



IX European Congress of Mammalogy  
(ECM9)

31 March - 04 April 2025, Patras, Greece

**BOOK OF ABSTRACTS**



## IX European Congress of Mammalogy (ECM9)

31 March - 04 April 2025, Patras, Greece

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## BOOK OF ABSTRACTS

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# PREFACE

Dear ECM9 Attendees,

It is our great pleasure to welcome you to the IX European Congress of Mammalogy (ECM9) in the beautiful and historic city of Patras, Greece. This event, taking place from March 31 to April 4, 2025, is organised by the Hellenic Zoological Society, the European Mammal Foundation, and Mammal Conservation Europe, under the auspices of the University of Patras. We are honored to host over 250 participants from more than 40 countries, all united by a shared passion for mammalian research and conservation.

ECM9 continues the tradition of the European Congress of Mammalogy, a conference series that began in Lisbon in 1991 and has since been held in Southampton, Jyväskylä, Brno, Siena, Paris, Stockholm, and Warsaw. Over the years, these congresses have provided invaluable opportunities for collaboration and exchange, fostering scientific advancements in mammalogy across Europe and beyond.

The congress program covers a wide range of topics, reflecting the diverse and evolving nature of mammalian science. With 16 thematic sessions, ECM9 will explore subjects, such as Genetics and Genomics, Conservation Biology, various aspects of Ecology, including Disease and Parasite Ecology, Population Dynamics, Climate Change, and Innovative Methodologies in Mammal Research and New Trends in Taxonomy, Threatened Mammals, Wildlife Management etc. Through oral and poster presentations, as well as plenary sessions led by distinguished researchers, we aim to facilitate meaningful discussions and inspire future research directions.

Beyond the scientific program, ECM9 provides a unique opportunity to connect with colleagues, exchange ideas, and build collaborations that will shape the future of mammalogy. We encourage you to take advantage of the vibrant academic and social atmosphere of this congress. Patras, with its rich cultural heritage and stunning coastal setting, offers an excellent backdrop for both professional and informal networking.

We extend our heartfelt thanks to the members of the Organising and Scientific Committees, as well as to the Plenary speakers, session chairs, and all presenters for their invaluable contributions. We are also deeply grateful to our supporting institutions and sponsors, whose efforts and generosity have made this event possible.

Finally, we thank you—our attendees—for your participation and enthusiasm. Your contributions and discussions will be at the heart of ECM9's success. We hope you enjoy a stimulating and rewarding congress and take home new insights, collaborations, and memories.

Welcome to ECM9 and enjoy your time in Patras!

**George P. Mitsainas**

**On behalf of the ECM9 Organising Committee**

## SCIENTIFIC PROGRAMME-MONDAY, MARCH 31, 2025

Organizers:



Under the auspices of:



# IX European Congress of Mammalogy (ECM9)



**SUNDAY**  
30.03.2025

18:00 - 20:00 Registration

**MONDAY**  
31.03.2025

08:00 - 09:00	Registration
09:00 - 09:30	Opening (Room I)
09:30 - 09:50	Heikki Henttonen & Boris Kryštufek: <i>Historical Overview</i>
09:50 - 10:10	Laurent Schley: <i>EMMA2: Updating the Atlas of European Mammals</i>
10:10 - 11:10	Plenary Talk – Fiona Mathews: <i>Taking the breaks off infrastructure developments: what does it mean for Europe's mammals? (Room I)</i>

