in high use areas than in low use areas. According the predictions, jackrabbits are using areas with low vegetal cover and density but with high visibility, which are safer to them and correspond to high use for bobcats.

GS3 – Behaviour, Sociobiology, Physiology, Toxicology and Diseases

Utilization of feed mixtures in nutrition of farmed European hare *(Lepus europaeus)*

D. Mertin[1*], J. Slamečka[1], R. Jurčík[1], Ľ. Chrastinová[1] and N. Lukáč[2]

*[1]Slovak Agricultural Research Center, Hlohovská 2, SK-94992 Nitra, Slovakia. E-mail: *mertin@scpv.sk*
[2]Slovak Agricultural University, Trieda A. Hlinku 2, SK – 94901 Nitra.

Farm breeding of European hare is spread around Slovakia; the animals are used for restocking of hunting grounds. Approximately 1000 – 1500 individuals are produced yearly. We produced two pelleted feed mixtures: mixture I contained proteinous dried feedstuffs, dried feedstuffs – sugar beet pulp, wheat bran, oats, malt sprouts, sunflower meal, carob, additives. In mixture II we excluded sugar beet pulp, carob, soya, and used a secondary raw material obtained from oat-flakes production. Both mixtures had similar content of crude protein (164.16 and 163.19 $g.kg^{-1}$), nitrogen-free extract (460.01 and 467.08), and organic substance (832.16 and 833.92 g.kg-1). In mixture II decreased crude fibre (from 179.38 to 163.45) and increased fat (from 28.63 to 40.20 $g.kg^{-1}$). Number of leverets per one female (fed with mixture II) was higher (3.25) compared with the mixture I (3.00) (not significant). At the age of 21 days was a tendency towards weight increase in favour of animals fed feed mixture II (701 g) (mixture I - 633 g). From the age of 28 days (weaning) increases the weight of leverets fed mixture II ($P \leq 0.05$) from 957 g to 1550 g at the age of 49 days compared with weight of animals fed mixture I (925 – 1510 g). Daily weight gains varied 19.7 – 21.9 g (mixture II), and 18.4 – 20.9 g (mixture I). From the proposed feed mixtures is the mixture containing by-product from oat-flakes production more suitable for brown hare feeding. This work was supported by the Slovak Research and development Agency under the contract No. APVV 27 012 405.

GS3 – Behaviour, Sociobiology, Physiology, Toxicology and Diseases

Effect of permanent and periodic hyperthermic stress on broiler rabbits

Ľ. Ondruška[1], V. Parkányi[1], J. Rafay[1], Ľ. Chrastinová[1], J. Pivko[1], P. Massányi[2], N. Lukáč[2] and M. Capcarová[2]

[1] *Slovak Agricultural Research Centre, Hlohovská 2, SK-94992 Nitra, Slovakia, ondruska@scpv.sk*
[2] *Slovak University of Agriculture, Trieda A. Hlinku 2, SK – 94901 Nitra, Slovakia*

The aim of this study was to verify the effect of defined hyperthermic stress and physiological response of broiler rabbits to this stress. We studied the effect of permanent (34 ± 4°C, 1st experiment) and periodic (36±3° C, 12 hours with and 12 hours without hyperthermy - 2nd experiment) hyperthermic exposure on: mortality of growing rabbits, growth of live weight, digestibility of nutrients and haematological characteristics (calcium, glucose, total albumins, cholesterol). In the experimental groups (EG) and control groups (CG) too, were integrated 32 (16 ♂, 16 ♀) young rabbits (35 days old). The animals in control groups were stabled in air-conditioned facilities. First experiment: In the EG was significantly lower digestibility of nutrients than in the CG (dry mater 63.78% vs 68.03%, crude protein 74.68% vs 79.27%, fat 79.38% vs 83.78%, crude fiber 30.57% vs 31.70%, organic matter 64.75% vs 69.22%). The differences between young rabbits in EG and CG groups were in weight gain (23.67 g vs 32.76 g).The rabbits in the EG produced lower weight gain (-509.02 g/rabbit) vs CG and live weight (2500 g) was achieved about 20.79 days later as in CG. Second experiment: The periodic hyperthermy condition affects negatively their physiological processes. The changes are demonstrated on all observed biological levels: feed intake (-10.04%) and conversion, growth intensity (-235.2 g), haematological characteristics (leucocytes, erythrocytes, haematocrit), biochemical values (calcium, glucose, cholesterol, crude proteins) and viability. (This work was supported by the Slovak Research and Development Agency under the contract No. APVV-27-005505).

GS3 – Behaviour, Sociobiology, Physiology, Toxicology and Diseases

Advances in the study of the Tehuantepec jackrabbit *Lepus flavigularis* in Mexico

C. Lorenzo[1], Y. Rico[2] and G. Cantoral

El Colegio de la Frontera Sur, Departamento de Ecología y Sistemática Terrestres, Carretera Panamericana y Periférico Sur s/n. C. P. 29290, San Cristóbal de Las Casas, Chiapas, México. Tel. +52 (967) 6749000, ext.1309. E-mail: clorenzo@ecosur.mx[1], yrico@oikos.org.mx[2]

At present, the Tehuantepec jackrabbit (*Lepus flavigularis*) is distributed in an area not protected around the Inferior and Superior Lagoons at the Tehuantepec Isthmus, Oaxaca, Mexico, in four populations separated geographically, occupying an estimated area of 84 km^2, along grasslands, shrub lands and coastal dunes. The number of individuals of *L. flavigularis* per area unity goes of 7.47 jackrabbits/km^2 to 17.60 jackrabbits/km^2. Molecular analyses (microsatellites) determined that the Tehuantepec jackrabbit presents a scarce genetic variability, a heterozygote deficiency and high indexes of inbreeding, and through DNA mitochondrial, we confirm its limited genetic variability and the genetic differentiation between its populations, genetically structured in two groups, with scarce genetic flow between them. The Tehuantepec jackrabbit principally feeds of grasses (*Bouteloua dactyloides*, *Cathestecum brevifolium*, *Digitaria ciliaris*) throughout the year. Through the ecological niche modeling, the potential distribution of *L. flavigularis* might happen in its original distribution in the state of Chiapas, but only if there are still the necessary conditions for the species survival. The principal threats that put in danger the survival of *L. flavigularis* are the degradation and loss of its habitat (induced fires and extensive cattle-raising), and the excessive hunt. The existence of the Tehuantepec jackrabbit is seriously threatened and its future is not promising if specific and urgent actions do not take place to preserve this unique species in Mexico and in the entire world.

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Breeding and parental care in the endangered Tehuantepec jackrabbit (*Lepus flavigularis)*

T. Rioja[1], C. Lorenzo[2], E. Naranjo[3], L. Scott[4] and A. Carrillo-Reyes[5].

El Colegio de la Frontera Sur, Departamento de Ecología y Sistemática Terrestres, Carretera Panamericana y Periférico Sur s/n. C. P. 29290, San Cristóbal de Las Casas, Chiapas, México. Tel. +52 (967) 6749000, ext.1309 [1,2,3,5] Facultad de Ciencias Forestales, Universidad Autónoma de Nuevo León. Carretera Panamericana km 145 s/n, Linares, N. L. México[2] trioja@ecosur.mx [1]; clorenzo@ecosur.mx [2]; enaranjo@ecosur.mx [3]; lscott@fcf.uanl.mx [4]; acarrillo@oikos.org.mx [5]

For the first time we documented temporality and duration of breeding, nursing behavior, parental care and offspring survival, vital information for the captive breeding of the Tehuantepec Jackrabbit (*Lepus flavigularis*), an endangered, endemic, and very important economic species from the Isthmus of Tehuantepec, Oaxaca, Mexico. This is the *Lepus* species with the southernmost distribution, and there was no previous information of the reproductive behavior of this. Between June 2006 and May 2008, 60 adult radio-collared jackrabbits were observed in Santa Maria del Mar, Oaxaca, Mexico. The breeding season (from mating to weaning) of this jackrabbit lasted 250 days within a year, with a high reproductive activity during the rainy season (May-October). Thirty-two days after copulation, females gave birth to 2±0.9 leverets, which were put in “beds” consisting of depressions in the ground covered by prairie grass (*Jouvea pilosa*). Females separated and remained apart of their offspring, at distances of 20±9.1 m to 50±10.2 m. They returned for nursing and grooming their leverets once a day until weaning, 12±2.01d after birth. Females had an average of 2±0.5 litters per breeding season. The breeding rate of the Tehuantepec jackrabbit (4±1 leverets per female in a single breeding season) is low compared to other *Lepus* species, but the survival rate of these (50% at seventeen day) is equal to that of *L. europaeus*, and bigger than those of *L. californicus* and *L. americanus*. The breeding temporality and parental care of this lagomorph are similar to those of other hares. The Tehuantepec jackrabbit breeding has a reproductive synchrony determined by the stationality. Understanding the reproductive behavior of the Tehuantepec jackrabbit and its relationship with the environment and its habitat, is critical for the success of potential captive breeding and reintroduction programs of this endangered species.

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Hematological parameters of zacatuche rabbit (*Romerolagus diazi)* at Chapultepec Zoo, Mexico City

A. Rivas[1]; I. Rangel [2] and R. Campos-Morales[2]

[1]Facultad de Estudios Superiores Cuautitlan, UNAM, México. E-mail: tanyre80@yahoo.com.mx
[2]Chapultepec Zoo, Mexico City/ Dirección General de Zoológicos y Vida Silvestre/ Secretaría del Medio Ambiente de la Ciudad de México.

