32ND EUROPEAN
MUSTELID COLLOQUIUM
15-17 NOVEMBER 2017

Book of Abstracts



32nd European Mustelid Colloquium
15-17 November 2017

Université Claude Bernard Lyon 1, Villeurbanne, Lyon

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Welcome

We are very pleased to welcome you all to the 32nd European Mustelid Colloquium in Lyon. This is the first time that the Colloquium has been held since 2013 and we are delighted to be welcoming 112 delegates from 13 countries. We hope that the Colloquium will provide an opportunity to share research findings and ideas, and discuss opportunities for collaborations and future work to address the many challenges facing mustelids throughout Europe. We have designed the session themes around some of the most relevant issues and challenges in mustelid conservation in Europe today. These will be addressed through 25 oral presentations (including four keynotes), a mini-workshop and 28 poster presentations over the two days of the Colloquium.

The planning and implementation of the Colloquium has been the result of a French-British collaborative effort between Le Laboratoire de Biométrie et Biologie Évolutive (The University Claude Bernard Lyon1-CNRS), Office National de la Chasse et de la Faune Sauvage and The Vincent Wildlife Trust. We are exceptionally grateful to the scientific committee, who contributed to planning the Colloquium and reviewed the submitted abstracts. We are also grateful to the following organisations that have sponsored the Colloquium: The Laboratory of Biometry and Evolutionary Biology, National Hunting and Wildlife Agency (ONCFS), CNRS DR07 Délégation Rhône Auvergne, Université Claude Bernard Lyon1 and the very aptly named technology company, Polecat! The Book of Abstracts was designed by Helen Kidwell (The Vincent Wildlife Trust).

We look forward to meeting you all over the coming days and hope you have an enjoyable, thought-provoking and productive time at the Colloquium.

Steve Carter & Lizzie Croose, The Vincent Wildlife Trust, UK

Sébastien Devillard, Laboratoire de Biométrie et Biologie Evolutive, France

Sandrine Ruette, Office National de la Chasse et de la Faune Sauvage, France

Committees

Organising Committee

Steve Carter (The Vincent Wildlife Trust (VWT))

Lizzie Croose (VWT)

Hilary Macmillan (VWT)

Helen Kidwell (VWT)

Sébastien Devillard (Laboratoire de Biométrie et Biologie Évolutive, France (LBBE))

Nathalie Arbasetti (LBBE)

Jeanne Duhayer (LBBE)

Sylvia Pardonnet (LBBE)

François Debias (LBBE)

Mickaël Jacquier (LBBE/Office National de la Chasse et de la Faune Sauvage (ONCFS))

Sandrine Ruette (ONCFS)

Yoann Bressan (ONCFS)

Jean-Michel Vandel (ONCFS)

Michel Albaret (ONCFS)

François Léger (ONCFS)

Scientific Committee

Dr Johnny Birks, Swift Ecology, UK

Dr Steve Carter, The Vincent Wildlife Trust, UK

Lizzie Croose, The Vincent Wildlife Trust, UK

Dr Sébastien Devillard, Laboratoire de Biométrie et Biologie Évolutive, France

Professor Robbie McDonald, University of Exeter, UK

Dr Catherine O'Reilly, Waterford Institute of Technology, Ireland

Dr Sandrine Ruette, ONCFS, France

Dr Margarida Santos-Reis, Centre for Ecology, Evolution and Environmental Changes, Portugal

Dr Izabela Wierzbowska, Jagiellonian University, Poland

Sponsors

Le Laboratoire de Biométrie et Biologie Évolutive

The Laboratory of Biometry and Evolutionary Biology (LBBE) is a research unit in Ecology, Population Genetics, Evolutionary Biology and Molecular Biology, headquartered in Villeurbanne, Rhône.

Office National de la Chasse et de la Faune Sauvage

The National Hunting and Wildlife Agency (ONCFS) is a public administrative institution. Its mission relates to the knowledge of wildlife and its habitats through studies and research, hunting and nature police, technical support to policy makers, land planners and managers of rural areas and the organization and issuance of hunting permits.

CNRS DR07 Délégation Rhône Auvergne

CNRS is the French National Center for Scientific Research. Its activities cover all fields of sciences.

Université Claude Bernard Lyon1

The University Claude Bernard Lyon1 is a science and technologies university covering all fields of sciences.

Polecat

Polecat is a fast-growing technology company that uses big data analytics to provide risk intelligence to customers in the healthcare, energy and finance sectors. Based in the UK and US, the choice of Polecat as a company name was inspired by the bravery, tenacity and audacity of its wild counterpart.

Important Information

Colloquium Dinner

The traditional Colloquium Dinner will take place at 20:00 on Thursday 16th November at a restaurant located in the Vieux Lyon (the historical district of Lyon) in the town centre. The restaurant is "Chez Grand-mère" (http://www.chezgrandmere.fr) located in 11 rue du boeuf 69005 Lyon.

Raffle

During the colloquium dinner, we will be holding a raffle. Ticket price will be 1 or 2 euros and this will go towards student bursaries for the next colloquium. Conference delegates are invited to bring a small contribution from their country as a prize in the raffle. Contributions of a mustelid nature are particularly welcome!

Registration

The Registration Desk will be open from 17:00 to 20:00 on Wednesday 15th November, from 08:30 to 09:05 on Thursday 16th November and from 08:30 to 9:00 on Friday 17th November.

Information for speakers

Speakers should come to the lecture theatre 5 minutes before the start of their session to meet the Chair and have a quick introduction to the presenting equipment.

Social media

We encourage people to tweet about the Colloquium using the official hashtag #EMC32. If you would not like photographs or information from your presentation shared on social media, please state this at the start of your talk.

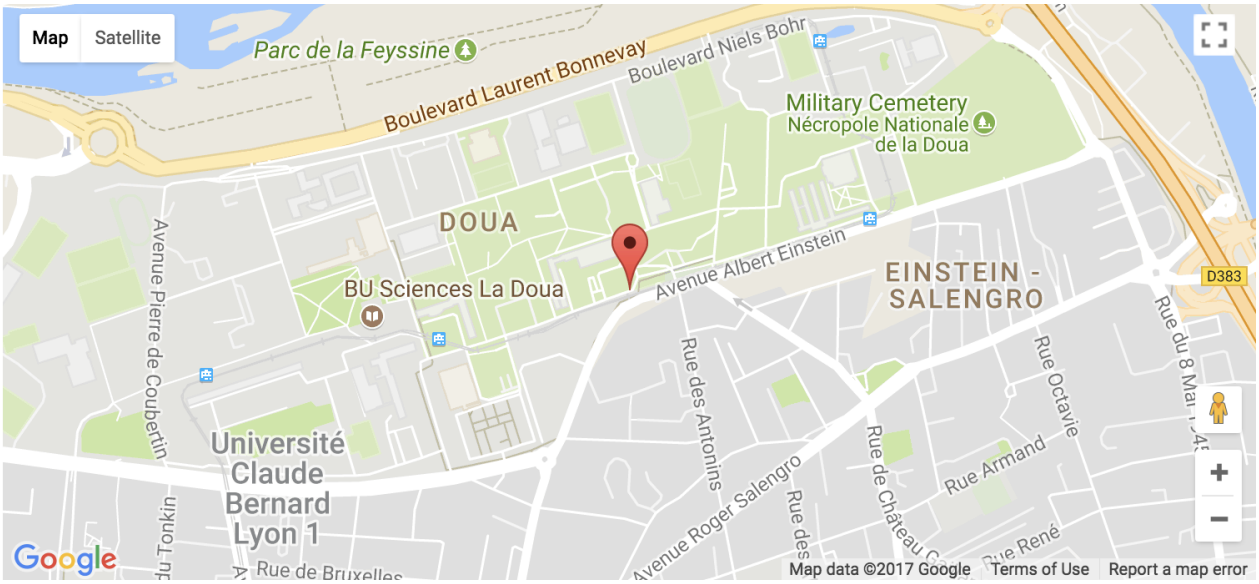
Information for poster presentations

Posters can be put onto boards during the welcome cocktail and during the coffee break on Thursday morning. During the poster session authors are requested to stand by their posters.

Prizes for best presentations

We will be awarding a prize for the two best student presentations (oral and poster) and the two best non-student presentations (oral and poster). These have been kindly donated by Oxford University Press and Johnny Birks.

Colloquium Venue



The colloquium will be held at the 'Amphithéatre Emilie du Châtelet' of the INSA Marie Curie Library:

Bibliothèque Marie Curie de l'INSA, campus de La Doua
Université Claude Bernard Lyon 1
31 avenue Jean Capelle
69100 Villeurbanne

The welcome cocktail and coffee breaks will be in Room 202-203 at the Marie Curie Library.



Keynote Speaker Biographies



Margarida Santos-Reis, Centre for Ecology, Evolution and Environmental Changes, Portugal

Margarida is based at the University of Lisbon in Portugal, where she is associate professor at the Animal Biology Department of the Faculty of Sciences and the coordinator of the Centre for Ecology, Evolution and Environmental Changes. She started her research career with mustelid work by studying the ecology and dynamics of a weasel population in an agroecosystem. For many years she has been involved in carnivore conservation ecology, but along the years her interests have expanded to themes more inter-disciplinary such as human-wildlife conflict, sustainability of the cork-oak ecosystem, conservation of Mediterranean landscapes, and ecosystem services. However, her interest on carnivores continues today with an emphasis on the responses at the community level to anthropogenic changes to the landscape and subsequent management options. Among the mustelids, stone martens, badgers and otters have been the primary focus in her carnivore-oriented research.



Robbie McDonald, University of Exeter, UK

Robbie is based at the University of Exeter's Penryn campus in Cornwall, where he holds a Chair in Natural Environment. He works on a wide range of interdisciplinary research projects in wildlife ecology and management. He started his research career with mustelid work and is still at it 25 years later. His honours project was on otters, but he didn't see any and, like so many other students before him, worked on spraint analysis. After graduation, and conducting surveys of Californian sea otters, Alaskan martens, Scottish badgers and Welsh martens, he undertook a PhD on weasels and stoats. More work on NZ and Irish stoats, martens, otters, mink and ferrets ensued before he finally succumbed to the inevitable and started work on badgers and TB. This is still a major focus, but thankfully, he now also gets to work with The Vincent Wildlife Trust on marten and polecat conservation and exciting non-mustelids (see photo) once in a while. This year he took his family on holiday to Costa Rica and didn't see a tayra.



Izabela Wierzbowska, Institute of Environmental Sciences Jagiellonian University

Izabela Wierzbowska received a PhD in Biological sciences from Jagiellonian University, Krakow, Poland. She is currently a Senior Lecturer at the same university teaching several courses on nature conservation, urban ecology, ecology of Carnivora, game biology and biodiversity. Her professional interests focus on habituation of mammals to urban habitats, consequences of synurbisation, ecology of carnivores and their relationship with prey, and morphological adaptations of large ruminants. Her current projects include monitoring of large carnivores by camera traps in southern Poland, trophic analysis of carnivore community in Gorce National Park, analysis of hot spots of human-wildlife conflicts in Krakow city. She has published 50 scientific papers and books in the field of biology of large mammals. In addition, she is a member of *Martes* Working Group and The Wildlife Society Urban Working Group.



Pascal Fournier, Groupe de Recherche et d'Etude pour la Gestion de l'Environnement (GREGE), France

Following his veterinary studies, Pascal focused his career on wildlife studies and conservation. After an initial research project on spatial behaviour and habitat utilisation of wild boar in south-eastern France, he was responsible for the “Saut Vata” upstream capture camp as part of the wildlife rescue and translocation programme during the filling of the “Petit Saut” hydroelectric dam in French Guiana. In 1996, he led the first radiotracking studies on European mink in south-western France and was strongly involved in the first French National Action Plan for the European mink in collaboration with the French Mammal Society (SFEPM). Pascal has been Director of the GREGE office for 18 years and works on a wide range of topics on emblematic semi-aquatic and terrestrial mammals, including inventories, bio-health studies, environmental studies, compensatory measures and conservation actions. As a recent example, the GREGE is an associated beneficiary in the ambitious LIFE project “Conservation of the European mink and associated community species and habitats of the Charente River Basin” which started in September 2017.