11:10 – 12:00 Coffee Break

	Room I	Room II	Room III
12:00 – 18:30	<b>CONSERVATION BIOLOGY:</b> Fiona Mathews	<b>NEW TRENDS IN MAMMAL TAXONOMY:</b> Boris Kryštufek	<b>URBAN ECOLOGY:</b> Lucas Wauters & Claudia Tranquillo
12:00 – 12:20	John Koprowski <i>How do we make a difference? Finding the purple bike</i>	Keynote: Frank E. Zachos <i>Mammals and the species problem – grey areas in taxonomy and why they are here to stay</i>	Emilie Hardouin <i>Urban mammal species, communities and our attitudes towards them</i>
12:20 – 12:40	Jhonnell Villegas <i>Human-wildlife interactions: Cultural sensitivities and perspectives influence the conservation of the Philippine brown deer (Rusa marianna Desmarest, 1822)</i>		Olivia Dondina <i>Spatial and habitat drivers of small-mammal diversity in urban green areas: Lessons for urban green planning</i>
12:40 – 13:00	Samantha Bremner-Harisson <i>From planning to impact: Using the Conservation Standards to achieve measurable and sustainable results for mammal conservation</i>	Boris Kryštufek <i>Mammalian species delimitation in historical perspective</i>	Maria Vittoria Mazzamuto <i>Urban disturbance at the wildland-urban interface: Mammalian responses on Bogd Khan Mountain, Mongolia</i>
13:00 – 13:20	Rafal Kowalczyk <i>Refugees among mammals</i>	Georgy Shenbrot <i>Evolution of habitat niches in Palearctic Arvicolinae rodents</i>	Enrico Mirone <i>Exploring the urban large and medium-sized mammal assemblage in a small city of South-Central Italy. Implications for human-wildlife conflicts and coexistence</i>
13:20 – 13:40	Nika Knez <i>Influence of habitat use and diet quality on reproductive performance of European bison across Europe</i>	Mateusz Baca <i>The evolutionary history of the field vole species complex revealed by modern and ancient genomes</i>	Leonardo Ancillotto <i>Who stays and who is gone: trait-driven bat extinctions in Italian cities</i>
13:40 – 15:10	Lunch		

## SCIENTIFIC PROGRAMME-MONDAY, MARCH 31, 2025

Organizers:



**MAMMAL**  
CONSERVATION EUROPE



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# IX European Congress of Mammalogy (ECM9)

15:10 – 15:30	<b>Panagiotis Georgiakakis</b> <i>Bat colonies in Mediterranean sea caves: research and conservation challenges</i>	<b>Josef Bryja</b> <i>DNA barcoding of African rodents: advantages and pitfalls in taxonomy</i>	<b>Christian Voigt</b> <i>How mobile generalist bats survive in a resource-depleted urban environment</i>
15:30 – 15:50	<b>Silviu Petrovan</b> <i>National-scale monitoring of some widespread mammal species in the UK using citizen science: status, challenges and opportunities</i>	<b>Paolo Colangelo</b> <i>Population genomics of <i>Talpa europaea</i> reveals distinct lineages and adaptive divergence in a widespread subterranean mammal</i>	<b>Valeria Mazza</b> <i>Small mammals along a gradient of human presence and disturbance: behavioural and cognitive perspectives from the wild</i>
15:50 – 16:10	<b>Ferdia Marnell</b> <i>The current conservation status of the otter (<i>Lutra lutra</i>) in Ireland</i>	<b>Gerald Heckel</b> <i>Taxonomic uncertainty in the vole world</i>	<b>Lucas Wauters</b> <i>Phenotypic variation of an arboreal mammal along a rural-urban gradient</i>
16:10 – 16:30	<b>Marna Visagie</b> <i>Assessing the population density and feeding ecology of Tswalu Kalahari Reserve's elusive carnivore species</i>	<b>Alexey Yanchukov</b> <i>Genome-wide phylogeny of subterranean blind mole rats Spalacinae (Gray 1821)</i>	<b>Christel Rose Bachmann</b> <i>Bat habitat use in urban environment based on citizen science data</i>
16:30 – 16:50	<b>Elham Ebrahimi</b> <i>Automating camera-trap data reporting for wildlife monitoring</i>	<b>Adam Konecny</b> <i>Phylogenomic relationships of Afrotropical crocidurine shrews: An overview of diversity and distribution</i>	<b>Emiliano Mori</b> <i>A new dawn for the Eurasian beaver in Italy? Ecological and social implications</i>
16:50 – 17:30	<b>Coffee Break</b>		
17:30 – 17:50	<b>Rémi Bodinier</b> <i>Towards a better understanding of area of greater conservation concerns for the critically endangered European Mink (<i>Mustela lutreola</i>) in France</i>	<b>Miloš Macholán</b> <i>Taxonomy and introgression: a case of <i>Mus</i></i>	<b>Fran Tattersall</b> <b>Wildlife Acoustics (Workshop):</b> <i>New Opportunities for Surveying Mammals with Bioacoustics – an Introduction</i>
17:50 – 18:10	<b>Danilo Russo</b> <i>The conservation potential and pitfalls of woodland islands for tree-dwelling bats in conventional farmland</i>	<b>Nedko Nedyalkov</b> <i>Penial morphology of moles (genus <i>Talpa</i>, Eulipotyphla) – a useful tool for species delimitation</i>	
18:10 – 18:30	<b>Giorgia Castiello</b> <i>Evaluating sustainable forest management practices for bat conservation</i>	<b>Vida Jojić</b> <i>Are five cryptic species of the lesser blind mole rat <i>Nannospalax leucodon</i> morphologically uniform or not?</i>	
20:00	<b>WELCOME PARTY (ROYAL)</b>		