The hematic values were determined from a sample of 47 adult healthy zacatuche rabbits (25 females, 22 males), which were physically restrained to get blood samples by jugular venipuncture. Reference ranges were calculated as the mean +/- 2 SD. So the reference ranges for the total sample were: Packed Cell Volume (PCV) 31–48.5 %, Hemoglobin 7.7–15.2, Erythrocytes 4.2–7.8 /µl, Mean Corpuscular Volume 47.5– 87.3 fl, Mean Corpuscular Hemoglobin 13.1–25.7 pg, Mean Corpuscular Hemoglobin Concentration 21–36.8 %, Reticulocytes 1.3–7.6 %, Leukocytes 1.2–10.4 /µl, heterophils 0.1–2.7 /ml, Lymphocytes 0.5–7.5 /ml, Monocytes 0.07–0.7 /ml, Eosinophils 0–0.06 /ml, Basophils 0 /ml. Furthermore, we determined Plasma Proteins (range: 5.7–7.5 g/dl), and Fibrinogen (range: 0–0.2 g/dl). Preliminar result showed that there are some differences by sex, for exemple: PCV was higher in males, but lymphocytes, neutrophils, and reticulocytes were higher in females. Because this is the first report on hematology values for this species, these results can be used as population parameters for captive or wild zacatuches.

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Hematological values description in the Mexican cottontail rabbit *Sylvilagus cunicularius* under captive conditions

L. Rodríguez-Martínez[1], M. Flores-Morales[2], J. Vázquez[1], A. Bautista[1] and M. Martínez-Gómez[1,3]

[1]Centro Tlaxcala de Biología de la Conducta, Universidad Autónoma de Tlaxcala. E-mail: maluisarod@yahoo.com.mx
[2]Maestría en Ciencias Biológicas, Universidad Autónoma de Tlaxcala
[3]Instituto de Investigaciones Biomédicas, UNAM

Hematological parameters have been used in confined wild animal species to monitor their health. In Tlaxcala, Mexico, as part of a wide project on the biology of *S. cunicularius*, an enclosure at La Malinche National Park central Mexico (3000 masl) was established to maintain this species confine. Our aims were 1) to assess if hematological values such as hematocrit (PCV), Erythrocyte Sedimentation Rate (ESR) and Leukocyte Count, vary with the individual development, and 2) if this parameters are affected by the captive conditions of the rabbits.From Jun 2006 to July 2008, 13 cottontail rabbits have been monitored during different periods. Data analysis for the firsts 16 months of confinement, show that range for PCV in juvenile and adult rabbits were from 48.1 to 68.7% (mean 54.15%), and from 39.2 to 63.8 (mean 52.7%) respectively. ESR in juvenile rabbits presents a range from 0 to 5.11 mm/h (mean 1.31 mm/h) whereas adults range was from 0 to 9.7 mm/hr (mean 1.56 mm/h). In the Leukocyte count, as for the juvenile rabbits we found 40.1 lymphocytes, 5.03% monocytes, 5.42% eosinophils, 0.6% basophils, and 48.86% neutrophils, as for the adult rabbits we found 45.19% of lymphocytes, 5.03% monocytes, 3.11% eosinophils, 0.44% basophils and 47.31% neutrophils We found that the hematological parameters are similar between juveniles and adults, and that hematological values fall into the ranks of those described for our own research group in a sample of free-ranging Mexican rabbits in the same study area. CUPIA 2007 UATLX-CA-191

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Interspecific variability of parasite aggregation associated with the haematocrit in two sympatric lagomorph species in the Chihuahuan Desert

A. Santa Anna[1], A. Martínez[1], D. Romero [2] J. Guerrero [3] and J. Vázquez [4]

[1] Instituto de Neuroetología, Universidad Veracruzana, Veracruz, México. E-mail: arisabelle@hotmail.com, armartinez@uv.mx
[2] Facultad de Veterinaria, Universidad Veracruzana, Veracruz, México. E-mail: romerosd58@yahoo.com.mx
[3] Facultad de Ciencias Biológicas, Universidad Autónoma del Estado de Morelos. E-mail: aguerrero@buzon.uaem.mx
[4] Centro Tlaxcala de Biología de la Conducta, Universidad Autónoma de Tlaxcala. E-mail: jvazquez@garza.uatx.mx

The dynamics of the parasite-host system is bound to factors like age, seasonal variation, sex, physiological condition, and abundance of the parasite community, which defines intensity and prevalence. Therefore, the study objective was to evaluate the parasite load in the sympatric lagomorphs' species *Lepus californicus* and *Sylvilagus audubonii* in the Mapimi Biosphere Reserve, Durango, Mexico. For this purpose, we captured leporids and collected, from pellets, the adults' ectoparasite, and eggs and oocysts of intestinal endoparasites, variables that were associated with the hematocrit and sex of the host during two warm seasons. Two ectoparasites were recorded, *Pulex irritans* and *Dermacentor parumapertus*, and five intestinal endoparasites, *Eimeria sp*., *Trichostrongylus colubriformis* and *Graphidium sp*. in both lagomorph species, and *Cittotaenia pectinata* and *Passalurus ambiguus*, which were only using three rabbits as hosts. The parasitic prevalence varied interspecifically, with 68% of *P. irritans* in *S. audubonii* and 50% in *L. californicus*. In contrast, the tick *D. parumapertus* affected 96% of the hares and only 3% of the rabbits. Also, *Eimeria sp.´*s oocytes and *T. colubriformis´*s eggs were abundant in leporid pellets, although *L. californicus* was the most prevalent. The total load of ecto and endoparasites varied between seasons and species, and the hematocrit covariable had a marked influence. Ticks were very abundant in hares and fleas in rabbits, varying only between warm seasons. Furthermore, female hares and male rabbits had more *Eimeria sp*. oocytes and *T. colubriformis* eggs. However, the amount of *Graphidium sp*. eggs only differed between females and males leporids. Consequently, the parasite-host interaction in sympatric lagomorph species that cohabit in the same desert habitat type is dynamic and variable.

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Investigations on health status in German European brown hares (*Lepus europaeus*) with regard to diseases possibly affecting juvenile mortality

S. Speck[1], M. Franke[1], C. Szentiks[1], K. Frölich[2], R. Stark[3] and U. Voigt[4]

[1]*Leibniz Institute for Zoo and Wildlife Research (IZW), Alfred-Kowalke-Str. 17, 10315 Berlin, Germany; E-mail: speck@izw-berlin.de*
[2]*Tierpark Arche Warder, Langwedeler Weg 11, 24646 Warder, Germany*
[3]*Laurentiusstr. 19, 53123 Bonn, Germany*
[4]*Institute for Wildlife Research, University of Veterinary Medicine Hannover, Foundation, Bischofsholer Damm 15, 30173 Hannover, Germany*

Free-ranging juvenile European brown hares (*Lepus europaeus*) from Lower Saxony, Germany, were investigated regarding their health status and diseases related to juvenile mortality. Individuals up to 35 days of age were traced at night using thermal imaging cameras. Hares (n=134) were captured, examined in a veterinary check-up including recording body condition and body metrics, and were individually marked. Blood samples for antibody detection were collected using blood-sucking bugs (*Dipetalogaster maximus*, *Rhodnius prolixus*), nasal and rectal swabs were taken for bacteriological investigations and fecal pellets for parasitological investigations. Swabs and faeces were stored in liquid nitrogen until further investigation. Swabs were processed for routine bacteriological examinations. Blood-plasma samples were investigated for antibodies against *Yersinia* spp. (*recom*Line Yersinia IgG, Mikrogen) and European brown hare syndrome virus (Serology kit, IZSLER, PRRD 010120). These investigations were completed by histopathological, bacteriological and virological investigations on hares from winter hunts (n=204). A non-specific mixed bacterial flora was cultured from 50% of the rectal swabs and 30% of the nasal swabs, respectively. The majority of cultured bacteria were Gram-positive. Twenty-eight swabs (2 nasal, 26 rectal swabs) revealed Gram-negatives, mainly *Escherichia coli*. *Yersinia* (*Y.*)

enterocolitica was isolated from one and *Pasteurella pneumotropica* from 3 rectal swabs. Of 25 fecal samples available for parasitological investigation 18 (72%) contained coccidia. Histopathology of hunted hares revealed coccidia in the intestines of 67 young (33%) and 7 adult hares (3%). All samples investigated were negative for *Toxoplasma gondii* by immunohistochemistry. *Yersinia enterocolitica* (n=11), *Y. pseudotuberculosis* (n=8), *Y. fredericksenii* (n=1), *Y. kristensenii* (n=1) and *Yersinia* species (n=1) were isolated from faeces of 20 individuals (10% of shot hares). More than 80% of these hares aged ≤6 months. Two hares revealed growth of *Y. pseudotuberculosis* and *Y. enterocolitica.* So far, our results demonstrate that coccidia and bacteria of the genus *Yersinia* are prevalent among juvenile and young free-ranging hares. Both pathogens are able to cause severe disease especially in young hares and are likely to contribute to increased juvenile mortality and local population decline.

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Prevalence of *Francisella tularensis* and *Brucella Suis* in brown hares´ population in lower saxony - the latest results

M. Wedekind[1,2], M. von Keyserlingk[1], U. Voigt[2], A. Grauer[2], W. Splettstoesser[3], P. Otto[4], W. Müller[4], F. Melzer[4], K. Pohlmeyer[2] and M. Runge[1]

[1] Veterinärinstitut Hannover, Niedersächsisches Landesamt für Verbraucherschutz und Lebensmittelsicherheit, 30173 Hannover, Germany. E-mail: Martin.Runge@LAVES.Niedersachsen.de
[2] Institute of Wildlife Research, University of Veterinary Medicine Hannover, Foundation, 30173 Hannover, Germany
[3] Institut für Mikrobiologie der Bundeswehr, 80937 Munich, Germany
[4] Friedrich-Loeffler-Institute, Federal Research Institute for Animal Health, 07743 Jena, Germany

Tularemia and brucellosis are highly infectious zoonoses. In recent years the incidences let these diseases returning into focus of the public discussion. Brown hare apply for *Brucella Suis* 2 and *Francisella tularenis* as pathogens reservoir. About the current spread of these pathogens in the wild animal population, however, is unknown. Therefore the aim of the investigations is to estimate the prevalence in Brown hares´ population in Lower Saxony. A total of 900 animals were investigated by PCR, thereof seven were infected with *Francisella tularensis* (CI 95% [0.3;1.54]) and one with *Brucella* spp. (CI 95% [0.003;0.6]) respectively.