Scientific and Social Programme

Wednesday 15 November 2017

17:00 - 20:00 WELCOME COCKTAIL AND REGISTRATION
(Marie Curie Library, Campus de la Doua, Room 202-203)

Thursday 16 November 2017

08:30 - 09:05 ARRIVAL AND REGISTRATION (Marie Curie Library of INSA, Campus de la Doua, Amphithéâtre Emilie du Châtelet)

09:05 - 09:15 OPENING REMARKS

09:15 - 10:35 CONSERVATION INTERVENTIONS

- 09:15 - 09:55 Updating mustelids research trends in Europe: Are we addressing the challenges imposed by the changing world? - *Margarida Santos-Reis, Centre for Ecology, Evolution and Environmental Changes (KEYNOTE SPEAKER)*
- 09:55 - 10:15 The Otter Action Plan in France, what are the achievements? - *Rachel KUHN, Société Francaise pour l'Etude et la Protection des Mammifères*
- 10:15 - 10:35 Genetic Monitoring of a Donor Population of Translocated Pine Marten - *Catherine O'Reilly, Waterford Institute of Technology*

10:35 - 11:05 COFFEE BREAK

11:05 - 12:05 CONSERVATION INTERVENTIONS

- 11:05 - 11:25 Can personality be used as a tool to improve European mink (*Mustela lutreola*) conservation? - *Marianne Haage, Stockholm University*
- 11:25 - 11:45 Think national, act local: small mustelid conservation in Switzerland - *Irene Weinberger, Quadrapoda*
- 11:45 - 12:05 Understanding carnivore restoration: using Q Methodology to reveal perceptions of a pine marten (*Martes martes*) translocation - *David Bavin, University of Exeter & The Vincent Wildlife Trust*

12:05 - 12:30 HOUSEKEEPING ANNOUNCEMENTS (Lunches, Colloquium Dinner and Prizes)

12:30 - 13:50 LUNCH

13:50 - 15:50 MONITORING MUSTELIDS

- 13:50 - 14:30 Big changes for small carnivores – *Robbie McDonald, Environment and Sustainability Institute, University of Exeter (KEYNOTE SPEAKER)*
- 14:30 - 14:50 Estimating the spatial distribution of *Mustelidae* in France with opportunistic data -*Clément Calenge, Office National de la Chasse et de la Faune Sauvage*

14:50 - 15:10 Using genetic methods to estimate vaccination coverage and population size in the European badger - *Andrew Robertson, University of Exeter & Animal and Plant Health Agency*

15:10 - 15:30 Into the wilderness: the expansion of the pine marten in the Val Grande National Park - *Alessandro Balestrieri, University of Milan*

15:30 - 15:50 Multi-site variation in pine marten density: Towards national population estimates -*Declan O' Mahony, Agri-Food and Biosciences Institute*

15:50 - 17:00 COFFEE BREAK AND POSTER SESSION

17:00 - 18:00 WORKSHOP ON MONITORING SMALL MUSTELIDS

a) Research and conservation of small mustelids...present and future – *Jeroen Mos, Dutch Small Mustelid Foundation*

b) Developing a new method to detect small mustelids – *Nils Ratnaweera, ZHAW, School of Life Sciences and Facility Management*

20:00 - 23:55 COLLOQUIUM DINNER (Restaurant Chez Grand-Mère, 11 rue du boeuf 69005 LYON)

Friday 17 November 2017

08:30 - 09:00 REGISTRATION (Marie Curie Library of INSA, Campus de la Doua, Amphithéâtre Emilie du Châtelet)

09:00 - 11:00 MUSTELIDS IN A CHANGING LANDSCAPE

09:00 - 09:40 Mustelids in the city – case studies of urban adapters - *Izabela Wierzbowska, Institute of Environmental Sciences, Jagiellonian University (KEYNOTE SPEAKER)*

09:40 - 10:00 Conflicts and conservation challenges for a recovering pine marten (*Martes martes*) population in Ireland - *Ruth Hanniffy, The Vincent Wildlife Trust*

10:00 - 10:20 Movements of the European pine marten when facing landscape constraints - *Marina Mergey, URCA-CERFE*

10:20 - 10:40 A road risk map for the Eurasian badger (*Meles meles, Carnivora, Mammalia*) in Central Italy - *Mauro Fabrizio, Università degli Studi del Molise*

10:40 - 11:00 Make a living by what we get: Ecological plasticity of badgers in an agroforestry and cattle ranching area of Central-West Portugal - *Dário Hipólito, Departamento de Biologia & CESAM*

11:00 - 11:30 COFFEE BREAK

11:30 - 12:50 GENERAL ECOLOGY

11:30 - 11:50 Host heterogeneity and TB dynamics in badgers - *Richard Delahay, Animal & Plant Health Agency*

11:50 - 12:10 Badgers as Super-Rangers: An investigation of Ranging Strategies in a European Badger Population - *Aoibheann Gaughran, Trinity College Dublin*

12:10 - 12:30 Food for thought: Prey availability rather than competition as determinant of relative abundance of Dutch mustelids - *Tim Hofmeester, Swedish University of Agricultural Sciences & Wageningen University*

12:30 - 12:50 Expand or disappear? Why related Mustelid species follow different roads. Lessons from the genetic study of mink, polecat and otter - *Johan Michaux, Université de Liège*

12:50 - 14:00 LUNCH

14:00 - 14:10 INTRODUCTION TO THE "POLECAT" SESSION - Johnny Birks

14:10 - 16:00 WESTERN POLECAT: Conservation status and current threats

14:10 - 14:40 Conservation status of the polecat (*Mustela putorius*) in France: national synthesis and main threats - *Pascal Fournier, Groupe de Recherche et d'Etude pour la Gestion de l'Environnement, Société Française pour l'Etude et la Protection des Mammifères (KEYNOTE SPEAKER)*

14:40 - 15:00 A review of the status of the Western polecat *Mustela putorius*: a neglected and declining species? - *Elizabeth Croose, The Vincent Wildlife Trust*

15:00 - 15:20 Exposure of European polecats (*Mustela putorius*) in Britain to Toxoplasma gondii, Leptospira and Canine Distemper Virus - *Kari-Anne Heald, University of Edinburgh*

15:20 - 15:40 Monitoring secondary exposure to anticoagulant rodenticides in a recovering carnivore: the European polecat *Mustela putorius* in Great Britain - *Katie Sainsbury, University of Exeter*

15:40 - 16:00 Rodenticide exposure of stone marten and polecat: effects of regulatory restrictions and exposure risk modelled on landscapes - *Morten Elmeros, Aarhus University*

16:00 - 16:30 COFFEE BREAK

16:30 - 17:00 CONCLUDING REMARKS & PRIZES

Conservation Interventions



KEYNOTE LECTURE

Updating mustelid research trends in Europe: are we addressing the challenges imposed by the changing world?

Margarida Santos-Reis[1], Luís Miguel Rosalino[2], Ana Luísa Barros[1]

[1]Centre for Ecology, Evolution and Environmental Changes, Lisbon University, Portugal, mmreis@fc.ul.pt

[2]CESAM, Aveiro University, Portugal

In 2011, at the 29th European Mustelid Colloquium held in Southampton (UK), research efforts on the ecology and conservation of mustelids in NW Europe were reviewed based on a literature search that allowed summarising available knowledge for the period 1990-2011 (617 papers) and identifying research gaps and needs. Results obtained demonstrated that knowledge was strongly biased in terms of species, geographic scale and research themes. Most studies were focused on describing ecological features of a few single-species, largely concentrated on the UK populations. Also, among other conclusions, there was a clear need for multi-species approaches and to integrate lessons learned with human perceptions and land use management practices and policies. Given the unsustainable exploitation of resources, exacerbated by climate change and other anthropogenic environmental impacts, such needs should have been prioritised to allow defining long-term effective conservation.

Using a similar approach (literature review) for the 2012-2017-time period (509 papers), here we update the present findings pursuing the following objectives: i) determining the current knowledge status; ii) understanding how research efforts have changed from five years ago; and, iii) evaluate if and how researchers are addressing the right challenges imposed by a changing world.

The findings suggest that researchers are not adequately handling the issue and that new and concerted actions need to be put in place to build successful conservation approaches and to call for a wider institutional/political and societal support. Furthermore, environmental problems act at different scales and can be addressed only by comparing populations of both local and global ecosystems requiring us to develop standard monitoring protocols and new methods of study design. Only by conducting research at all levels and by developing novel approaches can we hope to address the challenges faced today.

The Otter Action Plan in France, what are the achievements?

Rachel Kuhn[1], Véronique Barthélemy[2], Hélène Jacques[1], Franck Simonnet[1]

[1] Société Française pour l'Étude et la Protection des Mammifères (SFEPM), 19 allée René Ménard, 18 000 Bourges, France, rachelkuhn@yahoo.fr

[2] DREAL Nouvelle Aquitaine, 22 rue des Pénitents Blancs, 87032 Limoges, France

Keywords: *conservation, communication, cooperation, conflict management, citizen conservation.*

A national action plan for the Eurasian otter was implemented in France from 2010 to 2016 in order to encourage the natural recolonisation, while avoiding severe conflicts of interests between otters and humans. This is part of the policy and strategy of the Ministry of Ecology. The plan has been compiled in 2009 by the French Mammal Society (SFEPM), which became the national coordinator, under the supervision of the DREAL (regional department of the Ministry of Ecology) Limousin (now DREAL Nouvelle-Aquitaine, since the French regions were merged). The implementation was at a national and at a local level. All possible key players (NGOs, scientists, authorities, road contractors, fishers…) were involved, which required considerable networking efforts, and the organisation of many meetings, seminars and workshops. Thus, relations and cooperation to improve research and conservation developed. The plan also integrated with existing policies and initiatives. The consideration of otters improved.

The strategy presented in the plan covered a broad spectrum of subjects. Monitoring and especially the gathering of data was improved in order to update the distribution map. The potential of areas across France to be suitable for otters was assessed. Conservation measures were taken, for example to reduce road mortality. A key issue was to reconcile otters and fish-farming, which included convincing fish-farmers to coexist with otters and offering them assistance to protect their facilities against otter predation. Education, of the public and stakeholder, was a major part of the plan (events, conferences, booklets, exhibits, movies and articles). A special initiative was the *Opération Havre de Paix* (Otter Haven), a citizen conservation project involving riparian land owners who want to manage their property in an otter friendly way and to advertise this.

Genetic Monitoring of a Donor Population of Translocated Pine Marten

Ciara Powell[1], Jenny Macpherson[2], Catherine O'Reilly[1]

[1] Waterford Institute of Technology, Cork Road, Waterford, Ireland, ciarapowell@gmail.com

[2] The Vincent Wildlife Trust, 3&4 Bronsil Courtyard, Eastnor, Ledbury, Herefordshire, HR8 1EP, UK

Keywords: *Population reinforcement; genetic diversity; Martes; microsatellites.*

Genetic information in addition to an understanding of ecology and demography of the reintroduced species is an important aspect of reintroduction programs. Genetic drift can be caused by a reduction in population size due to a genetic bottleneck caused by human activities such as hunting or removal, resulting in a reduction in genetic diversity.

This study is a genetic survey, investigating the genetic diversity of pine marten populations at donor sites in Scotland, used in a translocation of pine marten for population reinforcement in Wales conducted within the VWT's Pine Marten Recovery Project.

Prior to the translocations in both 2015 and 2016, scat surveys and live trapping was conducted in a range of forest sites in Scotland. Further scat surveys were conducted at the donor sites post removal. Hair and scat samples from each site were genotyped using a panel of eight microsatellite markers for individual identification.

A minimum number alive was produced for each site and genetic diversity and genetic structure were investigated in pre- and post- removal populations. Results of this study will be presented along with recommendations for further monitoring and guidelines for removal strategies that would safeguard existing populations as wider interest in the translocation of pine martens grows.

Can personality be used as a tool to improve European mink (*Mustela lutreola*) conservation?

M. Haage[1], A. Angerbjörn[2], U.A. Bergvall[3], B. Elmhagen[4], K. Kiik[2], T. Maran[3,4]

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[2]Department of Zoology, Institute of Ecology and Earth Sciences, Tartu University, Vanemuise 46, 51014 Tartu, Estonia
[3]Conservation Research Lab, Tallinn Zoological Gardens, Paldiski mnt. 145, Tallinn 13522, Estonia
[4]Institute of Veterinary Medicine and Animal Sciences, Estonian University of Life Sciences, Kreutzwaldi 62, 51014 Tartu, Estonia

Keywords: *European mink, personality, conservation, boldness, exploration*.

Personality signifies stable differences in behaviour between and within individuals and can be divided into personality trait domains (e.g. boldness and exploration). As personality affects fitness it is of relevance for conservation efforts such as reintroductions that often have high failure rates that can be difficult to explain. Here we investigated personality effects on reintroduction success in European mink. We used an Estonian conservation-programme with captive breeding, where reintroductions have been made yearly since 2000 on two islands (Maran *et al*. 2009). In Haage *et al*. (2013) we examined personality structures and if personality expression was affected by situation (breeding season and non-breeding season) and context (test environment). Three repeatable domains were identified; boldness, exploration and sociability. Test environment influenced which personality trait domain that was measured, showing the importance of proper measuring techniques in order to avoid misinterpretation. Personality also changed plastically over seasons, indicating that fitness effects in the wild could vary with season. In Haage *et al*. (2017) a field experiment was made where animals were personality tested in captivity and post-release survival was monitored via 60 days of radio-tracking in two different years and islands. Boldness had a positive impact on survival in the European mink but the influence of exploration was more complex as the correlation was negative or positive depending on year/island. Sociability had no effect, which is expected in a solitary-living species. Predation was the leading cause of death in both years. Overall personality can be important in conservation, but personality and fitness can have a complex relationship. This complexity is likely related to mechanisms such as fluctuating selection, which can maintain variation in personality trait domains over evolutionary time. Further studies should investigate these mechanisms and how to implement personality with conservation.

References

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STUDENT PRESENTATION

Think national, act local: small mustelid conservation in Switzerland

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Keywords: *Weasel; Stoat; conservation; fragmentation; connectivity*.

Populations of weasels (*Mustela nivalis*) and stoats (*Mustela erminea*) have declined in large parts of Switzerland. Habitat destruction and fragmentation due to an increase of the human population and its demand for infrastructure is thought to be cause for the decline. Additionally, the concurrent intensification in agriculture and the resulting loss of small structures such as stick piles and stone walls which are necessary requirements for weasels and stoats to raise their young and hide from predators.