## SCIENTIFIC PROGRAMME-TUESDAY, APRIL 1, 2025

Organizers:



**MAMMAL**  
CONSERVATION EUROPE



Under the auspices of:



**TUESDAY**  
**01.04.2025**

08:30 - 08:45 Opening (Room I)  
08:45 - 09:45 Plenary Talk – Nigel G. Yoccoz: *Seasonality and comparative analysis of small vs large mammal demography: revisiting Caughley and Krebs* (Room I)

	Room I	Room II	Room III
09:55 – 13:15	<b>CONSERVATION BIOLOGY:</b> Fiona Mathews	<b>INVASIVE AND ALIEN SPECIES:</b> Sandro Bertolino	<b>POPULATION DYNAMICS:</b> Janne Sundell
09:55 – 10:15	<b>Tea Hutten</b> <i>Are rare species truly rare? Possible causes of data deficiency for several bat species in Croatia</i>	<b>Jana A. Eccard</b> <i>The timid invasion: Why are native wood mice in Ireland displaced by invasive but shy bank voles?</i>	<b>Zbigniew Borowski</b> <i>Water deficit inhibits induction of silicon-based anti-herbivory defence in wetland ecosystems</i>
10:15 – 10:35	<b>Stefanos Kyriakidis</b> <i>Comparative study of two brown bear (Ursus arctos) subpopulations in Pindos Mountain range with camera traps and bio-signs</i>	<b>Stephanie Wray</b> <i>Searching For Shrews: A citizen science approach to tracking the spread and impact of non-native small mammals</i>	<b>Dominika Bujnakova</b> <i>The legacy of wolf extirpation now engraved in the bones</i>
10:35 – 10:55	<b>Steve Carter</b> <i>50 years of evidence-based carnivore conservation actions by Vincent Wildlife Trust</i>	<b>Claudia Tranquillo</b> <i>Adaptations of an invasive alien species to urban areas: the grey squirrel in Italy</i>	<b>Dime Melovski</b> <i>A decade of monitoring the critically endangered Balkan Lynx in its core area: Insights from spatial capture recapture models</i>
10:55 – 11:15	<b>Bledi Hoxha</b> <i>Conservation and Recovery of the Balkan Lynx: Achievements, Challenges, and Future Prospects of the Balkan Lynx Recovery Programme (BLRP)</i>	<b>Valentina La Morgia</b> <i>Managing alien squirrels in Italy: an update on presence, impacts, and the European context</i>	<b>Heikki Henttonen</b> <i>Ecology of sympatric bank and red voles, Clethrionomys glareolus and C. rutilus, in northern Finland</i>
11:15 – 11:35	<b>Maria Petridou</b> <i>Wolf and free-ranging livestock interactions in Northwestern Greece</i>	<b>Paola Correa</b> <i>How can integrated efficient management of the European rabbit in Chile be approached?</i>	<b>Elena Bykova</b> <i>Mammals of the world's youngest desert "Aralkum"</i>
11:35 – 11:55	<b>Julie Bommerlund</b> <i>Movement patterns of wild and captive-bred Arctic foxes in Scandinavia</i>	<b>Glenn Lelieveld</b> <i>Accidental eradication of American mink: a gamechanger for European mink?</i>	
11:55 – 12:35	<b>Coffee Break</b>		
12:35 – 12:55		<b>Anna Loy</b> <i>The first Atlas of Mammals in Italy: an updated overview of native and introduced species</i>	
12:55 – 13:15		<b>Jan Giordano</b> <i>Alien mammals in Italy: pathways of entry and the EICAT assessment of impacts</i>	
13:30	<b>MID-CONFERENCE EXCURSION</b>		



Organizers:



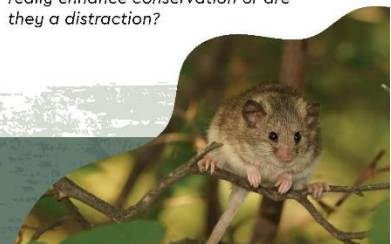
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## IX European Congress of Mammalogy (ECM9)