GS4 – Population Management and Conservation

Seasonal and regional influences on habitat preferences of European hares (*Lepus europaeus*) in modern cultivated agriculture areas

S. Braun[1], D. Weber[2] and K. Hackländer[1]

[1]Institute of Wildlife Biology and Game Management, University of Natural Resources and Applied Life Sciences, Gregor Mendel Strasse 33, A-1180 Vienna, Austria. E-mail: stepbraun@yahoo.com, klaus.hacklaender@boku.ac.at
[2]Hintermann & Weber AG, Austrasse 2a, CH-4153 Reinach, Switzerland. E-mail: weber@hintermannweber.ch

Since the 1960's the number of European hares has been declining throughout Europe. In line with this, hare populations in three research areas in the canton of Baselland, Switzerland, which have been monitored since 1996, are in a critical condition. The annually ascertained hare densities range between less than 1 hare/km^2 to 5 hares/km^2. The declining hare populations have been investigated by numerous scientists in Europe, resulting in many hypotheses about the reasons of the population decline. In accordance with one hypothesis the hare's habitat use changed as a result of the agricultural intensification. We investigated the hares' preference for various habitat characteristics and analysed seasonal and regional differences. In three areas the hares were counted with spotlight in autumn 2007 and spring 2008. Thereby, the position of each hare was recorded on a map. In the same months the landscape composition and agricultural use of the three areas was documented and digitised with GIS-software. Around each point, where a hare was mapped, a circle with the size of 50 ha was drawn and the landscape composition of this area was analysed. The same procedure was done with points chosen at random in these three areas. The hares' habitat composition was then compared with the landscape composition of the random points. The aim of this research is to elaborate scientifically sound management strategies that increase the hare density in Switzerland.

GS4 – Population Management and Conservation

Warren characterization in low-density rabbit populations

I. Catalán[1]*; G. Bueno[2] and F. S. Tortosa[1]

[1]*Departamento de Zoología, Universidad de Córdoba. E-mail: *b42cabai@uco.es*
[2]*Instituto Pirenaico de Ecología, CSIC*

Rabbit decline constitutes a serious problem in the Iberian Peninsula, both for the conservation of endangered predator species and for sport hunting activities, and therefore many efforts are being made on the recovery of its populations. Artificial warren building is a frequent tool to reinforce rabbit populations in places where their numbers have declined. This method avoids some problems attributed to other techniques, such as translocations. To improve the efficiency of these measures a sound knowledge of warren ecology is needed, and therefore the characterization of natural warrens can provide useful data. In this study we analysed which factors determine warren use and location in a low density area within the species original distribution range, and we generated a map predicting the areas most suitable for warren building. Both warren location and use seem to be determined mainly by spatial factors, suggesting that at a lower scale, such as the hunting estate level, population processes might be playing a main role. These considerations should be taken into account for population management in low density areas.

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Survival in large-scale European wild rabbit restockings

M. D'Amico[*1], Z. Tablado[*2] and F. Palomares[*3]

**Doñana Biological Station (CSIC), Department of Conservation Biology. Seville, Spain. E-mail: [1]damico@ebd.csic.es, [2]zutal@ebd.csic.es, [3]ffpaloma@ebd.csic.es*

European wild rabbit is a keystone species in Iberian Peninsula, where also holds considerable importance as game species. Wild rabbit restocking is a traditional practice to reinforce small populations for hunting, but in the last decades it has started to be used as a conservation tool. With such purpose a large-scale restocking was carried out in Doñana Biological Reserve. In this poster we show a survival study of restocked rabbits. We released 2130 individuals (sex ratio: 1 males for about 2 females) in two areas (both of 600 ha) and 101 of them were equipped with radio-collars. First area (Vera) consisted of 12 fenced and 12 unfenced 5 ha plots, equally distributed between dry and wet scrubland. Second area (Lagunas) consisted of 9 fenced and 9 unfenced 5 ha plots, in which different release rabbit densities (high: 19 rabbit/ha; low: 5) were applied. We recorded the highest mortality in the first month after release. In this interval we found difference in survival between sexes only in the Lagunas. We did not find differences between survival in dry and wet scrubland, and high and low release density (probably due to the scale of restocking). We did not find differences between survival in unfenced or fenced plots, in which carnivore and raptor impacts might be compensatory. In our restocking, predation determined only 45% of mortality, and we did not record surplus killing. The rest of individuals dyed for unknown causes (inside the warrens or without myxomatosis/RHD/predation marks). We suggest that large-scale restockings limit predator concentration, avoiding surplus killing and scavenging. The lack of scavenging makes possible the detection of dead individuals that in other studies were often misinterpreted as predated. Therefore, predation could have been overstimated in the past.

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Conservation of a Mediterranean hare endemism, *Lepus corsicanus*, in man made habitat

*G. de Filippo and S. R. Troisi

*Istituto di Gestione della Fauna, Napoli (Italy). E-mail: *gabrieledefilippo@libero.it*

Italian hare, *Lepus corsicanus,* is an endemic species of southern Italy, originated during Pleistocene from *Lepus timidus* populations. This species has lived in coevolution with man made activities, since during centuries peoples have built a typical landscape, characterized by a patchiness of natural and man-made habitats. Man activities were related to the grazing of sheep, cows and coats, and to mountain cultivations of wheat, legumes and fodders; it produces secondary grasslands, that are the ecological equivalent of primary grasslands, that are a rare vegetation in the original habitat of southern Apennines. During the last 50 years, the abandon of these activities, due to the lack of competitiveness in a global market and the modification of style of life, have determined the recolonization of natural vegetation; so secondary grasslands became threatened and Italian hare too. In the National Pak of Cilento and Vallo di Diano we have focused a conservation plan allowing the protection of Italic hare considering the management of its man made habitat. Action plan deals with: 1) Maintenance of scrubs and woods patches in the landscape; 2) Direct protection of man made habitats by new buildings and roads; 3) Increasing the competitiveness of economy based to traditional activities, in order to maintain cows on the secondary grasslands; 4) Allowing participation of farmers and shepherds in monitoring and conservation programs; 5) Involving students in educational activities.

GS4 – Population Management and Conservation

Climate change effect in the distribution of the volcano rabbit *Romerolagus diazi*

A. Domínguez Pérez and C. González-Salazar

Instituto de Biología, Laboratorio Análisis Espaciales, Universidad Nacional Autonóma de México, Circuito exterior s/número, Ciudad Universitaria. E-mail: angydp_30@yahoo.com.mx, cgs@ibiologia.unam.mx

Global warming is altering significantly the climate regimes, around the world which, in turn, are having an impact on the biodiversity's spatial distribution. Of particular concern are mountainous species, such as the Volcano Rabbit (*Romerolagus diazi*), an endemic and highly restricted species from Central Mexico. We evaluated the potential effect of climate change on the distribution of the Volcano Rabbit, by means of modeling its ecological niche under environmental conditions current and projected to future scenarios (2010 and 2050) using the Genetic Algorithm for Rule-set Production (GARP). A statistical analysis of historic trends of temperature and precipitation (1949-1998), detected a significant increase in the minimum and maximum temperature and an increase in precipitation during winter. The results obtained with the ecological niche models show a significant reduction of Volcano Rabbit's potential distribution at low altitudes, limiting its distribution between the 2400-3000sl. Field surveys showed that the species' distribution has reduced, mainly in its lower altitudes. The results suggest that the climate is changing in the area, as well as the distribution of the rabbit as we expected. But it is difficult to identify whether the reduction in the rabbit's distribution is mainly attributable to climate change or that land use changes that have been observed in the area in the last decades. Supported by IN-215102.

GS4 – Population Management and Conservation

Dispersal of rabbits after translocation; the use of burrows

J.M. Drees[1], J.J. Dekker[2], L.Wester [1] and H.Olff [1]

[1]University of Groningen, Community and conservation biology
[2]Society for the Study and Conservation of Mammals

Rabbit restocking is a management measure frequently used to counter declining rabbit populations due to Rabbit Haemorrhagic Disease (RHD). Stress, predation and dispersal have been suggested reasons for the low survival rate in these restocking programmes. We compared resident and restocked rabbit movement as part of an evaluation of a rabbit restocking program in Dutch coastal dune areas. The translocation was successful with only one of the 58 translocated rabbits dieing in a trap. Although the quality of food in the new habitat was sufficient, and the translocated animals had an acquired immunity to RHD, post-release mortality was a high. Fox predation accounted for 42% mortality in the first two days. 90% of the rabbits moved during the first night after translocation from the artificial burrows to neighbouring unused natural burrows. Dispersal was limited to less than 150 m. spatial settling is considered to be an indicator of success in rabbit translocation projects. Our results suggest that the presence of empty natural burrows not only limits post-release dispersal but also aids survival. Routine switching of burrows might be useful as anti-predator behaviour in rabbits.

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What can genetics tell us about the European rabbit (*Oryctolagus cuniculus*) restocking operations in Portugal?