In 2012, the foundation WIN Wieselnetz initiated a large-scale conservation project for weasel and stoats in Switzerland. Within areas comprising more than 50 km^2 each, measures are being implemented to enhance hunting habitats and to re-establish connectivity corridors. Measures include set asides, hedges and the establishment of small hiding structures. In new stick piles, natural caves are additionally incorporated to enhance reproduction success. By seeking synergies with the government, small carnivore conservation has found its place in many parts of Switzerland and some measures are subsidized today.

However, there is a need to understand the effect of fragmentation on the dispersal abilities of the small carnivores due to the high competition for space between agriculture, nature reserves and urban sprawl. With a complementary study, we aim to understand how small carnivores move through an anthropogenic landscape depleted of hiding structures. We therefore selected 23 locations in an area characterized by intensive agriculture. Tracking tunnels were set and checked for a period of six weeks in spring in two consecutive years. Surprisingly, we recorded eight tracks of the rare weasel and 34 of stoats in three and ten patches, respectively. Preliminary analyses show that the occurrence of these carnivores depends on the distance to the nearest patches and is most likely dependent on the corridor type available to small carnivores.

STUDENT PRESENTATION

Understanding carnivore restoration: using Q Methodology to reveal perceptions of a pine marten (*Martes martes*)translocation

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Keywords: *Pine marten, social feasibility, public opinion, translocation, Q Method, Likert scale.*

Carnivores are of major concern to conservation practitioners and are increasingly targeted for translocation. However, they are naturally rare due to their positions at the top of the food web, and have a relatively high risk of extinction due to a number of traits including high trophic level, small populations, low population density and large home ranges. Conflict between people and carnivores is often the most intractable issue in their conservation and this needs to be fully addressed for a carnivore translocation to succeed. Assessing the social feasibility of translocating wildlife is a key recommendation of the IUCN Reintroduction Specialist Group, and has hitherto been achieved by surveys predominantly employing R-based methods such as forced choice questions and Likert style questionnaires. This study employs Q-methodology, derived from the field of psychology and the social sciences, to understand the viewpoints of people living within a release area towards a European pine marten (*Martes martes*) translocation by The Vincent Wildlife Trust. Twenty-nine participants contributed to the analysis, which disclosed four predominant viewpoints. Three of the factors were in broad support of a pine marten translocation, albeit for distinctive reasons, whilst one was unequivocally opposed. Q-methodology was found appropriate for identifying distinct viewpoints, differences both within and between groups, and areas of consensus. The methodology potentially allows the aetiology of views to be derived, resulting in a rich understanding of the views within the affected communities. The approach has potential to form part of effective engagement that could be inclusive of all stakeholders and address a key prerequisite for long-term success for conservation translocations.

Monitoring Mustelids



KEYNOTE LECTURE

Big changes for small carnivores

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Although the British Isles are home to only seven* native and non-native species of mustelid, there is great variation in their histories of population change in these islands. We will explore these species' histories, taking diverse approaches and adopting a range of perspectives. We will sample 20,000 years of change, from the post-glacial origins of this subset of the European fauna, through factors driving their ups and downs over centuries, decades and years up to the present time, with an analysis of more contemporary processes of decline, recovery, expansion and contraction. We will address the current threats they face, the threats they present and the challenges they create. Throughout, we will acknowledge the uncertainty and technical difficulties of determining their changing population status. We will reveal that this select group of small carnivores provides an effective and extraordinarily comprehensive set of models of anthropogenic influences on populations and of the challenges of wildlife conservation and management.

*arguably eight, if we include feral ferrets, which we do at some points in the lecture!

Estimating the spatial distribution of *Mustelidae* in France with opportunistic data

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Keywords: *opportunistic data collection; spatial distribution; sampling effort estimation; detectability.*

The "small carnivorous species logbook" program, implemented since 2002 by the French hunting and wildlife agency, consists of the systematic report of the place, date, species and status (dead or alive) of every random encounter of *Mustelidae* by the 1500 national wildlife protection officers during their working time. Although this program allows a large-scale sampling of these species at low cost, it also raises a number of statistical questions. First, an estimation method of the species abundance should account for a detectability varying between species and status. Moreover, due to the heterogeneous spatial distribution of the officers, the sampling effort is not spatially uniform. It also varies between dead and living animals. On one hand, more living animals are expected to be seen if officers spend a longer time at a given suitable place. However, because the spatial distribution of the time spent by officers is unknown, the sampling effort of living animals cannot be used to correct sampling biases. On the other hand, for dead animals (mostly roadkills), the sampling effort is rather a function of the distance travelled by officers around in a given region. We can use the mileage of the cars to calculate this distance, and therefore calculate the sampling effort for dead animals in all regions of interest. We used a statistical approach developed by Calenge *et al.* (2015), which uses the known sampling effort for the dead animals to estimate the relative abundance of all 6 species of *Mustelidae* in all French agricultural regions during two periods (2004–2008 and 2009–2012). This approach uses data on both living and dead animals, while accounting for both variable sampling effort for dead and living animals and variable detectability between species and status.

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Using genetic methods to estimate vaccination coverage and population size in the European badger

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Keywords: *Badger; Vaccination; Population estimation.*

Large scale wildlife management interventions can require significant financial and human resources. As a consequence, it is important that such interventions are evaluated in order to demonstrate effectiveness and so that future operations may be refined. The European badger (*Meles meles*) is a wildlife reservoir for bovine TB and options for managing the disease include the culling or vaccination of badgers. Evaluating badger management inventions involves producing accurate estimates of population size, which is a challenge for any elusive nocturnal species.

In this study, we used a modified capture mark recapture technique to estimate vaccine coverage in a wild population of badgers vaccinated using injectable BCG as part of a four-year control initiative in Wales, United Kingdom. Our approach involved genotyping vaccinated animals and matching these to a sample of the background population collected using wire hair traps deployed at badger setts. This approach produced an estimate of the percentage of badgers vaccinated in a single year (2016), while also simultaneously producing an estimate of population size. Using a simple quantitative model, we also estimated cumulative vaccine coverage over the four-year period, corresponding to the total duration of the vaccination campaign.

The results suggest that in the year of study 44-65% of the population received a vaccine dose. This corresponds to an estimated population size of 1645-2457 badgers in the 288 km^2 study area. The model estimated that 70-85% of the total population would have received at least one vaccine dose over the course of the vaccination campaign.

This study represents the first application of this novel approach for measuring vaccine coverage in wildlife. Comparisons with other methods for estimating population sizes are discussed.

Into the wilderness: the expansion of the pine marten in the Val Grande National Park

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Keywords: *Martes, camera-trapping, genetic census, Italian Alps.*

Following widespread abandonment of low-intensity farming and livestock rearing, on European mountain areas forest cover has progressively increased, with a positive effect on forest-dwelling species. On the Alps, the pine marten (*Martes martes*) may have taken advantage of this increase in forest cover (ca. 50 % between the 1960s and 2000), recolonising mountain districts from which it had disappeared in the 20th century and expanding in less suitable lowland areas (Balestrieri *et al*. 2016).

The Val Grande National Park (NW Italy), is the largest wilderness area of the Alps. The abandonment of traditional land use practices since the end of World War II has led to the decline of pastures and cultivated lands from 59% of the whole area to 5% ca in 1999. Most previously cultivated areas currently show various successional stages.

The first records of the pine marten in the Park date back to October 2014 (Mosini 2015). With the aim of assessing its distribution in relation to that of the widespread stone marten (*Martes foina*), in July-October 2015 we surveyed a 42 km^2 large area by both camera-trapping (N=27; 2163 trap-nights) and faecal DNA-based genetic sampling (N=112).

The pine marten was recorded 6 times (out of a total of 945 videoclips) in only 4 sites, while the stone marten occurred in 21 sites, for a total of 156 videoclips. A PCR-RFLP method (Ruiz-González *et al*. 2008) allowed to classify 12 faecal samples as *M. martes* and 82 as *M. foina*. Our results support the hypothesis that the pine marten is recolonising the protected area. Habitat changes and persecution throughout the last century, rather than interspecific competition, may play a major role in shaping the current distribution and relative abundances of the two *Martes* species.

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Multi-site variation in pine marten density: Towards national population estimates

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Keywords: *pine marten, non-invasive surveys, density estimation, conservation management.*

Although pine marten (*Martes martes*) are a widely distributed mustelid, there have been generally few studies that have determined spatial variation in pine marten density, in a minority of countries and regions within which the species occurs. Given that the species is subject to national and European legislative requirements to determine population abundance and trends, there needs to be increased effort in density estimation related research on this species.

In this study, a large-scale non-invasive survey was undertaken in 14 forested study sites throughout Ireland to assess variation in pine marten density and abundance using spatially explicit capture recapture models. Hair tube surveys were conducted in each site for a 1 month period, with 3 weekly sampling sessions per site. Real-time quantitative PCR and microsatellite analyses were used to confirm species identity, assign sex and generate individual capture histories for pine marten in each site.

Across all study sites, 93 individual pine marten were identified and captured 217 times. Estimated pine marten density varied from 0 to 2.60 individuals per km^2 of forested habitat, with all but a single site having estimated densities of ≤1 pine marten per km^2 of forest habitat. Pooled capture data across all sites generated a mean density estimate of 0.64 (95% CI 0.49–0.81), which combined with current pine marten distribution and occupancy data indicated a national population abundance in the low thousands.

This study successfully implemented the largest countrywide pine marten density estimation research in any part of the species' range. It has clearly found that in Ireland, pine martens typically exist in low density populations in forest habitat and that despite the recent recovery in terms of distribution, the magnitude of the species national abundance is low which is perhaps unsurprising in a country with the lowest levels of forest coverage in Europe.

WORKSHOP ON MONITORING SMALL MUSTELIDS

a) Research and conservation of small mustelids...present and future

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Since 2010, the Dutch Small Mustelid Foundation (SKM) has been delving into the ecology and conservation status of small sustelids (Common weasel *Mustela nivalis,* Stoat *M. erminea and* Polecat *M. putorius*) in the Netherlands, with a particular focus on the development of reliable techniques to study these elusive animals in the field. The SKM has been successful with the development of the so-called *Mostela* method, a plywood camerabox with a modified PVC tracking tube and camera trap allowing the recording of passing small mammals. Strategically placed in the microhabitat of weasel and stoat, the technique has proven to be effective in pinpointing the presence of weasels in particular.

Through international collaboration, the SKM seeks to promote more comparative research into the status of Small Mustelids in different environmental contexts and in light of environmental changes in parts of Europe. In order to enhance and exchange knowledge on the ecology and conservation status of small mustelids during this workshop, the following issues and queries are addressed:

- Who is doing what in small mustelid research and what has been achieved to date, especially regarding the conservation status of these animals (contexts may differ).
- Methodological enhancements and limits to field research coupled with known biology and ecology of small mustelids.
- Development of a broader collaborative research community for small mustelid research.

b) Developing a new method to detect small mustelids

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Keywords: *Mustela nivalis, Mustela erminea*, *Tracking, Camera trapping, Monitoring.*

Settlement expansion and intensification of agriculture are major threats for small mammals. According to experts, the populations of least weasels (*Mustela nivalis*), stoats (*M. erminea*), polecats (*M. putorius*) and pine martens (*Martes martes*) in the Central Swiss Plateau are in decline, and hence must be monitored. Today, small mustelids are still tracked using labour-intensive and costly ink and paper tracking tunnels developed in the Seventies (King & Edgar, 1977). This technique comes with several disadvantages, including: 1) requiring high maintenance (preparation of ink, weekly changes of ink and paper; 2) dependence on expert knowledge for identifying tracks, 3) presence-only detection, no temporal data. Technological advances within the field of image capturing, processing, and data transmitting have opened novel avenues for tracking small mustelids. We are working on combining such technologies with the well-established concept of the tracking tunnel. Therefore, we have replaced the wooden tunnel with a PVC tube and the ink and tracking paper with a custom-built wildlife camera. With this combination, we hope to: 1) reduce maintenance; 2) remove dependency on expert knowledge; and 3) detect more than presence-only (time of visit, visiting patterns).

An initial test series with captive stoats and least weasels provided the proof of concept. The tests have shown that the animals integrate the tunnels in their space-use (between 5 and 15 visits per day, mean visit duration 4 seconds, ranging from milliseconds up to 30 seconds). We did not find a tunnel preference when comparing bare PVC to a bitumen lined interiors. Further tests with polecats as well as Dormice (*Grilidae*) are planned for autumn 2017. Overcoming the obvious captive bias, we are currently testing the tunnels in an agricultural area where we have simultaneously installed camera traps and tracking tunnels.