WEDNESDAY  
02.04.2025

08:55 - 09:00	Opening (Room I)		
09:00 - 10:00	Plenary Talk – Orly Razgour: <i>Using genomics to inform bat conservation under global change</i> (Room I)		
	<b>Room I</b>	<b>Room II</b>	<b>Room III</b>
10:10 – 17:20	<b>BEHAVIOURAL ECOLOGY:</b> Zbigniew Borowski & Jana Eccard	<b>GENETICS AND GENOMICS IN MAMMALOLOGY:</b> Elena Bužan, Josef Bryja, Alain Frantz & Frank Zachos	<b>MAMMAL CONSERVATION EUROPE:</b> Fiona Mathews
10:10 – 10:30	<b>Irene Belardi</b> <i>Avoidance vs. attraction: long-term changes in spatiotemporal interactions and dietary relationships between recolonising wolves and red foxes</i>	<b>Keynote 1: Gerald Heckel</b> <i>Escaping doom for 10,000 generations of complete isolation</i>	<b>MCE</b> <i>Mapping the habitat requirements of woodland mammals. Where are the synergies and conflicts?</i>
10:30 – 10:50	<b>Jennifer Hatlauf</b> <i>The social structure of a golden jackal group during one reproductive season in Samos</i>		
10:50 – 11:10	<b>Ilias Foskolos</b> <i>Greater noctule bats embrace a low-risk, low-gain foraging strategy</i>	<b>Barbora Pavlíčková</b> <i>Unravelling the secrets of two gerbil genera: Distribution and genetic structure on the Sahara's edge amid climate shifts</i>	
11:10 – 11:30	<b>Artemis Papafoti</b> <i>Diel activity patterns of forest dormouse (<i>Dryomys nitedula</i>) in northern Greece</i>	<b>František Vejmelka</b> <i>Overlooked diversity of the putatively monotypic smallest rodent genus from the largest tropical island</i>	<b>MCE</b> <i>Forest management for fire- and disease-control. How can it be made more wildlife-friendly</i>
11:30 – 11:50	<b>Tea Hutten</b> <i>Activity of the endemic Martino's Dinaric Vole (<i>Dinaromys bogdanovi</i>) and Western Dinaric Vole (<i>Dinaromys longipedis</i>) in Croatia recorded on camera traps</i>	<b>Jan Nahlovsky</b> <i>Bottleneck and selection effects on MHC variability in relict and reintroduced Eurasian Beaver populations</i>	
11:50 – 12:30	<b>Coffee Break</b>		
12:30 – 12:50	<b>Adam Wójcicki</b> <i>The impact of forest roads and tourist trails on the use of space by wild ungulates</i>	<b>Keynote 2: Laura Gramolini</b> <i>Intraspecific epigenomics divergence in brown bears (<i>Ursus arctos</i>): insights from genome-wide DNA methylation patterns</i>	<b>MCE</b> <i>Forest management for fire- and disease-control. How can it be made more wildlife-friendly (cont.)</i>
12:50 – 13:10	<b>Dido Sotiropoulou</b> <i>Behavioural study in white-beaked dolphins, mother-offspring pairs, with the use of Unoccupied Aerial Vehicles in Skjálfandi Bay, Iceland</i>		<b>MCE</b> <i>Tree veteranisation and artificial den/nest/roost provision: do they really enhance conservation or are they a distraction?</i>