Liliana Farelo[1,2], Raquel Godinho[2], David Gonçalves[1,2], Nuno Ferrand[1,2], Armando Geraldes[1,3] and Paulo Célio Alves[1,2]

[1]CIBIO, Centro de Investigação em Biodiversidade e Recursos Genéticos, Universidade do Porto, Campus Agrário de Vairão, 4485-661 Vairão, Portugal.
[2]Departamento de Zoologia e Antropologia, Faculdade de Ciências da Universidade do Porto, 4099-002 Porto, Portugal.
[3]Department of Ecology and Evolutionary Biology, University of Arizona, Tucson, AZ, 85721, US

The European rabbit *Oryctolagus cuniculus* is endemic to the Iberian Peninsula, where two subspecies occur, *O. c. algirus* that is confined to the southwestern region and *O. c. cuniculus* which occupies the northeastern region, defining a narrow contact zone across a northwest-southeast axis. Genetic studies with uniparental non-recombining markers (mithocondrial Cytochrome b and SRY gene from the Y chromosome) revealed the existence of two distinct, highly structured, parapatric lineages with a distribution corresponding to the subspecies *O. c. algirus* (lineage A) and *O. c. cuniculus* (lineage B). Furthermore, the analysis of four X-linked loci detected two divergent lineages, as well as low recombination rates, reduced nucleotide variability and little introgression in the centromeric loci (MSN e SMCX). Due to the severe decline of wild rabbit populations in the Iberian Peninsula, restocking with individuals of unknown origin or with hybrids between European and domestic rabbits (that derive from *O. c cuniculus*) became a more frequent practice. It constitutes a serious threat to the conservation of the genetic and sanitary integrity of the autochthonous populations, since it increases the risk of hybridization between subspecies or between wild and domestic animals. In this work, we studied a total of 519 individuals from 61 Portuguese populations by PCR-RFLP for SNPs diagnostic for the two subspecies in a 434 bp fragment of the

MSN gene and two fragments (450 and 291bp) of the SRY gene. For both sex-linked chromosomes, lineage A was found in most of the Portuguese territory and lineage B is primarily restricted to the northern region. The X-linked lineage B exhibits a very broad distribution in the north, while the Y-linked lineage B shows lower levels of introgression, as it is restricted to two northwest populations and two in the northeastern border. When comparing the geographic distribution and levels of introgression between the mitochondrial and sex-linked lineages, we found that cytochrome b haplotype distribution patterns are largely concordant with the distribution of the X-linked lineages, as the northern populations exhibit higher lineage B frequencies. Based on the individual genetic profiles obtained, rabbits with lineages of both subspecies are classified as hybrids and were detected mainly in the north. Considering the high level of restocking, mainly in north and central Portugal, the introgression patterns identified suggest a very low success of these practices that can be eventually associated to the existence of reproductive isolation mechanisms between rabbit subspecies. Project funded by Fundação para a Ciência e Tecnologia (FCT), Programa Operacional e Inovação 2010, POCI & PPCDT/CVT/61754/2004

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The effects of habitat fragmentation and landscape features on the genetic structure of New England cottontail populations

L. Fenderson[1], A. Kovach[2], J. Litvaitis[2*] and M. Litvaitis[2]

[1]Zoology Department
*[2]Department of Natural Resources, University of New Hampshire, Durham, NH 03824 USA. E-mail: *john@unh.edu*

The New England cottontail (*Sylvilagus transitionalis*, NEC) has experienced severe population decline and range contraction in recent decades due to habitat loss and land use changes. It is has long been a species of regional conservation concern and is currently a candidate for threatened or endangered status. Persistence of remaining populations of NEC are dependent upon connectivity among remaining habitat patches. To this end, we initiated a study to investigate the genetic structure of remnant populations of NEC and used recently developed landscape genetic methods to evaluate population connectivity. Microsatellite genotyping was completed on 195 individuals sampled across the entire range of the NEC via live-trapping or noninvasive collection of fecal pellets. Population genetic analyses were performed using conventional approaches (F-statistics) and individual-based methods that were conducted without defining subpopulation boundaries a priori. There was significant population differentiation overall, suggesting limited gene flow among geographically separated populations. Heterozygote deficits were found at multiple loci among populations, suggesting a loss of genetic diversity. Landscape genetic methods are being used to identify dispersal corridors and identify areas where habitat restoration and introductions would improve gene flow and advance recovery.

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European wild rabbit (*Orytolagus cuniculus*) body weight curve in a Mediterranean habitat.

A. J. Ferreira* and S. Gouveia

*IMAR-CIC. Universidade de Coimbra, 3004-517 Coimbra, Portugal. E-mail: *ajf@zoo.uc.pt*

The mean postnatal body weight of a species is often used to assess the health/fitness of animals. There are few studies about the body growth of European wild rabbit in a Mediterranean environment. The aim of the present study was to describe postnatal body weight growth in male and female European wild rabbit from birth to adult age, of a population maintain in a semi-extensive fenced area. More than 200 measurements were taken at regular intervals throughout life from both male and female European wild rabbit. We know the age of birth, with the accuracy of a two weeks, and reproduction status for most of those used animals.

GS4 – Population Management and Conservation

A field enclosure establishment for the study of the Mexican cottontail rabbit *Sylvilagus cunicularius* at the Malinche National Park, Mexico

M. Flores-Morales[1*], J. Vázquez[2], L. Rodríguez-Martínez[2], A. Bautista[2], H. Pérez-Roldán[1] and M. Martínez-Gómez[2,3]

*[1]Maestría en Ciencias Biológicas, Universidad Autónoma de Tlaxcala. E-mail: *floresmles@gmail.com*
[2]Centro Tlaxcala de Biología de la Conducta, Universidad Autónoma de Tlaxcala
[3]Instituto de Investigaciones Biomédicas, UNAM.

The cottontail *S. cunicularius* is the largest in size and distribution among the Mexican rabbit endemic species. It is an important game species and food source in rural communities. However, this species is nearly threatened due to increase poaching and habitat destruction. Despite this, basic biology knowledge about this species is lacking. Our aim was to establish a group of *S. cunicularius* fenced in a field enclosure to address basic question about this species' biology. A 530 m2 area located in La Malinche National Park was fenced. Grass Patches (GP) where disposed separately to provide shelter for rabbits. To facilitate behavioral observations, a grass free area was left in the center of the enclosure. In Jun 2006 three males and one female (and in December 2007 another two females) were introduced, when they still were juvenile. Since then, hematologic and body length parameters of individuals as well as high and coverage of GP, number of feces and soil pH were regularly monitored. Grass and soil values also were measured outside the enclosure. Grass high and coverage were significant highest outside the enclosure, whereas feces number had an inverse pattern. Inside and outside of the enclosure these parameters varied through the year apparently according to weather season. Soil pH was more alkaline inside the fence than outside. Both, hematologic and growth rates were similar to those of rabbits outside enclosure. In this year two females have already produced four litters. Furthermore, thanks the enclosure establishment we have evidence that females *S. cunicularius* digs natal borrows whose entrance they cover and close with grass, and give birth litters from two to six pups. Whit this results, we considered that our enclosure in its current state can provide detailed information about some aspects of the *S. cunicularius* biology. CONACyT (MFM 198761) and CUPIA 2007 a UATLX-CA-191

GS4 – Population Management and Conservation

Management of wild rabbit (*Oryctolagus cuniculus*) populations in Andalusia

M. González[1] and C. San José

Egmasa-Consejería de Medio Ambiente, Junta de Andalucía, Spain. E-mail:
[1]mdgonzalez@egmasa.es

The wild rabbit is a species of reference in the Mediterranean forest. In response to its importance and due to the problems they are experiencing which are causing their populations to decline, the Regional Andalusian Government, through their Environmental Ministry, has drawn up different lines of work with the objective of improving the sustainability of this natural resource and guaranteeing the balance in the ecosystems. Under this norm, a series of complementary actions have been outlined: •Follow-up of the rabbit populations by means of systematic sample-taking since 1998, relating the abundance with different factors such as the effect of diseases, drought years, or the intensity of hunting. The values of density taken as a reference the sampling of June have oscillated between 37 and 120 animals per km^2. °Tasks of detection and control of demographic explosions (more than 350 animals km^2). °Detection and follow-up of the effect of diseases such as myxomatosis and VHP. •Genetic characterisation of the rabbit in Andalusia, verifying the high genetic diversity and the phylogenetic tree with the presence of two widely spread haplotypes (A and B). •Maintenance of a rabbit reservoir (Rabbit Reference Station) where, in addition to maintaining a pool of animals with genetic-health guarantees, the idea is to monitor for diseases and promote research projects. •Subscription to agreements with owners of hunting reserves with the objective of maintaining rabbit populations which sustain the emblematic species such as the Spanish Imperial Eagle, the Iberian Lynx and other raptors and carrion-eaters. •Creation of help-lines to owners of hunting reserves to favour rabbit habitats and promote agricultural practices compatible with natural rabbit populations. •Adaptation of the closed hunting seasons and the hunting limits to balance the rabbit populations and mitigate the effects of diseases or puntual demographic explosions.

GS4 – Population Management and Conservation

Challenges to maintaining a radio-collared sub-population of reintroduced riparian brush rabbits (*Sylvilagus bachmani riparius*)

M. Lloyd[1], P. Kelly[1] and R. Larsen[2]

[1]California State University, Stanislaus Endangered Species Recovery Program Department of Biological Sciences Turlock, California 95382, USA.
[2] University of California, Davis Wildlife Health Center School of Veterinary Medicine Davis, CA 95616 Phone: 00-1-209-664-6686 Email: mlloyd@esrp.csustan.edu Web Site: http://esrp.csustan.edu

Since July 2002, 771 endangered riparian brush rabbits, all of which were born and reared in captivity, have been released in areas of protected, suitable habitat in the San Joaquin Valley of California. Sixty-eight percent (526/771) of the translocated rabbits were radio-collared to study habitat and space use, survivorship, and dispersal. The resulting data are used to refine management objectives and to provide recommendations on subsequent rabbit releases. Radio-collaring numerous rabbits for durations of up to ~3 years has resulted in several challenges, including the determination of appropriate transmitter and collar sizes, antenna length, and collaring material. To minimize collar-related mortality and morbidity, rabbits wearing various radio-collar configurations were recaptured at regular intervals to assess their radio-collars and make adjustments where necessary. The collective effort has resulted in more rigorous and standardized collaring procedures that have contributed to survivorship and the overall success of the reintroduction program.