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Mustelids in a changing landscape



KEYNOTE LECTURE

Mustelids in the city – case studies of urban adapters

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Keywords: *urban wildlife; adaptations; human-wildlife conflict HWC.*

The growth of human population and a greater demand for ecosystem resources and services have modified habitats all over the globe, deeply affecting the community structure and functioning of the species. Consequently, wildlife species increase their presence in human-altered habitats. Many have evolved adaptation features that allowed them to thrive in urban environments worldwide. They were classified as 'urban adapters' that might use various anthropogenic resources but still rely on natural environment. The typical adaptations include increase of social group size and population density, reduced home range size and reduced territorial behaviour. Among them avifauna and mammalia are the most recognized groups. Mustelids, like *Martes foina* and *Meles meles*, are examples of species that show flexibility in establishing shelter, foraging in human settlements, and even breeding in the city core. In several European countries, *M. foina* has been progressively moving and settling along urban gradient areas using buildings, mostly attics for resting sites. *M. meles* is more dependent on digging site selection, it has also been recorded using gardens and buildings in the city core. The rich food resources, access to shelter, low predation and competition positively affect survival of urban species. However, there are some potential negative factors, such as road collisions, risk of poisoning and human disturbance. Equally, for humans there are some negative aspects to a lesser or greater degree, including disease transmission, attacks to humans and pets, damage to properties, traffic accidents and general nuisance. Nevertheless, urban wildlife brings empathy in the world, increasing the awareness and leading to the improvement of nature conservation. Yet, the future of wild animal species in the urban environments is still unclear as it can follow different paths according to human actions.

Conflicts and conservation challenges for a recovering pine marten (*Martes martes)* population in Ireland

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Keywords: *pine marten; Ireland; conflict resolution.*

The pine marten is native to Ireland, and was driven to near extinction through persecution, hunting and deforestation. When legal protection was granted through the 1976 Wildlife Act, only a few fragmented populations remained in the west and southeast. In the past 40 years the population has recovered slowly, and is perceived to be thriving in places, particularly in the midlands. Despite legal protection, some persecution still persists and with the pine marten's recovery there has been some controversy, reflected in negative media coverage that has perpetuated myths and misinformation.

Alongside pine marten recovery there has been some conflict with humans - pine martens occasionally den in attics of houses causing problems for residents. Irish gun clubs rear game birds in pens designed to exclude foxes but which are often inadequate in excluding pine martens. Rearing domestic fowl has become more mainstream for families, though pens are unequipped to deal with mustelids. Folklore and fear passed over generations often goes unquestioned and further perpetuates negative attitudes.

Pine marten conservation in Ireland requires an alternative and reasonable approach addressing issues through practical conservation solutions to arising conflicts, whilst raising awareness of a natural part of the Irish ecosystem. This is best achieved with a regionally appropriate approach: on-going communication and education through print and online media, radio, television and public events; providing practical solutions to householders where martens have taken up residence or are regular visitors; creating artificial den sites in woodlands whilst promoting woodland management; working closely with local gun clubs to understand rearing and releasing of game-fowl and trialling electrified and battery powered deterrent systems. Fundamental to managing pine marten recovery is a full understanding and acknowledgement of the issues – real and perceived; working in partnership with those in conflict; and researching and communicating facts and practical solutions.

Movements of the European pine marten when facing landscape constraints

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Keywords: *Connectivity; GPS; pine martens.*

Human activities such as land use, creation of transport systems and urbanisation have generated an expansive footprint on landscapes, leading to a global loss of functional connectivity for wildlife. Disrupting movements and gene flows, these landscapes compromise the persistence of populations, and thus of biodiversity. In this context, we studied the movements of a forest dwelling species, the European pine marten (*Martes martes*) confronted to several levels of forest loss and fragmentation. We used global positioning system (GPS) collars on martens to accurately record movements and habitat use when moving under constraints. These data were also expected to bring insights on our genetic structure analyses of pine martens frequenting these landscapes.

We trapped 27 individuals in three study sites: a large continuous forest (considered as the ideal habitat type for pine martens), a hedged farmland, and a cereal plain crossed by waterways and navigation canals. We monitored 15 pathways on 4 individuals in the forest site, 16 pathways on 7 individuals in the farmland, and 38 pathways on 8 individuals in the cereal plain. Here, we present the preliminary results of these GPS pathways. First results allowed us to state that pine martens moved in the matrix using all the available forest patches and strongly avoided going out from these features. However, some of the martens had a different habitat use pattern, non-established to a zone and crossing several hundreds of metres of open fields to unconnected woodlots. Furthermore, rivers seemed to be crossed without any reluctance, but navigation canals were avoided. Further analyses are needed but we can already state that our approach could greatly advance region-wide conservation plans for the location of barriers and corridors.

STUDENT PRESENTATION

A road risk map for the European badger (*Meles meles*) in Central Italy

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Keywords: *road ecology; road mortality; SDM; connectivity.*

The interaction between wildlife and human activities is constantly growing as anthropic activities and wildlife diffusion increase. One of the artificial elements that mostly influences the relationship between man and animals is the road network, which is strictly connected with the ecological network. In particular, collisions between wildlife and vehicles represent the main conflict between infrastructures and ecosystems. Road mortality is the largest single cause of death for many vertebrates, representing a growing phenomenon of remarkable dimension. Some carnivores like the European badger *(Meles meles)* are more vulnerable to road traffic and road mortality as they are long-lived, slow at reproducing, and often explore unfamiliar habitats such as roads. We propose a modelling framework to produce spatially explicit assessment of road kill risk for the European badger as a useful tool to identify road stretches at high collision risk and optimize sites for mitigation measure. The modelling approach was produced for an Italian county in Central Italy (Abruzzo). The model was based on 70 records of road collisions collected between 2007 and 2016 that were combined with six environmental predictors measured on 50 m grid cells: Euclidean distance from urban areas, density of roads, traffic, badger habitat suitability and functional connectivity. Following the hypothesis that road mortality could not be directly related to a high habitat suitability for the species we used two separate species datasets to model habitat suitability and collision risk. For the same reason, we introduced the functional connectivity to differentiate the connection areas from the core areas derived from the suitability model. Road risk map reported a good level of predictive accuracy as indicated by ROC and TSS mean values of 0.811 and 0.560, respectively. Predictors that most affected the modelled road risk map were the road density and the connectivity.

STUDENT PRESENTATION

Make a living by what we get: Ecological plasticity of badgers in an agroforestry and cattle ranching area of Central-West Portugal

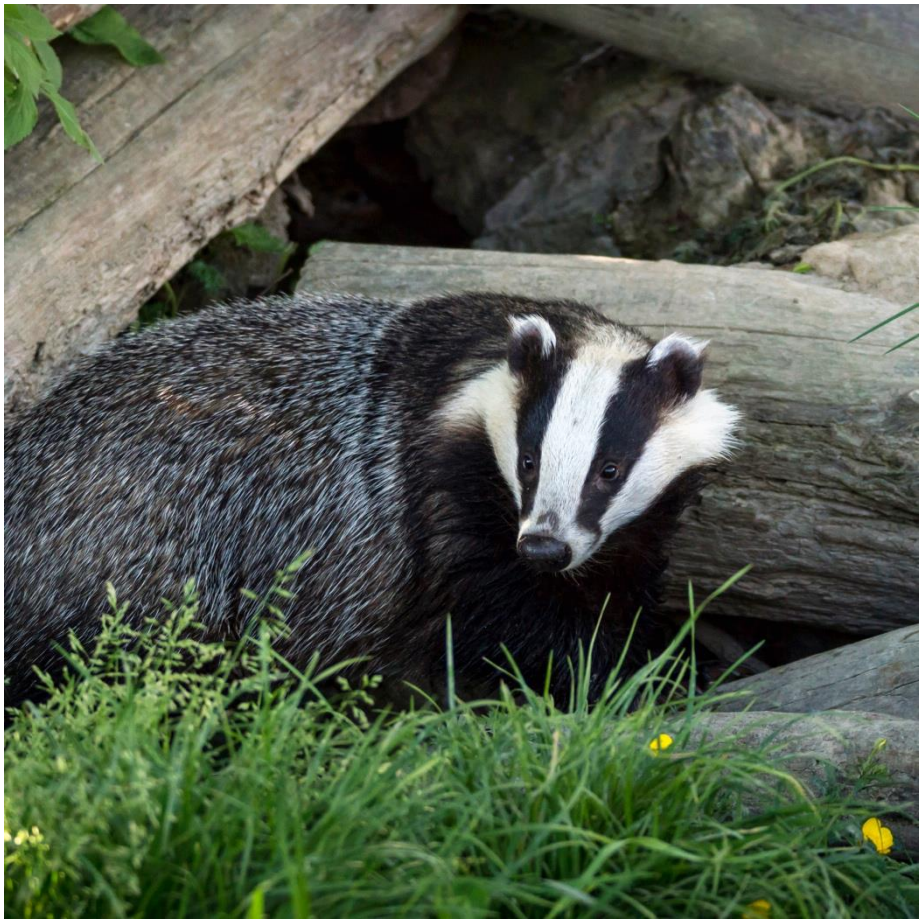
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Keywords: *Montado; Sett selection; Feeding habits; Meles meles; Mediterranean.*

Agro-silvo-pastoral management practices are the most common promoters of the spatial heterogeneity observed in the Mediterranean landscapes, including Iberian 'montados'. In these ecosystems, we have witnessed changes in management practices along the years. These changes in the ecosystem structure enhanced the wildlife's need to adapt to changes in resource availability. Agroforestry and cattle ranching activities can affect some of the key resources used by the European badger (*Meles meles*), thus affecting sett location and use, as well as diet. This study was carried out in Companhia das Lezírias, a Portuguese agroforestry and cattle ranching farmstead. We surveyed the area to detect badger setts and collect scats for diet analysis. Eighteen main setts were found and characterized using environmental parameters, seventeen were monthly monitored to evaluate their use patterns and in four badgers, diet was analysed. Using ecological modelling (CAR models) we analysed the influence of land cover, food and water availability, anthropic disturbance and their combined effect on sett locations. Furthermore, GLMMs were used to test the influence of land cover, water availability, disturbance, climate and their combined effect on sett use. Finally, we assessed badgers' diet changes associated with anthropic activities (e.g. game rearing, cattle ranching). Sett site selection seem to be negatively influenced by water streams, while grazing pressure showed a significant negative effect on sett use intensity. Badgers' diet seems to be dominated by resources associated with human activities, like wheat (*Triticum* sp.), available in game species feeding structures. This confirms the opportunistic character of badgers and the high degree of adaptation capacity of this mustelid in anthropic habitats. Nevertheless, a long-term monitoring of Mediterranean badger populations and the evaluation of the influence of anthropic changes must be implemented, especially when there are new disturbance factors arising or an intensification of the existing ones.

General Ecology



Host heterogeneity and TB dynamics in badgers

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Keywords: *badger, heterogeneity, behaviour, disease.*

The management of disease transmission amongst livestock and wildlife populations is a major global challenge. Bovine tuberculosis is the most serious endemic disease of livestock in the United Kingdom (UK) where its management is confounded by the presence of infection in the European badger (*Meles meles*). The persistence and spread of infection in badger populations is the collective result of badger physiology, behaviour, demography and interactions with their environment. Understanding how these processes influence patterns of disease risks for badgers and cattle across the landscape, and predicting the responses of both populations to management interventions is critical to the development of effective disease control strategies. An intensive capture-mark-recapture study of a badger population in south-west England has provided the opportunity to study how individual heterogeneity amongst badgers may relate to disease transmission risks, and to explore the potential for certain individuals to play a more pivotal role in disease persistence and spread. This long-term study has consistently identified behavioural correlates of *Mycobacterium bovis* infection in badgers, relating to ranging and foraging behaviour. Recent research on social networks, foraging behaviour, life history strategies and TB progression in badgers have provided further insights into the drivers of disease risk, which may also inform the development of practical and sustainable approaches to disease control in badgers and cattle.

STUDENT PRESENTATION & RECIPIENT OF STUDENT TRAVEL BURSARY

Badgers as super-rangers: an investigation of ranging strategies in a European badger population

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Keywords: *Meles meles; ranging behaviour; GPS tracking; disease transmission.*

We monitored the ranging of a wild European badger *Meles meles* population over 7 years by placing GPS tracking collars on 82 different individuals, yielding 26,522 collar-nights.

Badger range sizes varied seasonally and reached their maximum in June, July and August. We analysed the summer ranging behaviour and found that while most adult badgers (males and females) remained within traditional social group boundaries, several male badgers (on average 22%) regularly exceeded traditional boundaries. These adult males frequently ranged throughout two (or more) traditional home ranges. We therefore refer to them as super-rangers. While ranging across traditional boundaries has been recorded over short periods of time for extra territorial mating and foraging forays, or for pre-dispersal exploration, the animals in this study maintained their super-ranges from 2 to 36 months.

This behaviour constitutes a previously unrecognised ranging strategy in male badgers. Holding a super-range may confer an advantage in access to breeding females, but could also affect local interaction networks. In Ireland & the UK, badgers act as a wildlife reservoir for bovine tuberculosis (TB). Holding a super-range may facilitate the spread of disease by increasing both direct interactions between conspecifics, particularly across social groups, and indirect interactions with cattle in their shared environment. Understanding this super- ranging behaviour may both improve our understanding of TB epidemiology and inform future control strategies.