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13:10 – 13:30	<b>Elise Say-Sallaz</b> <i>Red deer and Bison fear the human "super predator" more than they fear wolves and lynx</i>	<b>Jonas Lescroart</b> <i>Conservation genomic status of Neotropical cats compared to felids globally</i>	<b>MCE</b> <i>Tree veteranisation and artificial den/nest/roost provision: do they really enhance conservation or are they a distraction? (cont.)</i>
13:30 – 13:50	<b>Lukas Graf</b> <i>Living under the scope – selection of human hunters for behavioral traits in a heavily harvested moose population</i>	<b>Andrej Gonev</b> <i>Quantifying the genetic load and recent inbreeding levels of the critically endangered Balkan lynx (<i>Lynx lynx balcanicus</i>)</i>	
13:50 – 15:20	<b>Lunch</b>		
	<b>Room I</b>	<b>Room II</b>	<b>Room III</b>
15:20 – 17:20	<b>BEHAVIOURAL ECOLOGY:</b> <b>Zbigniew Borowski &amp; Jana Eccard</b>	<b>GENETICS AND GENOMICS IN MAMMALOGY:</b> Elena Bužan, Josef Bryja, Alain Frantz & Frank Zachos	<b>SUBTERRANEAN MAMMALS IN A CHANGING WORLD:</b> Radim Šumbera & Attila Németh
15:20 – 15:40	<b>Fragkiskos Darmis</b> <i>How behaviour influences individual life-history trajectories in a changing world</i>	<b>Laurie Bedouet</b> <i>Unveiling the genetics of the Eurasian Lynx (<i>Lynx lynx</i>): Insights for conservation of Jura and Alpine populations in France</i>	<b>Ondřej Mikula</b> <i>How fast do mammals speciate under the ground?</i>
15:40 – 16:00	<b>Ester Rut Unnsteinsdóttir</b> <i>Stability in fertility – special adaptations of the Icelandic Arctic fox (<i>Vulpes lagopus</i>)</i>	<b>Christopher A. Cockerill</b> <i>That's so last season: Unravelling the genomic cost of fur farming in Arctic Foxes (<i>Vulpes lagopus</i>)</i>	<b>Patrick Arnold</b> <i>Museomics reveal the relictualization of Afro-tropical golden moles (<i>Chrysochloridae, Kiliamatalpa</i>)</i>
16:00 – 16:20	<b>Jan Adriaan Venter</b> <i>Rather the enemy you know: Territorial behaviour of spotted hyaenas in fenced protected areas</i>	<b>Karin Norén</b> <i>Inbreeding depression in the Swedish arctic fox – the role of strongly deleterious mutations</i>	<b>Radim Šumbera</b> <i>Breeding males, but not females have a stronger bite: comparison of bite force in five social African mole-rat species from the genus <i>Fukomys</i></i>
16:20 – 16:40	<b>Valeria Mazza</b> <i>The portrait of a bandit: individual differences in innovative problem-solving of non-native raccoons</i>	<b>Rita G. Rocha</b> <i>Evolutionary history of the red fox (<i>Vulpes vulpes</i>) in the Anatolian Peninsula</i>	<b>Attila Németh</b> <i>Evolution, Taxonomy and Conservation - Phylogenetic investigations of European blind mole rats of the genus <i>Nannospalax</i></i>
16:40 – 17:00	<b>Milena Zduniak</b> <i>Linking personality, space use and ectoparasite loads: insights from experimental parasite removal</i>		<b>Ferhat Matur</b> <i>Taxonomic review of Western Anatolian mole rat cytotypes (Genus <i>Nannospalax</i>) with descriptions of new species</i>
17:00 – 17:20	<b>Patrycja Popiel</b> <i>Interactions between the northern white breasted hedgehog <i>Erinaceus roumanicus</i> and the west European hedgehog <i>Erinaceus europaeus</i> in the Polish sympatry zone</i>		<b>Matěj Lövy</b> <i>Ecophysiological and morphological insights into the Upper Galili Mountain blind mole rat (<i>Nannospalax galili</i>): thermal biology, bite force, and their role in ecological speciation</i>
17:20 – 18:00	<b>Coffee Break</b>		
18:00 – 20:00	<b>POSTER SESSION</b>		



## SCIENTIFIC PROGRAMME-THURSDAY, APRIL 3, 2025

Organizers:



Under the auspices of:



# IX European Congress of Mammalogy (ECM9)

**THURSDAY**  
**03.04.2025**

**08:55 - 09:00** Opening (Room I)  
**09:00 - 10:00** Plenary Talk – John D.C. Linnell: *The recovery of large carnivores in Europe – what does it tell us about the future of coexistence with wildlife?* (Room I)