GS4 – Population Management and Conservation

Factors associated with hare mortality during coursing

N. Reid[1*], R. McDonald[2] and I. Montgomery[1]

[1]*Quercus, School of Biological Sciences, Queen's University Belfast. Northern Ireland (UK)*
[2]*Central Science Laboratory, York. England (UK)*
E-mail: *neil.reid@qub.ac.uk

Hare coursing, the pursuit of a live hare by one or more dogs for sport, is a widespread but controversial activity. Anti-hunting organisations cite both animal welfare and high mortality as their main objections to hare coursing. In an attempt to reduce hare mortality and mitigate the activity's impact on hare welfare, the Irish Coursing Club introduced measures including the compulsory muzzling of dogs in 1993. However, the efficacy of these measures remained the subject of heated debate. Official records, corroborated by independent video evidence, were used to assess the fate of individual Irish hares (*Lepus timidus hibernicus* Bell 1837) during coursing events from 1988–2004. Muzzling dogs significantly reduced levels of hare mortality. In courses using unmuzzled dogs from 1988/89-1992/93 mean hare mortality was 15.8%, compared to 4.1% in courses using muzzled dogs from 1993/94-2003/04. Further reductions in mortality could not be accounted for by the muzzling of dogs alone, supporting the efficacy of other factors such as improved hare husbandry in captivity. The duration of the head start given to the hare prior to the release of the dogs significantly affected the outcome of the course. Hares that were killed had head starts of greater duration than those that were chased but survived, suggesting the former may have been slower. The selection of hares by assessment of their running ability may provide means to reduce hare mortality during courses further. Our findings support the efficacy of measures taken to mitigate the impact of coursing on individual hares. However, it is necessary to evaluate the impact of removing hares from the source population and of returning coursed hares to the wild before the wider impact of coursing on wild hare populations can be determined.

GS4 – Population Management and Conservation

Is naturalization of the European Hare in Ireland a threat to the endemic Irish hare?

N. Reid[1] and I. Montgomery

Quercus, School of Biological Sciences, Queen's University Belfast. Northern Ireland (UK)
E-mail: [1]neil.reid@qub.ac.uk

On islands, one of the greatest risks to native wildlife is the establishment of alien species. In Ireland, the Irish hare (*Lepus timidus hibernicus* Bell 1837), the only native lagomorph, may be at risk from competitive exclusion and hybridisation with naturalised European hares (*L. europaeus* Pallas 1778) that were introduced during the late nineteenth century. Pre- and post-breeding nocturnal spotlight surveys during 2005 in the north of Ireland determined that European hare populations are well established in two discrete regions; mid-Ulster and west Tyrone. In mid-Ulster, European hares comprised 53-62% of the hare population, with an estimated abundance of up to 2000 individuals. Comparisons of habitat niches suggest that Irish and European hares have comparable niche breadths that at times completely overlap, suggesting the potential for strong competition between the species. Furthermore, genetic hybridisation between both species has been confirmed. Further research is urgently required to assess the degree of risk that naturalised European hares pose to the Irish hare population and what action, if any, is needed to ensure the future ecological security and genetic integrity of the native species.

GS4 – Population Management and Conservation

Distribution and abundance of the volcano rabbit (*Romerolagus diazi*) in a natural protected area: a GIS approach

A. Rizo-Aguilar[1], J. A. Guerrero[1] and M. G. Hidalgo-Mihart[2]

[1]Facultad de Ciencias Biológicas, Universidad Autónoma del Estado de Morelos. Av. Universidad 1001, C. P. 62209. Cuernavaca, Morelos México. areli_rizo@yahoo.com.mx, aguerrero@uaem.mx
[2]División Académica de Ciencias Biológicas, Universidad Juárez Autónoma de Tabasco, Villahermosa, Tabasco, México C. P.86039 gabriel.hidalgo@dacbiol.ujat.mx

The volcano rabbit is an endemic species considered endangered because of its limited distribution and specialized habitat requirements. As part of a monitoring program of this lagomorph in the Corredor Biologico Chichinautzin (COBIO), a natural protected area on the Mexican Transvolcanic Belt, we investigated its distribution and abundance in the Area. From June to November 2005 we surveyed 115 randomly selected squares of 50 m^2, in areas located 2800 m above sea level. In each square we counted the number of letrins/m^2 as a presence record and abundance index. The results showed that the volcano rabbit was present only in 64 squares, with abundance ranging from 0.2 to 6 letrins/m^2. We develop a Geographic information System (GIS) for modeling its distribution and abundance on the COBIO, combining the presence/absence and abundance observations with environmental layers such as altitude above sea level, orientation, aspect, temperature, current vegetation cover, presence of grassland, fire incidence and soil types. Using a Generalized Linear Model we develop a model and projected it on the GIS and create a series of maps of the COBIO with volcano rabbit presence likelihood and abundance. These maps will be useful to help in the identification of priority areas for volcano rabbit conservation on the COBIO.

GS4 – Population Management and Conservation

Predator exclusion or acclimatization to the release site, what is better in European rabbit translocations programs?

C. Rouco[1]*, P. Ferreras[1], F. Castro[1] and R. Villafuerte

[1]*Instituto de Investigación en Recursos Cinegéticos, IREC (CSIC-UCLM-JCCM), Ronda de Toledo s/n, 13005 - Ciudad Real, SPAIN. E-mail: *carlos.rouco@uclm.es*

In southern Europe, many methods have been tested in recent decades to increase the success of European wild rabbit, *Oryctolagus cuniculus* L. translocations for both conservation and game purposes. The main problem experienced during such translocations is the elevated short-term (first 10 days) mortality mainly attributed to predation during the first days following rabbit release. We carried out an experimental translocation in the Sierra Norte Natural Park (Sevilla Province, Southern Spain) where the effect of the exclusion of terrestrial predators on the survival of translocated rabbits was tested, combinated with a prior acclimatization period of the animals in the releases site. Four translocation plots (4 ha with 18 artificial warrens each) were constructed, two of them with a fence to exclude terrestrial predators. Seven hundred and twenty four rabbits, 45 of them fitted with radio-collars, were released to the translocation plots in five batches and forced to remain inside warrens for 7 days. Following liberation, the predator exclusion did not increase rabbit survival in the short-term. Contrary to expectations, three months after released, rabbits survival in the unfenced plot was slightly, but not significantly higher than in the fenced plot (0.57 and 0.40 respectively). Although predator control is a frequent management highly associated with rabbit translocations, and the acclimatization technique is practically unemployed in rabbit translocation programs, our results suggest that the former may not be as necessary as expected when rabbits are effectively acclimated to the release site.

GS4 – Population Management and Conservation

Wild rabbit recovery program when dealing with state-owner and private companies and landowners, in Hornachuelos Natural Park (Southern Spain)

C. Rouco[1,2]*, V. Morlanes[1], C. Marfil[1], J. A. García[1], and S. Moreno[1]

[1]Estación Biológica de Doñana-CSIC Avenida de Maria Luisa s/n, 41013 - Sevilla, SPAIN
*[2]Instituto de Investigación en Recursos Cinegéticos, IREC (CSIC-UCLM-JCCM), Ronda de Toledo s/n, 13005 - Ciudad Real, SPAIN. E-mail: *c.rouco@ebd.csic.es, carlos.rouco@uclm.es*

Many conservation programs in Spain, that deal with wild rabbit recovery purposes, are carry out as compensation measures due to the ecological damage that big civil works cause. Therefore it is necessary the involvement of state-owned and private companies and, of course, landowners. This is the case of the compensatory ecological measures that have been undertaken in the Hornachuelos Natural Park (Córdoba Province, southern Spain) for the construction of the Breña II Dam. The working area involves 28000 ha, where 8000 ha belong to the Natural Park. The recovery of the rabbit population in this area is important, because is considered as a possible future target area for Iberian Lynx translocation programs. The work was structured in three phases. First: design of all measures and the sites selection that belong to private owners, mainly gamekeppers. Second phase: the habitat restoration and the rabbit translocation were performed. Third phase: monitoring of the population. Six of the management areas were selected as 'intensive actuations areas' and the rest as 'extensive actuation areas'. In the six intensive areas were selected six plots (from 38 to 223 ha) that were provided with a protection fence against terrestrial predators. 30 artificial warrens surrounded by an effective capture device (96% of rabbits in the warren in one night) were set up inside the plots. Food increase for rabbits was carry out by sowing of cereal seeds. .Two main aims were pursued: a) to reach high rabbit densities to be used as a source for further reinforcement in the extensive actuations areas and b) to increase supplementary food to threatened predators in the area. The extensive actuation areas consisted in six areas (from 135 to 273 ha) where 30 artificial warrens were built and sowing of cereals were performed on each. From May to June in 2008, 1500 rabbit (70% were vaccinated against myxomatosis and rabbit haemorrhagic diseases) were translocated to the intensive plots (300 rabbits/plot in two areas and 150 rabbits/plot in the other two). Nowadays, we have detected up to two offsprings. The vaccination effectiveness seems to be very scarce at least against myxomatosis disease.

GS4 – Population Management and Conservation

Damages in agriculture caused by European hare *(Lepus europaeus)* and protection against them

J. Slamečka[1*], M. Grácová[2], J. Gašparík[2], P. Hell[1] and P. Massányi[2]

[1]*Slovak Agricultural Research Center, Hlohovská 2, SK-94992 Nitra, Slovakia. E-mail: *slamecka@scpv.sk*
[2]*Slovak Agricultural University, Trieda A. Hlinku 2, SK – 94901 Nitra, Slovakia*

Spring stocks of European hares in Slovakia seem to have increasing tendency but the harvest is declining. The population counts about 200 thousand individuals. The hunting area in Slovakia is 4.43 million hectares (52.5 % of it is agricultural land). Annually, about 30 thousand hares are harvested (9 % from the maximum in 1974). Some hunting grounds register increased population density what creates the conflict with farmers. The most damages are registered at the sunflower. Hares browse young plants after germination. A part of plants die, the other regenerate, but produce 43 % less corn compared with undamaged plants. In the hunting grounds with higher population density (more than 80 hares per km^2), the damages vary from 8 to 25 % what means the losses 126 – 197 EUR per hectare. The direct protection of large fields is not possible. By monitoring of water melon fields, we estimated that on not protected area 34.8 % of fruits were damaged (browsed peel). It means the loss of 15.6 tons per hectare (2425 EUR). Successful protection of smaller field is possible through combination of fencing and odour repellent Kornitol. In spite of intense grazing of rape and partially maize the damages on these plants are not significant. Measures for biodiversity increase and food availability are necessary. If the conflicts are not solved, it could lead to hare population reduction that regenerated with difficulties many years. This work was supported by the Slovak Research and development Agency under the contract No. APVV 27 012 405.