Food for thought: Prey availability rather than competition as a determinant of relative abundance of Dutch mustelids

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Keywords: *Camera trapping; Carnivore community; Detectability; Intraguild competition; Trapping rate.*

Food availability and the presence of competitors are two important determinants of population density. As several carnivore species are increasing in distribution and population size in Europe, intraguild competition might become more and more important in determining population densities of carnivores, especially for smaller species. I used camera traps (without bait) to study the relative abundance of pine marten (*Martes martes*), stone marten (*M. foina*) and polecat (*Mustela putorius*) in relation to prey availability and intraguild competition in 19 forest sites in the Netherlands. I used trap rate (number of passages per camera trapping day) corrected for differences in detectability between species and vegetation types as a measure of relative abundance. I used the relative abundance of the three Mustelid species and red fox (*Vulpes vulpes*) to determine the abundance of competitors and I used the relative abundance of lagomorphs as an index of prey availability. As well as camera trapping, I also performed live trapping of small rodents to determine rodent densities as an index of prey availability. The relative abundance of all three species of mustelid increased with prey availability, as expected. There was, however, no correlation with the abundance of competitors for any of the three mustelids, in contrast to my expectation. These results suggest that the abundance of pine marten, stone marten and polecat in Dutch forests is primarily determined by food availability.

Expand or disappear? Why related Mustelid species follow different roads. Lessons from the genetic study of mink, polecat and otter

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Keywords: *Genetic; Population; mink; otter; polecat.*

The present global changes have a strong impact on the survival of many species and on their demography and population dynamics. On one hand, some species undergo strong reduction of their populations due to the fragmentation of their habitats, competition with other species, pollution or degradation of their habitat or the appearance of new diseases. On the other hand, many species tend to expand their distribution range and can even be considered as invasive species in some cases.

The aim of our presentation will be to better understand which biological factors could lead to decreased populations of a species until extinction or in contrast, could help a species expanding its population densities and distribution area. These hypotheses will be illustrated by our recent results obtained through the genetic study of the European mink *Mustela lutreola*, the American mink *Neovison vison*, the polecat *Mustela putorius* and the European otter *Lutra lutra* (Cabria *et al*. 2011; Michaux *et al*. 2005; Pigneur *et al. In Prep*).

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Western Polecat: Conservation status and current threats



KEYNOTE LECTURE

Conservation status of the polecat (*Mustela putorius*) in France: national synthesis and main threats

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Keywords: *Conservation status; France; Mustela putorius; threats.*

Although the population trend of the European polecat is considered as decreasing, it is listed as "Least Concern" by the IUCN in view of its apparent large population sizes and wide distribution throughout Europe (Skumatov *et al*., 2016). Nevertheless, the confidence of this assessment is low, given the paucity of recent precise and accurate information on population trends across most of its range. In France also, while arousing concerns, the conservation status of this Mustelid is poorly documented, especially as there is no standardized national monitoring.

Therefore, Pierre Rigaux, an active member of the French Mammal Society (SFEPM), realised a large and significant bibliographical review by questioning different people or organisations in the various regions of France (Rigaux, 2017).

The aim of our communication will be to present, from this bibliographical review, the conservation status of the species in France and its main threats. This synthesis reflects the great heterogeneity of the available data and the difficulty for obtaining comparable data in time or in space. Nevertheless, this work allowed us to show that although the polecat seems relatively common in certain areas of France, its conservation status seems bad at the national level, due to several causes including mainly anthropogenic pressure.

Conservation measures seem essential before the situation deteriorates further, such as, for example, the inscription of the species on the French list of protected mammals, which involves both the protection of the individual animals and of its habitats.

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A review of the status of the Western polecat *Mustela putorius*: a neglected and declining species?

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Keywords: *Mustela putorius, population status, population trend, status review, Western polecat.*

The Western polecat *Mustela putorius* is a medium-sized carnivore with a widespread distribution across Europe and is currently listed as Least Concern by the *IUCN Red List of Threatened Species*. There have been increasing reports of polecat population declines in several countries, although a paucity of data means that range-wide population trends are poorly understood. This paper reviews and summarises information on the polecat's current status and population trends across its range. Information was gathered for 34 countries, from researchers and biologists studying polecats, from reviewing published and grey literature and national Red Lists. In countries where population trends were identified, the polecat population is known or suspected to be declining in 20 countries, is reported to be stable in five countries, stable or increasing in one country, and increasing in two countries, whilst in the rest, data are insufficient to discern population trends.

The main drivers of polecat decline are poorly understood, but may include degradation of habitat; changes in prey availability; competition with invasive carnivores; secondary poisoning and environmental pollutants; conflict with human interests; harvesting and accidental killing of polecats; and hybridisation. There is an urgent need to establish robust survey methods and systematic monitoring programmes to gather accurate up-to-date data on polecat population trends across the species' range.

STUDENT PRESENTATION & RECIPIENT OF STUDENT TRAVEL BURSARY

Exposure of European polecats (*Mustela putorius*) in Britain to *Toxoplasma gondii, Leptospira* and Canine Distemper Virus

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Keywords: *Toxoplasma gondii; Leptospira; Distemper; polecat.*

The European polecat (*Mustela putorius*) almost became extinct in Britain in the early 20th century, as a result of marked predator control. The species is now recovering throughout the mainland and this study aimed to assess exposure to the infectious pathogens *Toxoplasma gondii, Leptospira spp.* and Canine Distemper Virus, and discuss whether this could affect population recovery. Serum, lung and brain samples were collected from 149 polecats collected from across Britain which had died from road traffic accidents. Exposure to *T. gondii* and 12 *Leptospira* serovars was assessed serologically by antibody detection using the latex agglutination test and microscopic agglutination test respectively, and presence of CDV in lung and brain tissue samples was assessed using PCR. Season, gender, and location data were analysed using generalised linear models as risk factors for exposure, and morphometric data were also collected.

T. gondii seroprevalence was 71.8% (95% CI 64.2%-79.4%), similar to previous studies in carnivores. *Leptospira* seroprevalence overall was 14.5% (95% CI 8.6%- 20.4%), with exposure to three out of twelve serovars tested: Bratislava (7.6%; 95% CI 3.2%-12.0%); Saxkoebing (6.3%; 1.9%-10.7%) and Icterohaemorraghiae (1.5%; 0%- 3.5%). All organ samples were negative for CDV (0/79; 95% CI 0.00%-0.05%). Season, gender and location had no significant association with exposure.

Evidence of exposure to *T.gondii* and *Leptospira* in European polecats warrants further studies, including histological examinations, to assess whether these pathogens are associated with disease in this species, and any impact of exposure on polecat populations. Additional metadata, such as stomach contents, age, meteorological data and farm surveys related to domestic animals, rodent control, farm maintenance and toxins, would provide further information on possible routes of infection and risk factors for exposure. The absence of evidence of exposure to CDV is encouraging, although concerns about the re-emergence of this pathogen in Britain warrant on-going surveillance in wild carnivores.

STUDENT PRESENTATION & RECIPIENT OF STUDENT TRAVEL BURSARY

Monitoring secondary exposure to anticoagulant rodenticides in a recovering carnivore: the European polecat *Mustela putorius* in Great Britain

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Keywords: *Mustela putorius; second generation anticoagulant rodenticides; bromadialone; brodifacoum, difenacoum.*

The European polecat *Mustela putorius* is re-colonising Great Britain after a population decline during the nineteenth century (Langley & Yalden 1977). Previous studies found polecats were at risk of secondary exposure to second generation anticoagulant rodenticides (SGARs), likely the result of eating rats (Shore *et al.* 2003). This risk is thought to be higher in the winter when polecats make use of farmyards (Birks 1998). Polecat range expansion is now taking them into parts of the country traditionally subject to higher deployment of SGARs, which may represent an increased risk to polecat recovery in these areas. In order to evaluate the current risk of secondary exposure to polecats in Britain, we analysed polecat carcasses collected from across the country between 2014 and 2016 for residues of five SGARs. We carried out stable isotope analysis of whiskers from the same animals to examine the relationship between diet and exposure. We applied historical limits of detection to the new SGARs data to assess changes in polecat exposure over time. This study provides an up-to-date baseline of secondary exposure to SGARs in a mammalian predator known to consume rats. This is important in the context of changes to rules regarding the use of previously "indoor only" use SGARs in Britain, which may be increasingly deployed in light of rat resistance to other, currently more common, SGARs. During my talk, I will present the preliminary findings of the study and discuss the implications for polecats in Britain.

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Rodenticide exposure of stone marten and polecat: effects of regulatory restrictions and exposure risk modelled on landscapes

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Keywords: *Anticoagulants; rodent control; non-target exposure, spatial modelling.*

Secondary poisoning with anticoagulant rodenticide (AR) is widespread in predatory mammals and birds in Europe. To elucidate the pathways of the extensive exposure of predators, we examined the effects of recent regulatory restrictions in AR use aimed at reducing the secondary exposure by analysing the hepatic AR burdens in stone marten (*Martes foina*) and polecat (*Mustela putorius*) collected before and after the restrictions were implemented. Furthermore, we modelled the exposure risk for mustelids under different scenarios for AR usage at landscape levels. In Denmark, an estimated 33% of all buildings in rural areas are treated with ARs annually to control rats and mice, and until 2012 ARs could be used for plant protection in forestry and Christmas tree production to control voles. Model experiments were performed to evaluate exposure risk 1/ with and without AR usage away from buildings, and 2/ the effect of AR bating frequencies in and around buildings. No declines in AR prevalence were detected following the regulatory restrictions in either stone marten (Before: 98%, After: 100%) or polecat (Before: 93%, After: 97%). AR concentrations were higher in stone martens after the restrictions were implemented. The modelled AR exposure risk varied with species' home-range size and landscape composition, all mustelid territories were exposed to ARs in all landscapes each year. Cessation of AR use in forestry and Christmas trees only reduced exposure risk by 0-3%. The model experiments concur with empirical data on AR prevalence in stone marten and polecat. Reducing baiting frequency by 75% resulted in 2-12% reduction in exposure incidence depending on species and landscape composition. The results suggest that baiting frequency of buildings must be reduced radically to reduce secondary poisoning of predators in intensively human-dominated landscape.

Posters



Hedgehogs and mustelid species: major carriers of pathogenic *Leptospira*, a survey in 28 animal species in France (2012 – 2015)

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Human leptospirosis is a zoonotic and potentially fatal disease that has increasingly been reported in both developing and developed countries, including France. However, our understanding of the basic aspects of the epidemiology of this disease, including the source of *Leptospira* serogroup Australis infections in humans and domestic animals, remains incomplete. We investigated the genetic diversity of *Leptospira* in 28 species of wildlife other than rats using variable number tandem repeat (VNTR) and multispacer sequence typing (MST). The DNA of pathogenic *Leptospira* was detected in the kidney tissues of 201 individuals out of 3,738 tested individuals. A wide diversity, including 47 VNTR profiles and 8 MST profiles, was observed. Hedgehogs and mustelid species had the highest risk of being infected (logistic regression, OR=66.8, $CI_{95\%}$=30.9-144 and OR=16.7, $CI_{95\%}$=8.7-31.8, respectively). Almost all genetic profiles obtained from the hedgehogs were related to *Leptospira interrogans* Australis, suggesting the latter as a host-adapted bacterium, whereas mustelid species were infected by various genotypes, suggesting their interaction with *Leptospira* was different. By providing an inventory of the circulating strains of *Leptospira* and by pointing to hedgehogs as a potential reservoir of *L. interrogans* Australis, our study advances current knowledge on *Leptospira* animal carriers, and this information could serve to enhance epidemiological investigations in the future.

STUDENT PRESENTATION

The badger-cattle interface in southwestern France: environmental determinants of *Mycobacterium bovis* concomitant infection

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Keywords: *Mycobacterium bovis; European badger; cattle; interface; landscape epidemiology.*

France is officially free of bovine tuberculosis since December 2000. However, the infection still persists in a few regions at a low level, which is the case in *Pyrénées-Atlantiques – Landes*. In this area badger (*Meles meles*) populations are sometimes established in habitats close to cattle farms and both badgers and cattle have been reported infected (Cavalerie *et al*. 2015; Hauer *et al*. 2015). Depending on the location, the infection was found in both cattle and badgers, in badgers only, or in cattle only. The aim of our study was to find environmental variables which could be associated with *Mycobacterium bovis* concomitant infection in both cattle and badgers, in an area of this part of France. We defined circular spatial units (500 m and 1000 m radiuses) centred on 113 setts of trapped badgers and including cattle pastures. The characteristics of spatial units where only one species had been found infected were compared with the ones where both cattle and badgers had been found infected. A multivariate logistic regression model was used to analyse the association between concomitant infection and three groups of variables describing landscape, animal population and terrain features of spatial units. The terrain ruggedness index of pastures and the percentage of sand in their soil were positively associated with the odds of concomitant infection in spatial units. The number of neighbouring badger groups was negatively associated with the odds of concomitant infection (spatial units of 1000 m radius), whereas the number of cereal parcels was positively associated with the odds of concomitant infection (spatial units of 500 m radius). Our results suggest that terrain features may influence *M. bovis* transmission between badgers and cattle, leading to concomitant infection.