	Room I	Room II	Room III
<b>10:10 – 11:30</b>	<b>BEHAVIOURAL ECOLOGY:</b> Zbigniew Borowski & Jana Eccard	<b>ECOLOGICAL MODELLING:</b> Christos Astaras	<b>DISEASES &amp; PARASITES ECOLOGY:</b> Heikki Henttonen & Frauke Ecke
<b>10:10 – 10:30</b>	<b>Leszek Rychlik</b> <i>Differences in prey preferences among four sympatric species of shrews (Sorex and Neomys) in cafeteria tests</i>	<b>Beata Bramorska</b> <i>Socio-economic variables improve accuracy and change spatial predictions in species distribution models</i>	<b>Heikki Henttonen</b> <i>Biome specific epidemiologies</i>
<b>10:30 – 10:50</b>	<b>Wiebke Neumann</b> <i>Navigate among different risks of mortality – the role of experiencing a calf loss in a long-lived ungulate</i>	<b>Bronwen Hunter</b> <i>Ecologically relevant predictions to improve species distribution models for European bat research</i>	<b>Fraucke Ecke</b> <i>Mouse in the House – Citizen science data on indoor movement of a common rodent in rainy winters explain zoonotic risk</i>
<b>10:50 – 11:10</b>	<b>Zbigniew Borowski</b> <i>How does the risk of wolf predation affect deer foraging in forest ecosystems?</i>	<b>Despina Migli</b> <i>Spot the cat! Modelling and mapping the European wildcat occurrence in Northern Greece</i>	<b>Alena Fornuskova</b> <i>Lymphocytic choriomeningitis virus (LCMV) in Bulgaria: Spillover and Public Health Implications</i>
<b>11:10 – 11:30</b>	<b>Jana A. Eccard</b> <i>Animal behaviour has cascading effects on plant biodiversity</i>	<b>Natalia Kalevra</b> <i>Greening the land? Multi-scalar methods for designing green corridors in Greece</i>	<b>Fred Touzalin</b> <i>Modeling the Transmission Dynamics of EBLV-2: Insights from the First Serological Evidence in Myotis myotis bats</i>
<b>11:30 – 12:10</b>	<b>Coffee Break</b>		
	Room I	Room II	Room III
<b>12:10 – 13:30</b>	<b>THREATENED MAMMALIAN SPECIES:</b> George P. Mitsainas & Dionysios Youlatos	<b>MAMMALS AND CLIMATE CHANGE:</b> Maria da Luz Mathias & Anders Angerbjörn	<b>DISEASES &amp; PARASITES ECOLOGY:</b> Heikki Henttonen & Frauke Ecke
<b>12:10 – 12:30</b>	<b>Sandro Bertolino</b> <i>Rapid range decline of the garden dormouse (Eliomys quercinus): A call for urgent conservation action in Europe</i>	<b>Anders Angerbjörn</b> <i>The arctic fox under pressure in Arctic areas due to both direct and indirect consequences of climate change</i>	<b>Aleksandra Penezić</b> <i>Toxoplasma gondii infection in the golden jackal (Canis aureus)</i>
<b>12:30 – 12:50</b>	<b>Svetlana Miteva</b> <i>Can we save Roach's mouse-tailed dormouse for the European fauna?</i>	<b>Anna Wereszczuk</b> <i>Body mass changes in mustelids in Europe and North America during the Anthropocene</i>	<b>Ilija Pantelić</b> <i>Movement ecology of golden jackals (Canis aureus) and its implications for endoparasite spread: a step selection analysis approach</i>
<b>12:50 – 13:10</b>	<b>Dimitra-Lida Rammou</b> <i>Conservation of the European Ground Squirrel in Greece: A management approach for an Endangered small mammal</i>	<b>Magdalena Niedziałkowska</b> <i>Changes in the range of the moose (Alces alces) and suitable areas for the species since the Late Pleistocene in Eurasia</i>	<b>Elmo Miettinen</b> <i>Wild boars at the northern edge: movement patterns and impacts</i>



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## IX European Congress of Mammalogy (ECM9)