GS4 – Population Management and Conservation

Activity and adaptation of Amami rabbit *Pentalagus furnessi* inhabit in damp subtropical temperature

F. Yamada

Forestry and Forest Products Research Institute. E-mail: fumio@ffpri.affrc.go.jp

Amami rabbit *Pentalagus furnessi* is endemic to Amami-Ohshima Island (712 km^2) and Tokuno-Shima Island (248 km^2), which originally lacked predatory mammals, located in the subtropical zone in southern Japan. Habitat is forest including forest edges. Home range size (1.3 ha for 4 males and 1.0 ha for 3 females) was much smaller than those of other leporids. Active time is mainly at night, moving for feeding and dropping their pellets in open places, 100-200 m away from their burrows. Burrows are usually located in small valleys covered by dense forests. Food is mainly sprouts and young parts of plants, including cambium, and nuts from a wide range of plant species. Food is supplied mainly at edge of dense forest or gap. The entrance to the burrow is not often hidden in vegetation because there is very little undergrowth in dense forest. Entrances are horizontal or slightly oblique and of round shape, ranging between 10-20 cm high and 12-25 cm wide. Tunnels follow a straight line for 30-200 cm. L-shaped tunnels follow a straight line 30-200 cm long from the entrance. Rabbits also use bases of trees, bases of rocks and the inside of fallen trees for burrows. The maximum temperatures (21 and 24°C) of the burrows were 6°C lower than those (27 and 30°C) outsides in the daytime in summer. Rabbits seemed to leave their burrows when the temperature was below 24–25°C at night to avoid heat stress during activity in summer. Small home range size and nocturnal activity of the rabbit suggest the adaptation to the steep slopes and lack of food supply in dense forest, and to the high temperature in this sub-tropical zone, respectively.

AUTHOR INDEX

Autor index

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3rd WORLD LAGOMORPH CONFERENCE

PROGRAM

Sunday, November 9

Arrival of participants

Registration

Conference Reception will be open from **16.00** to **18.00h**.

Monday, November 10

08.00 Registration

09.00 **Welcome and Opening** *Auditorium*

Dr. Gerardo Bocco Verdinelli
Director
Centro de Investigaciones en Geografía Ambiental (CIGA-UNAM)

09.15 **Plenary Lecture** *Auditorium*

The role of lagomorphs in ecosystems: keystones and engineers

Andrew Thomas Smith

10.15 **General Session 1 - *Systematics, Evolution and Genetics*** *Auditorium*

Chair: Franz Suchentrunk and Andrew Thomas Smith

10.15 Molecular data pertinent to the systematic of South African cape hares (*Lepus capensis*)

Franz Suchentrunk, Hichen Ben Slimen and Ute Kryger

10.30 **Coffee**

11.00 Sharing of endogenous lentiviral gene fragments among leporid lineages separated for more than 12 million years (genera *Lepus*, *Sylvilagus*, *Bunolagus* and *Oryctolagus*)

Pedro J. Esteves, Joana Abrantes and Wessel van der Loo

11.15 Pilot study to assess the MHC class I variability in European wild rabbits (*Oryctolagus cuniculus*) in north Rhine-Westphalia, Germany

Joerns Fickel, Sophie Desaga, Tanja Noventa, Mathias Putze and Walburga Lutz

11.30 Biogeography and evolution of the cottontail genus S*ylvilagus* (Lagomorpha: Leporidae)

Jorge Salazar–Bravo and Luis A. Ruedas

11.45 Taxonomy of the pikas (*Ochotona*) from a complex approach standpoint: actual advances

Andrey A Lissosvsky

12.00 Contrasting mitochondrial and nuclear DNA phylogenies reveal recurrent mtDNA introgressions among hares (*Lepus* spp.)

José Melo-Ferreira, Pierre Boursot, Pedro J. Esteves and Paulo Célio Alves

12.15 Lunch

14.00 Plenary Lecture *Auditorium*

Epidemiological studies in European rabbits and hares: models for understanding diseases in other lagomorphs

Brian Cooke

14.45 **Behaviour and physiology in rabbits: from the field to the lab and back again**
Workshop 1 *Room 1 (West room)*

Convener: Margarita Martínez y Leticia Nicolás

Oral contributions

Factors affecting vigilance in European rabbits

Raquel Monclús

Reproductive biology of the Mexican rabbit *Sylvilagus cunicularius*: field and lab approaches

Margarita Martínez-Gómez and Jorge Vázquez

Long-term maternal and sibling effects in the European rabbit: results from a study on a field enclosure population

Heiko G. Rödel and Dietrich von Holst

The unusual life of the newborn European rabbit: uniting studies from lab and field

Robyn Hudson and Amando Bautista

14.30 ***Population Genetics and Phylogeography***
Workshop 2 *Room 2 (East room)*

Convener: Paulo Célio Alves

Oral contributions

Phylogeography and historical demography of North America's northmost ochotonid, the collared pika (*Ochotona collaris*)

Hayley C. Lanier and Link E. Olson

Recombination and speciation: loci near centromeres are more differentiated than loci near telomeres between subspecies of the European rabbit (*Oryctolagus cuniculus*)

Miguel Carneiro, Nuno Ferrand and Michael W. Nachman

Molecular evidence of natural hybridization between the Iberian and brown hares in northern Iberian Peninsula

José Melo-Ferreira, Hélder Freitas, Pierre Boursot and Paulo Célio Alves

16.45 Coffee and Posters Session

19.00 **Welcome Toast End**

Tuesday, November 11

09.00 Plenary Lecture *Auditorium*

Approaches and challenges of managing declining populations of lagomorphs

John A. Litvaitis

09.45 General Session 2 – Ecology, *Population dynamics and Dispersal*

Chair: Brian Cooke and Neil Reid *Auditorium*

9.45 A climate-based model defines the distribution of European rabbits *Oryctolagus cuniculus* (L.) in Australia

Brian Cooke

10.00 Reproductive strategies at different altitudes: the mountain hare (*Lepus timidus varronis)* as a model species

Klaus Hackländer

10.15 Worldwide variability in the reproduction of European wild rabbits and potential effects of climate change

Zulima Tablado, Eloy Revilla and Francisco Palomares

10.30 Coffee

11.00 Rabbit haemorrhagic disease and myxomatosis in the Netherlands

Marijke Drees, Jasja Dekker, Antonio Lavazza and Lorenzo Capucci

11.15 Does the presence of a putative ecological trap explain an apparent hare population paradox?

Neil Reid, Robbie McDonald and Ian Montgomery

11.30 Hunting statistics reveal influence of climatic oscillations and density dependence on Irish hare populations

Neil Reid, Karina Dingerkus, Ian Montgomery, Ferdia Marnell, Rebecca Jeffrey, Deidre Lynn, Naomi Kingston and Robbie McDonald

11.45 Plant productivity, predation and the abundance of black-tailed jackrabbits in the Chihuahuan Desert of Mexico

Lucina Hernández, John W. Laundré, Gloria Luz Portales Betancourt, Alberto González-Romero, Jorge López-Portillo, Karina M. Grajales, Abel García and Jesús M. Martínez

12.00 Survival rates and habitat use of juvenile brown hare (*Lepus europaeus*) – first results

Ulrich Voigt

12.15 GPS telemetry of European brown hare in central Italy: results of activity patterns

Marco Zaccaroni, Niccolò Biliotti, Sabrina Calieri, Marco Ferretti, Marco Genghini, Francesco Riga, Valter Trocchi and Francesco Dessì-Fulgheri

12.30 Lunch

14.30 **General Session 3 - *Behaviour, Sociobiology, Physiology, Toxicology and Diseases*** *Auditorium*

Chair: Klaus Hackländer and Robyn Hudson

14.30 Daily activity patterns of coyotes *(Canis latrans)* and lagomorphs *(Lepus californicus and Sylvilagus audobonii*) in the Chihuahuan Desert

Itzel Arias-Del Razo, Lucina Hernández, John Laundré and Orrin Myers

14.45 Circadian rythmicity in newborn rabbits is entrained by nursing

Ivette Caldelas, R. Montúfar-Chaveznava and Robyn Hudson

15.00 Ovarian dynamics in rabbits and brown hares in relation to seasonal variation

Norbert Lukac, Peter Massanyi, Jaroslav Slamecka, Robert Toman, Rastislav Jurcik, Julius Zitny, Jan Rafay and Grzegorz Formicki

15.15 Comparisons of digestive function between two sympatric lagomorphs, the European hare (*Lepus europaeus*) and the European rabbit (*Oryctolagus cuniculus*)

Philip Stott

15.30 Heavy metals (lead, cadmium, mercury) in liver and kidney of the brown hare (*Lepus europaeus*) and relation to blood plasma parameters

Peter Massanyi, Norbert Lukac, Jaroslav Slamecka, Frieda Tataruch, Rastislav Jurcik, Robert Toman, J. Kovacik, M. Capcarova, Adrana Kolesarova and Robert Stawarz

15.45 Concentration of trace elements in rabbits semen and their correlations

Robert Stawarz, Peter Massanyi, Norbert Lukac, Jaroslav Slamecka, Grzegorz Formicki, Ivan Chlebec, Jozef Trandzik and Aldona Putala

16.00 A shared unusual genetic change at the chemokine receptor type 5 between *Oryctolagus* and *Bunolagus*: can the accidental exposure to myxomatosis drive the critically endangered Riverine rabbit to extinction?