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Living with badgers in a peri-urban environment. Population study and treating conflicts with non-destructive solutions in the Lyon area

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Keywords: *Badger, peri-urban populations, conflicts, cohabitation.*

Rhône Alps Nature Protection Federation (FRAPNA) members have been studying badger populations around Lyon since the early 1970s (Ariagno, 1987). Use of a burrow counting method (Ruette *et al*. 2007), new equipment like trail scout and detailed knowledge of badger behaviour and the local environment have led to solid information about burrow locations, the evolution in the number of individuals and population connections. A high rate of urban occupation, several massive linear transport infrastructures and important human presence in natural areas results in a decrease of badger populations and lower density than usual (Do Linh San 2006). Meeting residents, farmers and local representatives also led to facing the problem between badger and human activities, such as crop consumption or harmful burrows which were traditionally solved by animal destruction. Considering global population decrease, an agreement between wild fauna administration, hunting representatives and FRAPNA has resulted in using destruction alternatives when problems with badgers occur. The combination of badger population knowledge, experimentation with systems of protection or deterrence and a social approach to the conflict, allow us to obtain efficient non-destructive methods. Firstly, this presentation will give the results of a 50 year-long study of badgers in Grand Lyon and the particularities of badgers living in peri-urban areas. Secondly, we will deal with problems between badger and human activities, the efficiency of solutions which we are improving and we will have an open discussion about badgers's learning and cognition.

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STUDENT PRESENTATION

Environmental factors influencing the diet and spatial distribution of the signs of Eurasian otter *Lutra lutra* in Vistula valley, central Poland

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Keywords: *Diet composition; otter; distribution; spraint analysis.*

After a severe decline of Eurasian otter populations in Europe in the mid twentieth century, its recolonization of Poland was successful. It is currently widespread and is regarded as a conflict species. This situation creates the opportunity for research, as the otters occupy not only preferable, but also suboptimal habitats. The project regards chosen stress hormone and contaminant levels in otters. With the progress in gathering and interpreting the data, we made some observations which can lead to conclusions about otter behaviour. The research area included the Vistula, and nearby smaller rivers between Warsaw and Włocławek. The area is very diverse, contains highly urbanized parts as well as nature reserves and Kampinos National Park. The field survey was carried out in 2016 and 2017, during six field trips. The tracks and some environmental data were noted, and faeces for the analyses collected. The diet composition was analysed using the standard method, resulting with estimated biomass percentage of prey groups. The number of faeces, tracks and other signs served as a measure of otter presence. The environmental data included such factors as: river width, other water bodies nearby, river bank modifications, trees, bushes or reed cover of the bank, dens or hiding places availability, proximity of forests, urbanized areas, busy roads. Small rivers in the research area are dry in some seasons and frozen during the winter time. The diet during winter season consisted only of fish, which are available almost exclusively in the Vistula river for the most part of the winter. We noted that the distribution of otter signs changes seasonally. Otters probably change their territories for the winter, when the individuals that can't forage in small rivers hunt in the Vistula river. How this influences stress levels of this highly territorial species is of interest to future research.

STUDENT PRESENTATION

Assessing fecal stress hormone metabolites levels in the spraints of Eurasian otter *Lutra lutra*

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Keywords: *Stress hormones; otter; spraint analysis.*

Stress hormone analysis is a widely used tool to assess the wellbeing of livestock, wild animals in captivity, and is becoming more popular in wildlife research. Factors like the choice of matrix, method of analysis, time from collecting the sample, conservation and extraction method, all have an impact on the final result. We did the first attempt of assessing fecal glucocorticoid metabolites levels of the Eurasian otter, and compared the results with some variables that might influence the stress level in this semiaquatic predator. Spraints were collected in the field, in central Poland, along the Vistula river and smaller rivers nearby, in three different seasons, in 2016. Only fresh faeces, not older than 24 hours after defecation, were used. Spraints were frozen during the field trip and stored frozen till extraction. From 62 suitable samples, the subsamples of approximately 0,3g of wet faeces were extracted in 5 ml of 96% ethanol and for the final analysis, 100 µl of extract was diluted with 200 µl of methyl alcohol. High performance liquid chromatography - mass spectrometry (HPLC-MS) analysis was performed. Hormones were not detected in every sample. It was probably caused by the structure of otter spraints, which contain relatively big amounts of undigested residues. Analysis repeated on less diluted samples revealed more positive results. Neither the time of collecting the sample, or undigested material dry weight were connected to hormone metabolite levels. None of the factors taken into consideration so far, such as season, river width, or diet composition explains the variation in the hormone levels. The study is in progress. Hopefully, more and larger samples of faeces used for the extraction, additional explanatory factors considered and different statistical approach will help to clarify the view.

STUDENT PRESENTATION

Parasites of badgers in Ireland - an untold story

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Keywords: *Badgers; Meles meles; helminths; zoonosis; vaccination.*

The European badger (*Meles meles*) is Ireland's largest terrestrial carnivore. Since 1970, badgers have been recognised as wildlife reservoirs for bovine tuberculosis (bTB) caused by *Mycobacterium bovis* infection. In Ireland bTB is of significant agricultural and economic importance and considerable efforts have been made to eradicate the disease, notably the strategic culling of badgers in bTB endemic regions. However due to the badgers protected status, there is now a focus on vaccination-led control programmes. It is therefore imperative to future control programmes that there is a complete understanding of badger ecology, behaviour and underlying parasitic infection. Such factors have all been shown to interfere with similar control programmes in other mammal species. There is currently no comprehensive study of the helminth parasite community of Irish badgers. Single parasite infections are rare in feral hosts. Rather, each individual host tends to harbour a community of parasite species. The co-occurrence of microparasites (e.g. *M. bovis*) and macroparasites (e.g. helminth worms) can have implications for the intensity of TB disease as well as the efficacy of vaccines. As badgers are fossorial feeders, eating earthworms and insects directly from the soil, there is an increased likelihood of contact with the reproductive products (eggs, larvae) of helminth worms as many are transmitted through the ingestion of faecal contaminated soil.

The significance of this study is not confined to Ireland, as bTB is a disease with a worldwide range and global economic impact, and co-infection a widespread phenomenon. Results from this study will aid in the understanding of badger ecology as well as the development of future bTB control programmes.

The distribution and diet of Sheffield's otters

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Keywords: *Otter, Sheffield, distribution, diet, DNA profiling*.

The Eurasian otter (*Lutra lutra*) underwent a severe decline in the UK due to pollution caused by pesticides, becoming locally extinct in much of England by the 1960s. Bans on pesticides and improvements in water quality, alongside legal protection and targeted conservation efforts have led to the return of otters to parts of their original range. In 2016 camera traps revealed that otters have returned to the River Don in Sheffield. We performed DNA analyses of otter spraints (faecal samples) to confirm species, and identify otter numbers, sex, distribution and diet. Spraints were collected from 24 km of the River Don surrounding Sheffield (2016-17). Genomic DNA was extracted and amplified with mitochondrial markers (12S and cytochrome b; to indicate species present and diet), and seven microsatellite markers and a sex marker (to estimate otter numbers). Individually- tagged amplicons of the mitochondrial markers were pooled and sequenced on an Illumina MiSeq sequencer. Mitochondrial sequences were compared against the NCBI sequence database revealing otter (and mink) at various sites. Microsatellite genotyping and sex- typing was performed on an ABI DNA Analyzer and DNA profiles were compared. Seven individual otters were identified, including at least two males. A female otter was also detected to the north of Sheffield in a more rural location. Several species of fish (including bullhead, common minnow and trout) and birds (including grey heron and moorhen) were detected in the otter spraint DNA. Additional markers (such as COI and 16S) will be used to detect other potential prey species, such as crayfish and water vole. The markers developed are currently being used to identify otter individuals in the Peak District surrounding Sheffield, to investigate if the same individuals are crossing between river systems, between urban and rural areas, whether this is seasonal, and if any barriers/drivers affecting distribution can be detected.

STUDENT PRESENTATION

Time partitioning in pine and stone marten from the Carnic Pre-Alps (NE Italy)

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Keywords: *Martes, camera-trapping, time niche, Eastern Italian Alps.*

The pine marten (*Martes martes*) and the stone marten (*M. foina*) are the most similar sympatric carnivores in Europe (Larroque *et al*. 2015). Recently, they have been reported to coexist without spatial segregation thanks to slight differences in activity patterns (Monterroso *et al.* 2016), while cathemerality has been reported to enhance pine marten's competitive ability with respect to the stone marten (Torretta *et al*. 2017). We investigated by camera-trapping the temporal activity patterns of the two martens in the Carnic Pre-Alps (NE Italy). The survey was carried out in 2015-2016, within a 1 x 1 km grid. We used 34 camera traps, one per cell. Within each cell, whenever possible camera traps were positioned in areas with dense forest cover and rock cavities, which were assumed to be preferred by both martens. All photos and videos of martens were subjected to a blind identification procedure by three of us. Diel activity patterns were estimated non-parametrically through the probability density function using Kernel Density Estimate and we tested the distribution uniformity using Watson's test (U^2). The overlap in the probability density functions of the two species was tested by Watson's two- sample test. The pine marten was recorded 14 times at 5 sites, while the stone marten occurred in 12 sites, for a total of 19 videoclips. The first showed a non-uniform activity pattern ($Wt = 0.34$, $P<0.01$), being mainly nocturnal (79% of videoclips). The pine marten showed a cathemeral pattern ($Wt = 0.084$, $P>0.1$), i.e. was active during hours of both daylight (64% of videoclips) and darkness. The two patterns differed significantly ($W2t = 0.23$, $P<0.05$), suggesting time niche partitioning. Being potentially active within a broader period, cathemeral species may be more ecologically flexible than strictly nocturnal species and therefore able to adjust their activity patterns to local conditions.

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Hybridization between the critically endangered European mink and the Polecat in Navarre, Spain: two recent cases with different phenotypes

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Keywords: *Hybridization; European mink; Polecat; Navarre; Phenotypes.*

Hybridization has been described in mustelids between the critically endangered European mink (*Mustela lutreola*) and the more abundant polecat (*Mustela putorius*) (Maran *et al*. 2016). It was reported that hybrids have distinct phenotypic characters which are intermediate to those exhibited by the parental species. However, the mixture of morphological characters is sometimes ambiguous because hybrids can express a great variety of possible parental phenotypes. The application of genetic markers provides many advantages over the use of phenotypic characters in characterizing hybridization and introgression.
A recent study on 317 European mink, 114 polecats and 15 putative hybrids collected from different localities in Europe, using both mitochondrial and nuclear data, revealed 3% hybridization and 0.9% introgression levels, mostly in the western region (Cabria *et al*. 2011). A few misidentifications based on the phenotype were detected.

We report here two recent cases of hybridization between European mink and Polecat observed on necropsied traffic victims from Navarre, Spain, showing two very different phenotypes. Genetic analyses and comparison with the database above cited revealed that:

- The first case, looking more like a polecat with a particularly dark underhair, was probably a back-cross between the two species (Hybrid F1 * polecat). Its sex was undetermined.
- The second case, an old European mink female having reproduced (4 placental scars), with a strange dark brown facial mask and a yellowish underhair, was classified only at 79% as a European mink, and at 82% as a hybrid F2, confirming a former hybridization and fertile progeny.

These two cases could reflect the increasing frequency of hybridization in those sympatric areas where European mink survives in lower densities, as the Navarre population dramatically decreased during these last ten years, in particular because of a Canine distemper epidemic (Fournier-Chambrillon *et al.* 2017).

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American mink eradication protocol for the project “LIFE LUTREOLA SPAIN”

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Keywords: *Mink raft; trapping; alien species; Spain.*

The expansion of American mink (*Neovison vison*) is the main threat to survival of the European mink (*Mustela lutreola*) population in Spain. The project “Life Lutreola Spain” (2014-2018) aims to improve the conservation status of the native mink and a number of activities are underway for this. The major emphasis is on the eradication of American mink within the range of the native mink and surrounding areas. After confirming the high effectiveness of the mink raft method in 2014, a protocol for eradication of American mink was prepared which has served in the frame of the project and elsewhere. The protocol defines trapping techniques, effort, period and area. Particular importance is given to the design and coordination of the work as the area covers different administrative territories and multiple river catchments. The basic strategy of the eradication is that the trapping effort is concentrated to a particular area (river catchment) and not dispersed. Success rate criterion is presented in the protocol, based on earlier experience of eradication of the American mink in other countries.

STUDENT PRESENTATION

Evaluating spatial variations in abundance and social organisation of badger populations in France – Preliminary results

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Keywords: *European badger; landscape; density; social organisation*.

Badger (*Meles meles*) densities are not precisely known in France. However, we know that badger's relative abundances vary across small agriculture regions at the national scale (Calenge *et al.* 2015). In addition to environmental variables, organisation of social groups and territoriality, may affect badger density. Social behaviours within and between groups have been studied in England, in a high-density population (Drewe *et al.* 2012), but not in France where group size variations are not known. This project aims to explain spatial variations in badger abundance and social organisation at three spatial scales. Firstly, we used Bayesian variable selection modeling to determine ecological correlates that can explain these national variations in relative abundances. Preliminary results confirm that various relevant environmental variables i.e. presence of food crops (maize, vineyards, orchard land), vegetal cover or roughness landscapes might explain higher relative abundances, as previously shown in other areas (e.g. Acevedo *et al.* 2014). On a regional scale, we estimated both the density of occupied setts and the social group sizes on 11 territories of 50 km² in France to evaluate badger density. We applied systematic line transect sampling and used multiple covariate distance sampling (MCDS) to estimate the density of setts in March-April. Estimation of group sizes for setts was then carried out by 2 weeks camera trapping, and by using hair-traps and faeces collection. Genetic analyses are in progress. Finally, to study spatial evolution and temporal structure of social groups, 4 to 5 contiguous reproductive setts are being studied in central-east France, on a local study site (10km^2). All individuals present on these setts are being equipped with GPS/Proximity logger collars (Sirtrack®) over a period of one year, to estimate movements but also the frequency and contact rates between individuals according to the key periods of the annual life cycle.