13:10 – 13:30	<b>Viorel-Dumitru Gavril</b> <i>Distribution of the Romanian Hamster (<i>Mesocricetus newtoni</i>) in the Natura 2000 Sites of Romania: Implications for conservation</i>	<b>Melitjan Nezaj</b> <i>Keeping track of Prespa's bats, Albania</i>	<b>Johan Wallén</b> <i>Consequences of repeated sarcoptic mange outbreaks in an endangered mammal population</i>
13:30 – 15:00	Lunch		
	<b>Room I</b>	<b>Room II</b>	<b>Room III</b>
15:00 – 16:40	<b>THREATENED MAMMALIAN SPECIES: George P. Mitsainas &amp; Dionysios Youlatos</b>	<b>PALEONTOLOGY George Iliopoulos</b>	<b>DISEASES &amp; PARASITES ECOLOGY: Heikki Henttonen &amp; Frauke Ecke</b>
15:00 – 15:20	<b>Orsolya Moldován</b> <i>Conservation status of the blind mole rat species endemic to the Pannonian region (Rodentia: Spalacinae: Nannospalax)</i>	<b>Mateusz Baca</b> <i>Biogeographic history of the European small hamsters (subfamily Cricetinae) during the Late Pleistocene</i>	<b>Mounir Abi-Said</b> <i>Gastrointestinal parasites in rodents from Five Himas in Lebanon</i>
15:20 – 15:40	<b>Eva K. Nóbrega</b> <i>Macaronesian bats: a review of research effort and directions</i>	<b>Maria Kolendrianou</b> <i>Beyond systematics: how can the study of small mammals contribute to a better understanding of the Upper Pleistocene palaeocommunities of Greece</i>	<b>Boris Krasnov</b> <i>Identification of the missing links in ectoparasite-small mammal networks using the dark diversity concept</i>
15:40 – 16:00	<b>Maria G. Granados</b> <i>Unlocking Iberian lynx recovery: Enhancing habitat models with European rabbit availability for long-term successful lynx restoration</i>	<b>George Iliopoulos</b> <i>The Pleistocene fossiliferous mammal localities of Peloponnese, Greece, and their fauna</i>	
16:00 – 16:20	<b>Jan Decher</b> <i>Conservation of rare and threatened mammal species in Ghana, West Africa</i>		
16:20 – 16:40	<b>Arshyaan Shahid</b> <i>Understanding Human-Elephant conflict dynamics in a protected area of Eastern India: Implications for threatened species conservation</i>		
20:00	CONFERENCE DINNER		



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# IX European Congress of Mammalogy (ECM9)

FRIDAY  
04.04.2025

08:55 - 09:00 Opening (Room I)  
09:00 - 10:00 Plenary Talk – Joseph A. Cook: *NextGen Mammal Collections: Key infrastructure for a changing planet* (Room I)

	Room I	Room II	Room III
10:10 – 15:40	LANDSCAPE AND SPATIAL ECOLOGY: Francesca Cagnacci	REINTRODUCTIONS AND WILDLIFE MANAGEMENT IN CHANGING ECOSYSTEMS: Laurent Schley & Alexandra Sallay	NEW METHODOLOGIES IN MAMMAL RESEARCH: Fabiola Iannarilli
10:10 – 10:30	Francesca Cagnacci <i>Mapping out a future for ungulate migrations</i>	Glenn Lelieveld <i>Wolves in the highly populated Netherlands – what could possibly go wrong?</i>	Vanja Bugarski-Stanojević <i>Species-specific soil eDNA survey of the lesser blind mole rat – a game changer for biodiversity monitoring of terrestrial mammals</i>
10:30 – 10:50	Steffen Mumme <i>Protection of threatened migrating ungulates – overlap between mapped ungulate migration corridors and protected areas</i>	Tomaž Skrbinšek <i>From a pilot study to essential conservation and management tool: genetic monitoring of brown bears in Slovenia after 20 years</i>	Angeliki Savvantoglou <i>Can flies help us map bears? Expanding the ecological application of iDNA for monitoring terrestrial mammals</i>
10:50 – 11:10	Melinda Boyers <i>Mapping the world's largest land migration: Antelope in South Sudan</i>	Rafal Kowalczyk <i>Using public-sourced photos to track changes in moose antlers size during a 20-year hunting ban</i>	Marjeta Konec <i>New red deer STR markers for population monitoring: application in the Romanian Carpathians using faecal pellets</i>
11:10 – 11:30	Wibke Peters <i>Crossing the line – partial migration in a transboundary red deer population</i>	Marta Kołodziej-Sobocińska <i>March or get infected: influence of winter ranging shaped by supplementary feeding on the spread of non-native nematode <i>Ashworthius sidemi</i> in European bison populations</i>	Andrea Bonacchi <i>Decoding rodent diets: multi-marker metabarcoding on three syntopic species in a Mediterranean oak forest</i>
11:30 – 11:50	Francesca Cagnacci <i>Moving in busy mountains: migration and spatial responses of large mammals in the Alps</i>	Samantha Ball <i>Hair-raising insights: Estimating badger densities in Ireland using Non-invasive genetic methods to Inform bTB management efforts</i>	Angelos Bintirinis <i>Ballad of the Shrews: Vocals of the Cretan endemic <i>Crocidura zimmermanni</i> and its partially sympatric congeneric <i>C. gueldenstaedtii</i></i>
11:50 – 12:10	Marco Salvatori <i>Species body mass and habitat modulate spatio-temporal responses of mammals to human outdoor activity</i>	Simone Giovacchini <i>After 50 years Eurasian otters are (slowly) returning to central and northern Italy</i>	Edward Hurme <i>Bats surf storm fronts during spring migration</i>
12:10 – 12:30	(12:10 – 12:20) Alejandro Valladares-Gómez <i>Small terrestrial mammal's diversity across the arid ecosystems of the Atacama Region, northern Chile</i>  (12:20 – 12:30) Myrto Smyriliou-Zerva <i>Occurrence and diet of the Eurasian Otter (<i>Lutra lutra</i>) in protected areas of NW-W Peloponnese, Greece</i>	Kristina Vogt <i>Possible inbreeding effects on survival and reproduction in two reintroduced Eurasian lynx populations in Switzerland</i>	Charlotte Vanderlocht <i>Multi-disciplinary approach to understanding emerging ecological interactions in an Alpine mammal community</i>