Joana Abrantes, C. R. Carmo, Conrad A. Matthee, Wessel van der Loo and Pedro J. Esteves

16.15 Detection of positive selection in the major capsid protein VP60 of the rabbit haemorrhagic disease virus (RHDV)

Pedro J. Esteves, Joana Abrantes, Miguel Carneiro, Alexandra Müller, Gertudes Thompson and Wessel van der Loo

16.30 Coffee and Poster Session

19.00 **End**

Wednesday, November 12

09.00 Plenary Lecture *Auditorium*

Conservation approaches using Lagomorphs

Gerardo Ceballos

09.45 General Session 4 - *Population management and Conservation* *Auditorium*

Chair: John A. Litvaitis and Klaus Hackländer

09.45 The current distribution and the endangered status of lagomorphs in Asia

Royce To and Klaus Hackländer

10.00 Space use, dispersal and connectivity among populations of pygmy rabbits in Idaho and Montana, USA

Janet Rachlow, James Witham, Wendy Estes-Zumpf, Dana Sanchez and Lisette Waits

10.15 The riparian brush rabbit (*Sylvilagus bachmani riparius*): fighting fire and flood on the road to recovery

Patrick A. Kelly, Matthew Lloyd, Laurissa Hamilton and Daniel Williams

10.30 *The effects of Climate Change on lagomorph populations*
Will *Lepus* successfully respond to global warming: A proposed rangewide research initiative

*L. Scott Mills, Karen Hodges and Paulo Célio Alves**

10.45 Coffee

11.00 Is vaccination of juvenile wild rabbits against myxomatosis always effective if not systematic?

Catarina Ferreira, Esther Ramirez, Francisca Castro, Paulo Célio Alves, Pablo Ferreras and Rafael Villafuerte

11.15 Predictive model of European wild rabbit (*Oryctolagus cuniculus*) enclosed population

Alberto J. Ferreira and Sónia Pina

11.30 Agri-environment schemes: hare haven or pest paradise?

Neil Reid, Robbie McDonald and Ian Montgomery

11.45 Monitoring and population analysis of Amami rabbit *Pentalagus furnessi* based on pellet counting census and DNA extracted from pellets

Fumio Yamada, Ken Sugimura, Junco Nagata, Soh Kobayashi, Naoki Ohnishi, Taku Sakoda, Yumiko Nagai, Masaya Tatara and Shintaro Abe

12.00 Landscape colonization by rabbits: first results and perspectives of a spatially explicit simulation model

Antonio Lopez-Pintor and W. E. Grant

12.15 Effect of the climatic change in the spatial-temporal distribution of two lagomorphs in Mexico

Elizabeth Martínez-Villeda and Enrique Martínez-Meyer

12.30 Latest tendencies of the European wild rabbit in Spain

Jaime Muñoz-Igualada and S. Roig-Gómez

12.45 Lunch

14.30 The Importance of Landscape Structure and Elements for Lagomorphs
Workshop 3 *Room 1 (West room)*

Convener - Daniel Jiménez García

Facilitation of rabbits by cattle

Jasja Dekker, Nele Somers, Liesbeth Bakker, Leo Van Breukelen, Sip Van Wieren, Maurice Hoffman and Herbert Prins

Landscape perspectives for wild rabbit (*Oryctolagus cuniculus* l.) in the south eastern Spain

Daniel Jiménez-García, J. E. Martínez-Pérez, V. Peiró, J. Arques, J. Palacio-Núñez and A. Belda

Adaptability of habitat preferences and spatial organization of rabbit warrens across the landscape in contrasting ecosystems

Antonio Lopez-Pintor

Importance of landscape elements for rabbits and hares in semiarid environments in Mexico

Daniel Jiménez-García, J. Palacio-Núñez, G. Olmos-Oropeza, O. Martínez, J. Martínez-Calderas, J. Cordero, S. Jiménez and L. C. Victoria-García

14.30 Estimating Lagomorph Densities
Workshop 4 *Room 2 (East room)*

Convener: Neil Reid

European hare densities and pasture use: contrary results for a species of conservation concern in north east England

Silviu Petrovan, Alastair Ward and Phil Wheeler

Census techniques for European brown hare, *Lepus europaeus,* populations in an alpine environment: comparison and evaluation between spotlight count and faecal pellet count

Paolo Tizzani, Giorgio Ficetto, Andrea Dematteis and Pier Giuseppe Meneguz

Towards a standardized index to estimate European rabbit abundance in Mediterranean habitats of central-southern Spain

Javier Fernández de Simón, Francisco Díaz, Francesca Cirilli, Francisco Sánchez Tortosa, Rafael Villafuerte, Miguel Delibes-Mateos and Pablo Ferreras

Estimating lagomorph density: enhancing use and avoiding abuse of distance sampling

Neil Reid, Karina Dingerkus, David Borchers, Tiago Marques, Ian Montgomery, Ferdia Marnell, Rebecca Jeffrey, Deidre Lynn, Naomi Kingston and Robbie McDonald

16.30 Coffee and Poster Session

18.30 Book presentation

18.30 Historias del pastizal: La liebre de Tehuantepec

Consuelo Lorenzo Monterrubio

19.00 **End**

Thursday, November 13

09.00 Plenary Lecture *Auditorium*

Mexican Lagomorphs

Fernando A. Cervantes

09.45 *2008 Meeting SSC/IUCN Lagomorph Specialist Group (LSG)*

Convener: Andrew Thomas Smith *Auditorium*

11.00 Coffee

11.30 General Assembly of AMCELA *Auditorium*

Conveners: Adriana Romero Palacios y Verónica Farías González

12.30 **Lunch**

14.30 **Plenary Lecture** *Auditorium*

Landscape-based conservation, a new paradigm or a state of mind

Alejandro Velázquez

15.15 General Assembly of the World Lagomorph Society (WLS) *Auditorium*

Conveners: Paulo Célio Alves and Klaus Hackländer

16.30 **Coffee**

17.00 **Concluding Plenary Lecture** *Auditorium*

Trends in Lagomorphs Research

Paulo Célio Alves

17.45 **Closing ceremony** *Auditorium*

M. en C. Catalina Rosas Monge
Secretaria de Urbanismo y Medio Ambiente
Gobierno del Estado de Michoacán de Ocampo

19.00 **Banquet**

Poster contributions

November 10

GENERAL SESSION 1 - Systematics, Evolution and Genetics

1. Genetic and morphological variation in Tunisian hares (*Lepus capensis*)

   Hichem Ben Slimen and Franz Suchentrunk)

2. *Oryctolagus giberti* n. sp. (Mammalia: Lagomorpha) from the lower Pleistocene of Cueva Victoria (Murcia, Spain)

   Roger Joan De Marfà Taillefer

3. Morphometry of the third lower premolar of modern leporids from Western Mediterranean

   Roger Joan De Marfà Taillefer, C. Callou, M. Baylac, and R. Cornette

4. Success hints of a translocation program of wild European brown hares (*Lepus europeaus*)

   Claude Fischer and G. Yannic

5. Three methods for determining the geographic distribution area of species: a case study based on four species of lagomorphs in Mexico

   Elizabeth Martínez Villeda and Constantino González-Salazar

6. From *Lepus tanaiticus* gur. to *Lepus timidus* l. , the solution of that evolutional passage

   Nocolay Ovodov

7. Dental enamel comparison of the molariforms of Mexican hares (Leporidae: *Lepus*)

   Adriana Romero-Palacios and Fernando A. Cervantes

8. Molecular phylogeny of *Lepus* (Mammalia: Lagomorpha): a phylogenetic assessment including all the Mexican species

   Juan Pablo Ramírez Silva, Francisco X. González-Cózatl, Ella Vázquez-Domínguez and Fernando A. Cervantes Reza

9. Origin and present status of the Sardinian hare (*Lepus capensis*) assessed by morphometrical and molecular analyses

   Massimo Scandura, A. Cossu, L. Lacolina, R. Foddai, N. Cappai, Hichem Ben Slimen, Franz Suchentrunk and M. Apollonio

10. Is female brown hare (*Lepus europaeus*) reproductive success influenced by MHC and microsatellite variability?

    Steve Smith, J. G. de Bellocq, Claudia Zeitlhofer, Klaus Hackländer and Franz Suchentrunk

11. Microsatellite variation in brown hares (*Lepus europaeus*) from the mtDNA introgression zone in NE Greece and other Greek populations

    Franz Suchentrunk, Hichem Ben Slimen, C. Stamatis and Z. Mamuris

12. Variation of skull shape and size in cape hares (*Lepus capensis*) from three climatically different habitats in Kenya

    Franz Suchentrunk and John E. C. Flux

13. Diversity and evolutionary history of the MHC DQA gene in leporids

    Alison K. Surridge, Wessel van der Loo, Joana Abrantes, Miguel Carneiro, Godfrey M. Hewitt and Pedro J. Esteves

14. Phylogeographical analysis of mountain hares (*Lepus timidus varronis*) from Eastern Switzerland: is there a genetic signature of postglacial immigration?