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Landscape use by translocated pine martens revealed by radio and GPS tracking

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Keywords: *Pine marten; translocation; radio-tracking; GPS.*

In autumn 2015, 20 pine martens were translocated from Scotland to mid-Wales as part of The Vincent Wildlife Trust's Pine Marten Recovery Project. A year later, a further 19 pine martens were released in the same area. All of the animals were radio-tracked for up to 12 months after release to monitor their movements and ranging behaviour. This presentation describes what the data reveal about how the animals used the habitats in the release area, how they established territories in both empty and subsequently occupied landscapes and the challenges of using GPS technology for nocturnal, forest dwelling, small mustelids.

How do badgers (*Meles meles*) cope with the dense infrastructure in the Netherlands? A study with cameras and GPS-loggers

Jaap Mulder

Badgers were studied in the centre of the Netherlands, in an area where a highway, a railroad and a busy provincial road cross a badger population. In part of the study area there are badger fences along roads, as well as badger underpasses (tunnels) under roads and railroad, preventing traffic deaths. In another part of the area these measures are lacking. Badger tunnels were monitored with camera traps for many years, and about 20 badgers were followed for up to a year with GPS-loggers. The GPS-collars were 3D-printed, had an extremely smooth innerside and were therefore relatively welfare-friendly. Badger tunnels within a badger territory were intensively used throughout the year, whereas tunnels between badger territories were used mainly during spring and autumn. Badgers from both sides of the road crossed these tunnels, sniffed around a bit at the other side and returned mostly within an hour to their own side. These tunnels are important for dispersal of individuals. All badger tunnels in the study area were in use by badgers (and other species), even when their construction seemed to make their use unlikely.

Pine marten (*Martes martes*) field research in the Netherlands: identifying individuals and radio-telemetry

Jaap Mulder, Ruud van den Akker

In a small forest of about 800 ha the pine marten population has now been followed for about 10 years. Most of the pine martens were individually identified and followed with the help of feeding stations and camera traps. Since March 2016 four individuals have been followed with VHF-radio-telemetry as well: all three resident adult individuals and one subadult, which dispersed in June of his second year of life. The method of individual recognition on feeding stations is explained. Furthermore, the turnover of individuals in this small population is presented, as well as some results of the telemetry study. Momentarily the whole study area is inhabited by a single male pine marten, his territory overlapping with two by two adjoining females.

Assessing personality traits in European mink using keepers' ratings

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Keywords: *European mink; personality; aggression; captive breeding.*

The European mink (*Mustela lutreola*) is a critically endangered mustelid whose wild populations rely on captive breeding efforts. However, such efforts are often jeopardized by males behaving either too aggressively or too passively towards receptive females. It has been suggested that pairing males and females of matching 'personality' phenotypes could help increase pair compatibility (Martin-Wintle *et al.* 2017). Personality assessments in other zoo carnivores typically use two methods: animal-based tests (e.g. novel object test) and keepers' ratings of personality traits (e.g. Gartner & Powell 2011). Personality in the European mink has previously been assessed via animal-based tests (Haage *et al.* 2013), but whether keepers' ratings could also be used to assess their personality is unknown. We thus aimed to validate keepers' scores as a potential, practical way to assess personality in this species. For this, we had five keepers of varying degree of experience rate 102 mink (66 males, 36 females; between 6 months and 8 years old) in the pre-breeding season (October-February). Each keeper rated each mink only once, although not all keepers rated all the traits for all the mink. The assessment sheet had 7 *a priori* identified personality traits: bold, aggressive, curious, playful, impatient, social, and passive. Each personality trait was rated on a 1-10 scale. Our preliminary results show that degree of agreement between keepers varies according to trait, with keepers agreeing more strongly when rating boldness and impatience ($W=0.43$ and 0.48 respectively, $p<0.001$), and moderately agreeing on aggressiveness, curiosity, sociality and passivity (W between 0.26 and 0.38, $p<0.05$). Playfulness was not reliably rated ($W=0.20$, $p=0.489$). Future work will test if keepers' ratings align with results of animal-based personality tests (i.e. those used by Haage and colleagues) and with breeding records, to see if these 'personality' traits as agreed upon by the keepers are biologically relevant.

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Morphological variations among different age groups of sable in Yakutia (North-eastern Siberia)

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Keywords: *Yakutia, sable, age groups, morphology, craniometry.*

The age variability of morphological parameters in Yakutian sable was studied. For comparative analysis, the measurements of bodies and skulls of sables of various age (n=4264) were made. Hunters supplied the carcasses during the winters of 2002-2010. The measurements conducted using the generally accepted method (Novikov, 1956; Kuznetsov, 1975). Estimated age of sables based on annual increments in dental cement (Klevezal and Kleinenberg, 1967). Changes in sable body mass and length, as well as the development of skull structure were finished at age 2+. The tendency of male average body size to increase was continued until age 6, while females featured insignificant increment. The cranial variation also expressed as a growth of skull until sables reached the age of 6-8. The one-year-old animals and young specimens of the current year featured statistically significant less values of skull measurements as compared to elder age groups. Similar trends were found in American mink and Siberian weasel. For comparative morphological and craniological analysis of these three species, it is reasonable to use the measurement data of the animals older than 2 years old.

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Improved trapping technique of the American mink helps to save the critically endangered European mink in Spain

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Keywords: *Neovison vison; Mustela lutreola; Eradication; Alien species.*

Spain currently holds one of the last populations of European mink (*Mustela lutreola*) in the wild. Great effort has been made for its conservation since the early 2000s but the status of the species has worsened drastically during recent years. The main cause of decline of the European mink is the impact of alien American mink (*Neovison vison*). Populations of the American mink established in Spain since the 1980s and continuous expansion in their range has been observed thereafter. The impact of earlier culling campaigns was clearly insufficient to stop the invasion of American mink. In 2014, an experimental trapping of American mink was carried out in the frame of project "Life Lutreola Spain" to contrast a conventional trapping to the mink raft method. As a result, the mink raft method was 7.4 times more effective. Since 2015, an eradication campaign started within the range of the European mink and nearby. More than 1000 mink rafts have been set in the area of the project between 2015 and 2017, the area trapped increased in stages. Near half of the effort has been carried out at the Ebro river basin, the area which holds the main part of the European mink population in Spain. By now, the American mink has been eradicated along a 400km long section of river in the Ebro basin and the native mink is showing the first signs of recovery there.

A restoration plan for the Pine Marten in the North of France

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Keywords: *pine marten; restoration plan; protection; communication.*

The distribution and number of pine martens in France is poorly known. According to current scientific knowledge, they cover almost all the territory. The ONCFS (French National Office for Hunting and Wildlife) recently conducted a study to clarify the density and the change in density of the species, but did not deal with numbers. In France, the marten appears on the national list of huntable species, even if the status varies from one region to another. As the conservation of biodiversity falls under the competence of the "régions" in France, the ex-Nord- Pas-de-Calais région adopted its own biodiversity strategy, including the protection and reintroduction of native species. The région implemented regional biodiversity restoration plans after consulting local biodiversity experts. The pine marten has been chosen because of the scarcity of its numbers there and because it is located at the northern limit of its French range, in a densely human populated and highly fragmented area, hence most subject to isolation, collisions and trapping. The CMNF (local mammal trust for the north of France) has been entrusted with the restoration plan for the wildcat and pine marten, which has been ratified by the major regional actors (hunters, trappers, foresters, naturalists, regional scientists). The restoration plan is based on a long-term strategy maintaining the current distribution of the species along three themes. Studying actions focus on establishing a reference situation of the species (genetic studies, characterization of the regional population), protecting actions focus on the protection of habitat and the restoration of its ecological functionality, and raising awareness actions will help promoting the species and its acceptance by the local actors. One of these actions consists in installing marten den boxes built by the carpentry section of a local vocational school, and is still ongoing despite changes at the political level in the concerned area. The first results are expected in 2018.

Digging in undisturbed sites, but nearby food: badgers' exquisite taste for sett location

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Keywords: *Anthropic disturbance; Food accessibility; Meles meles; Portugal; Resting sites characteristics.*

Central-place foragers are species whose movements are determined by a focal area location, from which they depart to and return from foraging bouts. These core areas are usually a nest, den or sett, and understanding what may govern the spatial distribution of those sites is crucial to conserve or manage such species. European badgers (*Meles meles*) are considered central-place foragers, whose spatial ecology is mostly determined by sett location. Many studies have assessed the factors determining sett site selection throughout its European range, but are usually geographically limited and identified highly specific factors. Thus, a wider approach is needed to infer the key factors that determine sett locations in a broader scale. To fulfil this gap, between June 2014 and January 2017, we surveyed mainland Portugal to detect badger setts, over 657.5 km on walked line transects in cells of 10x10km. We detected 54 main setts in 136 surveyed cells. Each site, together with the non-sett sites (i.e. transects where setts were not detected), were characterised using bio-environmental variables. We used a Generalized Linear Mixed Model to test five hypotheses to explain the sett location: (H1) Land cover composition; (H2) Anthropic disturbance factors; (H3) Environmental abiotic factors; (H4) Trophic resources availability; and (H5) Combined effect of the previous factors. Our findings show that the key factors for badger sett site selection in Portugal are (1) disturbance avoidance (low beehive density; absence of luvisols (soil) and livestock; lower proportion of eucalyptus plantations; higher proportion of low- density shrublands, higher distance to hunting areas, but closer to highways and unpaved roads) and (2) providence of food associated resources (higher proportion of agroforests, deciduous/mixed forest and food production patches). Although specific factors within these wider groups of drivers may be acting locally or regionally, the major drivers identified elsewhere are still the same.

STUDENT PRESENTATION

Feeding behaviour of the Common otter in the lower Mondego river valley

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Keywords: *Adaptive plasticity; foraging behaviour; invasive species; Lutra lutra; Procambarus clarkia*

The Common otter is a predator that is currently threatened in Europe, mostly due to habitat fragmentation and low availability of prey. Nevertheless, its conservation status in Portugal changed to Least Concern, coinciding with the expansion of introduced species throughout the country. This phenomenon led to an increase of the otter population in Portugal, which is now considered one of the few populations thriving in Europe. The aim of this study was to understand the evolution of the feeding behaviour of otters in the lower Mondego river valley. The results point to the plasticity of feeding behaviour of this species, as changes were detected in their occurrence patterns and diet composition according to the seasonality and abundance of prey. In winter, otter abundance is higher in Arzila Marsh, with its main prey being fish species. In summer, otters moved to the surrounding areas of rice fields and had its diet dominated by crayfish, revealing an opportunistic feeding behaviour. After the expansion of crayfish, the otter's diet mainly constituted this invasive species. Currently, it presents a greater use of fish species. The evolution of diet composition may be related to a decrease in the abundance of crayfish, as a consequence of its predation by several species of birds and mammals, including Common otter. The Common otter may be playing a role as an umbrella species through the control of invasive species, from which the native species benefit. This pest control allows the native species populations to recover, increasing the biodiversity of the riparian ecosystems, as well as contributing to the reduction of damage caused to rice crops by crayfish, and thus providing an ecosystem service which directly benefits human populations and the local economy.

Nature conservation and invasion of the American mink (*Neovison vison*) in Poland – how science can assist in lawmaking?

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Keywords: *American mink, invasive alien species, nature conservation, Neovison vison.*

Intensification and globalization of American mink (*Neovison vison*) farming are the main driving forces of the dynamic increase in its range and in its effective adaptation to ecological niches in new areas. The first observations of mink in the wild in Poland took place in the middle of the last century. Within 60 years, the American mink colonized almost the entire country and the process of invasion and colonization is still ongoing. Dynamic geographical spread of allochthonous American mink is associated with a number of serious ecological problems, e.g. predation, competition and aggression against indigenous fauna, as well as disease transmission. In the absence of practical possibilities of its permanent eradication from Poland, local eradication programmes in vulnerable areas (e.g. ground-nesting birds breeding sites), as well as large-scale population size control, promotion of natural competitors, and improvement of living conditions of its prey species are recommended. The most important factor in monitoring and control programmes of alien populations is limitation of farm animal escapes and recognition of methods for simple and unambiguous identification of escapees. Indisputable determination of the free-ranging animal's origin would allow for taking the appropriate actions against owners of the unsafe farms. At the same time, implementation of a holistic and systemic approach to solve the problem of the presence of the American mink in the natural environment would help to fulfil obligations of the Polish state resulting from ratified international conventions and European Union law.