    Frank Zachos, M. Giacometti, Klaus Hackländer and Franz Suchentrunk

GENERAL SESSION 2 - Ecology, Population dynamics, Dispersal

15. Dispersal of the European hare (*Lepus europaeus*) in South America

    Never Bonino, Daniel Cossios and Joao Menegheti

16. The role of *Juniperus deppeana* seed dispersal by *Sylvilagus floridanus* in a semiarid region of Mexico

    Jaqueline Campos Jiménez and Armando J. Martínez Chacón

17. Resting and feeding sites of the Tehuantepec jackrabbit, an endangered lagomorph: conservation implications

    Arturo Carrillo Reyes, Consuelo Lorenzo, Eduardo Naranjo, Marisela Pando and Tamara Rioja

18. Home range and habitat selection of free-ranging Iberian hares (*Lepus granatensis*) in Doñana National Park (SW Iberian Peninsula)

    Francisco Carro, Ramón C. Soriguer, J. F. Beltrán and Ana C. Andreu

19. The rabbit's ecosystem: a review of the multifunctional key role of European rabbits (*Oryctolagus cuniculus*) in Mediterranean South-Western Europe

    Miguel Delibes-Mateos, Miguel Delibes, Javier Fernández de Simón, Pablo Ferreras and Rafael Villafuerte

20. Desert lagomorphs and hunting strategies of their mammalian carnivore predators
    Cynthia Elizalde-Arellano, Juan Carlos López-Vidal, Lucina Hernández and John W. Laundré

21. Habitat use of Volcano and Cottontail Rabbits in Pelado Volcano, México

    Yajaira García Feria and Verónica Farías

November 11

22. Characteristics of latrines and habitat use in *Lepus callotis* and *Sylvilagus floridanus*, sympatric species of the Trans-Volcanic Belt of Central Mexico

    José Luis González Galvéz, Armando J. Martínez Chacón, José G. García-Franco, Laura Teresa Hernández Salazar and Ariadna I. Santa Anna Aguayo

23. Monitoring the brown hare (*Lepus europaeus*) in Germany

    Andreas Grauer, Egbert Strauß, Bärbel Heyen, Roland Klein, Ludger Wenzelides, Grit Greiser, Alexander Muchin, Armin Winter and Ulrich Voigt)

24. Preliminary data on habitat preferences in *Lepus corsicanus* and *L. europaeus* in Latium region (Central Italy)

    S. Guglielmi, S. Properzi, F. Riga, A. Sorace and V. Trocchi

25. Factors associated with survival of reintroduced riparian brush rabbits in California

    Laurissa P. Hamilton, Douglas A. Kelt, Heiko U. Wittmer, Patrick A. Kelly and Daniel F. Williams

26. Spatial ecology and habitat selection of a translocated population of riparian brush rabbits

    Laurissa P Hamilton, Douglas A. Kelt, Patrick A. Kelly and Daniel F. Williams

27. Food habits of the cotton *Sylvilagus floridanus* from Puebla, Mexico

    Jesús Martínez Vázquez, Rosa María González Monroy and Lorena Martínez Ortiz

28. Fire effects on volcano rabbit population (*Romerolagus diazi*), in alpine grassland, central Mexico

    Héctor Rangel-Cordero

29. Life history strategies in European hares (*Lepus europaeus*): comparing Atlantic and Continental climate

    Claudia Zeitlhofer, Franz Suchentrunk and Klaus Hackländer

GENERAL SESSION 3 - Behaviour, Sociobiology, Physiology, Toxicology and Diseases

30. Serum concentrations of gonadal hormones in Mexican cottontail *Sylvilagus cunicularius* at La Malinche National Park, Tlaxcala

    Fernando Aguilar, Leticia Nicolás, María Luisa Rodríguez-Martínez, Jorge Vázquez, Laura García, Humberto Pérez-Roldán and Margarita Martínez-Gómez

31. Chemical restraint of the zacatuche rabbit (*Romerolagus diazi*) at Chapultepec Zoo, Mexico City

    Rogelio Campos Morales

32. Somatometry of adult zacatuche rabbit (*Romerolagus diazi*) in captivity at Chapultepec Zoo, Mexico City.

    Rogelio Campos Morales, Germán Mendoza Martínez, Javier Ojeda Chavez, J. Antonio García Martínez and Fernando X. Plata Pérez

33. Zacatuche´s (*Romerolagus diazi*) hypoglycemic and wasting syndrome in captivity

    Rogelio Campos Morales, Osvaldo López-Díaz and Ángeles Pintado-Escamilla

34. Fertility and leveret survival of the European hare *Lepus europaeus* in north-eastern Italy

    A. M. De Marinis, V.Trocchi, G. Nadalin, R. Petrucco and L. Masselli

35. Maternal care in the European rabbit, *Oryctolagus cuniculus*

    Marijke Drees, Ivo Mol (pictures) and Sim Broekhuizen (film)

36. Illustrations of hare and rabbit behaviour in New Zealand

    John E. C. Flux

37. The landscape of fear for jackrabbits (*Lepus californicus*) related to bobcats (*Lynx rufus*) at the Chihuahuan Desert

    Juan Carlos López-Vidal, Cynthia Elizalde-Arellano, John W. Laundré and Lucina Hernández García

38. Utilization of feed mixtures in nutrition of farmed European hare (*Lepus europaeus*)

    D. Mertin, Jaroslav Slamečka, Rastislav Jurčík, Ľ. Chrastinová and Norbert Lukáč

39. Effect of permanent and periodic hyperthermic stress on broiler rabbits

    Lubomir Ondruška, V. Parkányi, J. Rafay, Ľ. Chrastinová, J. Pivko, Peter Massányi, Norbert Lukáč2 and M. Capcarová

November 12

40. Advances in the study of the Tehuantepec jackrabbit *Lepus flavigularis* in Mexico

    Consuelo Lorenzo Monterrubio, Yessica Rico Mancebo del Castillo and Georgina Cantoral Trejo

41. Breeding and parental care in the endangered Tehuantepec jackrabbit (*Lepus flavigularis*)

    Tamara Rioja, Consuelo Lorenzo, Eduardo Naranjo, Laura Scott and Arturo Carrillo-Reyes

42. Hematological parameters of zacatuche rabbit (*Romerolagus diazi*) at Chapultepec Zoo, Mexico City

    Alejandra Rivas Gómez, Ignacio Rangel R., Rogelio Campos-Morales

43. Hematological values description in the Mexican cottontail rabbit *Sylvilagus cunicularius* under captive conditions

Luisa Rodríguez-Martínez, Minerva Flores-Morales, Jorge Vázquez, Amando Bautista, Margarita Martínez-Gómez

44. Interspecific variability of parasite aggregation associated with the haematocrit in two sympatric lagomorph species in the Chihuahuan Desert

Ariadna I. Santa Anna Aguayo, Armando J. Martínez Chacón, Dora Romero Salas, José A. Guerrero and Jorge Vázquez Pérez

45. Investigations on health status in German European brown hares (*Lepus europaeus*) with regard to diseases possibly affecting juvenile mortality

Stephanie Speck, Melanie Franke, Claudia Szentiks, Kai Frölich, Robert Stark and Ulrich Voigt

46. Prevalence of *Francisella tularensis* and *Brucella suis* in brown hares´ population in lower saxony - the latest results

Martina Wedekind, Michael von Keyserlingk, Ulrich Voigt, Andreas Grauer, Wolf Splettstoesser, Peter Otto, Wolfgang Müller, Falk Melzer, Klaus Pohlmeyer and Martin Runge

GENERAL SESSION 4 - Population Management and Conservation

47. Seasonal and regional influences on habitat preferences of European hares (*Lepus europaeus*) in modern cultivated agriculture areas

Stephanie Braun, D. Weber and Klaus Hackländer

48. Warren characterization in low-density rabbit populations

Isabel Catalán, G. Bueno and Francisco Sánchez Tortosa

49. Survival in large-scale European wild rabbit restockings

Marcello D'Amico, Zulima Tablado and Francisco Palomares

50. Conservation of a Mediterranean hare endemism, *Lepus corsicanus*, in man made habitat

Gabriele de Filippo and Sabatino Rosario Troisi

51. Climate change effect in the distribution of the volcano rabbit *Romerolagus diazi Angélica Domínguez Pérez and Constantino González-Salazar*

52. Dispersal of rabbits after translocation; the use of burrows

Marijke Drees, Jasja Dekker, L. Wester and H. Olff

53. The effects of habitat fragmentation and landscape features on the genetic structure of New England cottontail populations

Lindsey Fenderson, Adrienne Kovach, John Litvaitis and Marian Litvaitis

54. European wild rabbit (*Orytolagus cuniculus*) body weight curve in a Mediterranean habitat

Alberto J. Ferreira and Sofia Gouveia

55. A field enclosure establishment for the study of the Mexican cottontail rabbit *Sylvilagus cunicularius* at the Malinche National Park, Mexico

Minerva Flores-Morales, Jorge Vázquez, Luisa Rodríguez-Martínez, Amando Bautista, Humberto Pérez-Roldán and Margarita Martínez-Gómez

56. Management of wild rabbit (*Oryctolagus cuniculus*) populations in Andalusia

María Dolores González and Cristina San José

57. Challenges to maintaining a radio-collared sub-population of reintroduced riparian brush rabbits (*Sylvilagus bachmani riparius*)

Matthew R. Lloyd, Patrick A.Kelly and R. S. Larsen

58. Factors associated with hare mortality during coursing

Neil Reid, Robbie McDonald and Ian Montgomery

59. Is naturalization of the European Hare in Ireland a threat to the endemic Irish hare?

Neil Reid and Ian Montgomery

60. Distribution and abundance of the volcano rabbit (*Romerolagus diazi*) in a natural protected area: a GIS approach

Areli Rizo-Aguilar, José A. Guerrero and M. Gabriel Hidalgo-Mihart

61. Predator exclusion or acclimatization to the release site, what is better in European rabbit translocations programs?

Carlos Rouco, Pablo Ferreras, Francisca Castro and Rafael Villafuerte

62. Wild rabbit recovery program when dealing with state-owner and private companies and landowners, in Hornachuelos Natural Park (Southern Spain)

Carlos Rouco, Viviane Morlanes, Carlos Marfil, José Antonio García and Sacramento Moreno

63. Monitoreo de la poblaciones de teporingo (*Romerolagus diazi*) dentro del Parque Nacional Iztaccíhuatl- Popocatépetl, avances de investigación

Raúl Salamanca and A. Tagle Urrutia

64. Damages in agriculture caused by European hare (*Lepus europaeus*) and protection against them

Jaroslav Slamečka, M. Grácová, J. Gašparík, P. Hell and Peter Massányi

65. Activity and adaptation of Amami rabbit *Pentalagus furnessi* inhabit in damp subtropical temperature

Fumio Yamada

66. What can genetics tell us about the European rabbit (*Oryctolagus cuniculus*) restocking operations in Portugal?

Liliana Farelo, Raquel Godinho, David Gonçalves, Nuno Ferrand, Armando Geraldes and Paulo Célio Alves