Scientific activity of the Polish Society for Conservation Genetics LUTREOLA and conservation of the critically endangered European mink

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Keywords: *Conservation genetics, European mink, Mustela lutreola, species conservation, applied science.*

The Polish Society for Conservation Genetics LUTREOLA (www.lutreola.pl) is the first in Poland, and one of the first in the world; a scientific association dedicated exclusively to conservation genetics. The society's mission is to stop biotic diversity decline by initiating and supporting development of conservation genetics and to achieve its practical application in nature conservation. The society emerged from a demand of understandable and unequivocal definition of conservation genetics and its conceptual apparatus, especially in view of poor recognition of this branch of science in Poland. The aim of the society is primarily scientific activity supporting conservation genetics development and practical application of research results. One of the target species is the European mink, *Mustela lutreola*, one of the most endangered mammal species in the world, in 2016 listed as 'Critically Endangered' on the IUCN Red List. To address the dramatic situation of the species, the Polish Society for Conservation Genetics LUTREOLA, in cooperation with the Institute for Research on Biodiversity of the University of Szczecin, the West Pomeranian University of Technology and the Green Federation "GAIA", has initiated a research project dedicated to its conservation genomics. The aim of the project is to collect DNA samples from as many as possible preserved and extinct populations of the species, analysis of genetic diversity of the species, based on population and comparative genomics, development of tools enabling application of obtained results in increasing effectiveness of current and planned restitution activities (conservation breeding, reintroduction programmes, maintenance of the genetic fitness of recreated and vanishing populations). The society invites all individuals and institutions working on European mink conservation to cooperation, in the belief that only combined and coordinated efforts of all stakeholders enable the conservation of species on the edge of extinction. To popularize its research activities dedicated to European mink conservation, the society declared 31st March as European Mink Day. This grassroots initiative has a symbolic dimension and aims to raise public awareness on progressive extinction of this species and to encourage appropriate remedial actions.

Amphibians in otter diet: morphological examination of undigested remains reveals a greater-than-expected diversity

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Keywords: *Lutra lutra, food resources, diet analysis, Mediterranean region.*

In the diet of Eurasian otter *Lutra lutra*, amphibians are an important resource, particularly in the Mediterranean region. Their exploitation has been reported to allow otters to colonise small watercourses sustaining low fish biomass. Moreover, in southern Italy amphibians represent a major resource alternative to fish in winter-spring, when increased water discharge and turbidity hinder fish predation by otters (Remonti *et al*. 2008). Despite their importance for otter diet, undigested remains from faecal analysis are usually grouped in large food categories, with few or negligible details about both species identification and prey size. With the aim of filling this gap, we studied otter diet at the southern edge of its Italian range (Sila Massif, Calabria region), where amphibians might be expected to be largely preyed on by otters. Between July 2016 and June 2017, we collected 357 faeces. Taxonomic identification was based on available keys (e.g. Haller-Probst & Schleich, 1994, for caudate; Bailon, 1999, for anurans) and the osteological reference collection of the Dept. of Earth Sciences, University of Turin. Fish (mean percent Volume = 63.8) and amphibians (mV% = 30.3), formed the bulk of otter diet. Amphibian consumption was the highest in winter and spring (mV% = 35 and 41, respectively). Until now, a sub-sample of 62 faeces has been examined to identify amphibian remains at species-level. Whenever possible also the age (juveniles vs. adults) and sex of prey were also assessed. We recorded the occurrence of at least five amphibian species, belonging to four families: *Lissotriton italicus* (Salamandridae)*, Bufotes viridis* (Bufonidae)*, Hyla intermedia* (Hylidae)*, Rana dalmatina/italica* and *Pelophylax kl. esculentus/lessonae* (Ranidae). Moreover, two reptiles were identified at species level: *Hierophis viridiflavus* and *Natrix natrix.* Our results confirm the great feeding adaptability of the otter and, particularly, emphasize the diversity of prey on which otters can rely in Mediterranean habitats.

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European and American Mink in France: current knowledge and prospects for monitoring and conservation

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Keywords: *European Mink; American Mink; monitoring; conservation.*

European Mink *Mustela vison* is now classified as "Critically Endangered" by IUCN. In France, distribution area has been declining since the beginning of the 20th century. Despite a low level of monitoring during the past decade, it seems that this trend is continuing, leading to a probable disconnection with Spanish populations. On the other hand, American Mink *Neovison vison* has showed a continuous expansion in France, notably around the areas occupied by European Mink. Thus, American Mink expansion constitutes a direct threat that could rapidly lead to the extinction of French European Mink populations (Santulli *et al*. 2014). French national authorities decided to run new conservation actions in 2015. The two main purposes are to (i) evaluate the European Mink population in France (distribution, trend, location of core areas, etc.) and (ii) implement an ambitious control strategy against American Mink. A network of financial and technical partners is being built to reach these goals. For European Mink monitoring, 424 survey programmes using 10 traps for 8/10 nights have been planned between 2016 and 2019, in the river catchment where European Mink were still present 10 years ago and then concentrate the conservation actions on the population's cores. Between September 2016 and March 2017, 85 survey programmes were completed, leading to the captures of 3 European Mink. An ambitious operation of American Mink control has been planned in order to protect the last areas with European Mink populations in France and Spain. In 2016, 100 mink rafts were placed in Gironde administrative areas and 20 in a test zone at the border with Spain. To add to the last data collected in 2016 and early 2017, and improve the efficiency of the strategy, this network will be reinforced with 200 and 180 rafts respectively in the Gironde/Dordogne and Pyrénées- Atlantiques administrative areas.

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The feasibility of reintroducing mustelids: A case study using the proposed pine marten reintroduction to the Forest of Dean and lower Wye Valley, UK

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Keywords: *Conservation translocation; IUCN guidelines; conservation intervention; Martes martes*.

Conservation translocations, including reintroductions, have now been utilised for a variety of mustelids, including European pine marten (*Martes martes*), Eurasian otter (*Lutra lutra*), and European mink (*Mustela lutreola*). Here we show how the feasibility of reintroducing mustelids can be assessed by utilising key international guidelines on conservation translocations. We will discuss the reasons for a conservation translocation, including how conservationists can assess alternative solutions. Also, how the suitability of a release area can be assessed using tools such as Habitat Suitability Models and Population Viability Analysis will be discussed. How the potential ecological costs and benefits of a reintroduction may be assessed will also be outlined, including how geospatial analysis can be useful in predicting areas of impact. Furthermore, we will discuss the importance of assessing the socio-economic costs and benefits of a reintroduction, including the importance of stakeholder engagement and public consultation. Assessing the feasibility of any conservation translocation is vital to ensure evidence-based and informed decision-making. However, how feasibility studies can inform the planning of a reintroduction will also be outlined. Throughout the talk, examples from the feasibility study assessing the potential reintroduction of pine martens to the Forest of Dean and lower Wye Valley will be utilised.

Research of Cunis family fauna in Yakutia

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The Republic of Sakha (Yakutia) is the part of the Russian Federation located in the northeast of Asia, where it occupies over 3.2 million sq. km. The distance between the outmost northern and southern points, as well as between the eastern and western points is more than 2000 km. Over 40% of the territory lies beyond the Arctic Circle. The climate there is sharply continental; the amplitude of air temperature fluctuation is 100 °C in average (from 40°C in summer to -60°C in winter). In the territory of Yakutia, where the northern hemisphere's Pole of Cold is situated, the lowest temperature record was -71.2 ºC. The average July temperature in Yakutia is +16.6ºC and in January it reaches -37.1ºC. The modern fauna of Mustelidae family in Yakutia includes seven species: weasel (*Mustela nivalis* L., 1766), stoat (*Mustela erminea* L., 1758), steppe polecat (*Mustela eversmanii* Lesson, 1827), Siberian weasel (*Mustela sibirica* Pallas, 1773), American mink (*Neovison vison* Schreber, 1777), sable (*Martes zibellina* L., 1758), wolverine (*Gulo gulo* L., 1758) and river otter (*Lutra lutra* L., 1758). In Southern Yakutia, occasional invasions of badger (*Meles leucurus* Hodgson, 1847) are recorded. Collection and study of carcasses of game predator species are carried out annually since 2002. All major ecological and geographical regions of Yakutia are covered by monitoring. In addition to the network of monitoring sites, which provides us with samples every year, we also collect carcasses from other regions of Yakutia. The most numerous and common species in our studies is sable. In certain years, we managed to study more than 1000 specimens. Our current craniological collection comprises over 8000 sable skulls, over 200 skulls of American mink, 100 skulls of Siberian weasel, about 90 skulls of wolverine, etc. Each animal carcass undergoes complete morphological and anatomical examination. Each specimen is assigned a number under which all the data are entered into the database. They include the catching area, morphometric body and skull measurements, internal organs measurements, participation in reproduction and fertility, fatness estimation, presence and species diversity of helminths, food type and its amount in gastro-intestinal tract, etc. The age of all animals is estimated by counting annual layers in the teeth. Tissues are sampled for genetic studies as well. Over the past winter period of 2016-2017, more than 700 carcasses of sables, over 50 American minks, 30 stoats, 10 Siberian weasels, 6 wolverines and about 50 foxes were collected and studied. We work on expanding the range of research activity and are always open for cooperation and joint projects.

Survival of Eurasian otter in Northeast Asia

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Northeast Asia is a northern periphery of the Eurasian otter range. Its extent of occurrence extends to the Arctic Circle. This region is the coldest in the Northern Hemisphere where the otter meets the most adverse conditions of extremely low winter temperatures. Basic limiting factors are short frost-free season and deep-freezing of wetlands. Torrential watercourses are the only habitats corresponding to the otter ecological requirements, as stagnant reservoirs and smoothly flowing streams freeze through up to 1.5m. Consequently, the area of occupancy embraces presumably the system of high plateaus and mountain ridges situated east of the Lena River, while a vast lowland area is the extent of vagrancy. In such conditions, ice-holes and under-ice cavity formation on frozen rivers has critical importance besides a habitat foraging capacity. According to the torrent river specific 3–4 salmonids are the principal forage (supplemented locally with pike and burbot) in which the otter competes with the American mink (introduced in 1960s). Some torrents also freeze through, and otters that have occupied them are forced to search for other refuges in mid-winter. Moving through taiga they usually perish due to the lack of forage, frost or predation. Thus, the Eurasian otter in the northeast Asia environment survives on a margin of its capacity. Therefore, it has never been numerous or common. In the nineteenth century, annual pelt harvesting in Yakutia averaged (the extent of occurrence is about 1500000 km^2) up to 150, rarely as many as 500. Slightly more often, it occurs in the Pacific seaside zone with its milder winter climate. To date the otter decreased in number and extirpated over long reaches of many rivers and remains poorly studied with its unknown genetic structure. It has been listed as vulnerable in the majority of regional Red Data Books and is not commercially hunted but is occasionally trapped. Currently, major threats are coincident with the growth of accessibility of pristine areas with the arrival of water-jet propellers, hovercrafts, modern snowmobiles, etc., and industrial development. Undoubtedly, climate warming can facilitate the otter's survival, while any cooling will bring it to the verge of extinction.

Siberian weasel (*Mustela sibirica*) at the northern limits of its distribution area (North-eastern Asia)

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Keywords: *Yakutia, Siberian weasel, ecology, population characteristics.*

The distribution area of Siberian weasel in the north is limited to the Lena-Viluy and the Lena-Amga interfluves (the Republic of Sakha (Yakutia), North-Eastern Asia). The habitats are represented by river floodplains and lakesides. The survey carried out by the Game Department of the Republic of Sakha (Yakutia) states the population size of Siberian weasel as 7.1 thousand animals. According to the hunting statistics data, there were 13-15-year-long cycles of increase and decrease of population size that occurred during the period 1941-2014. The highest hunting rates were recorded in the mid 1950s, when up to 31.5 thousand Siberian weasels were killed, that is 78.8 times more than the present time (0.4 thousand). Most experts explain such decline in population size by competition with sable that recovered its numbers in Yakutia. Body sizes of males of various age differed significantly. The young animals were smaller than adults both by mass (381.3 and 487.1 g correspondingly) and body length (333.6 and 357.8 mm). The females did not show such tendency. In a total sample of the studied Siberian weasels (n=38) the ratio of males to females was nearly 1:1. Among young animals, females (73.7%) prevailed over the males (26.3%), significantly. While older females (36.8%), were much less common than males (63.2%), of the same age group. This was probably the result of relatively higher natural elimination rates. The young animals having fat on kidneys (73.7%) were less in number than adult animals (94.7%). Relatively low fatness of juveniles could probably be explained by higher energy costs due to settlement process. Fat females (90.5%) occurred more often than males (76.5%). This was explained by physiological peculiarities of female organisms intended for preservation and accumulation of energy resources required for successful reproduction.

Le Laboratoire de Biométrie et Biologie Évolutive

The Laboratory of Biometry and Evolutionary Biology (LBBE) is a research unit in Ecology, Population Genetics, Evolutionary Biology and Molecular Biology, headquartered in Villeurbanne, Rhône.

Office National de la Chasse et de la Faune Sauvage

The National Hunting and Wildlife Agency (ONCFS) is a public administrative institution. Its mission relates to the knowledge of wildlife and its habitats through studies and research, hunting and nature police, technical support to policy makers, land planners and managers of rural areas and the organization and issuance of hunting permits.

The Vincent Wildlife Trust

The Vincent Wildlife Trust (VWT) is a mammal conservation charity that has spent over 40 years carrying out research and practical conservation. It has focused particularly on the needs of British mammals including the otter, pine marten, polecat, stoat, weasel, water vole, dormouse and bats. Currently the VWT's work is centred on the pine marten, polecat, and the rarer bats.