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## IX European Congress of Mammalogy (ECM9)

12:30 – 12:50	<b>Francesca Malcangi</b> <i>Habitat complexity or prey abundance? Decoding the Eurasian Lynx's habitat selection in Finland</i>	<b>Attila Németh</b> <i>Translocation of subterranean blind mole rats as a conservation tool to save endangered species and recover dry grassland ecosystems</i>	<b>Fabiola Iannarilli</b> <i>Zooming on urban predators: Domestic cats and their interactions with mammal and bird communities in urban areas</i>
12:50 – 14:20	<b>Lunch</b>		
14:20 – 14:40	<b>Tim R. Hofmeester</b> <i>Eurasian lynx (<i>Lynx lynx</i>) site-use probability in winter is higher in the presence of reindeer despite potential risks</i>		<b>Patrick Jansen</b> <i>Uncovering temporal patterns of wildlife activity, habitat use and habitat preference from camera-trap data</i>
14:40 – 15:00	<b>Nikolaos Kiamos</b> <i>Shrewing around: Notes on sampling, distribution and ecology of the family Soricidae in Greece</i>		<b>Yorgos A. Iliopoulos</b> <i>Estimating densities of unmarked prey and predator species with camera traps and Random Encounter Models</i>
15:00 – 15:20	<b>Pita Amick</b> <i>Monotonic decline in bat diversity is ubiquitous along elevational gradients</i>		
15:20 – 15:40	<b>Ricardo Rocha</b> <i>Harvesting the power of remote-sensing technologies to investigate the spatiotemporal dynamics of insular vertebrates and their interspecific interactions</i>		
15:40 – 16:15	<b>Coffee break</b>		
16:15 – 16:30	<b>ROOM I: CLOSING CEREMONY-ANNOUNCEMENT OF BEST POSTER AND BEST TALK PRIZES</b>		
16:30	<b>END OF CONFERENCE-START OF POST-CONGRESS EXCURSION</b>		



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# ***PLENARY TALKS***

## PLENARY TALK

### Taking the breaks off infrastructure developments: what does it mean for Europe's mammals?

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**Keywords:** Wind-energy, solar, infrastructure, policy, modelling

Many European governments are tackling their financial crises by promoting infrastructure developments. In addition to delivering long-term benefits such as improved transport and housing, the immediate investment of public and private money is expected to kick-start economic growth. 'Green Energy' generation facilities and distribution networks are also undergoing massive expansion across the continent, with the aim of securing energy supplies whilst also contributing to greenhouse gas emissions. Yet these developments carry ecological costs that are rarely considered. For example, transport and energy generation infrastructure poses collision risks, whilst high speed rail and major roads can fragment populations. In this talk I will discuss the species likely to be at particular risk, how we might reconcile the conflicting needs of people and wild mammals and call for more co-ordinated research and communication by scientists and conservation practitioners. I will explore a variety of novel approaches that can help to generate the evidence to help evaluate the impacts of development. For example, in relation to collision risks posed to bats, 3-dimensional flight-path reconstruction can help to identify collision risks with vehicles, whilst at a broader spatial scale, radiotracking using static receiver networks is beginning to identify pinch-points where infrastructure developments would be particularly damaging. Interactive apps based on robust underpinning data can also help stakeholders to understand the relative ecological costs of placing a development in one place rather than another. Finally, I will highlight some of the key knowledge gaps that currently make it difficult to predict impacts on the Favourable Conservation Status of receptor species and suggest how they might be filled.

## PLENARY TALK

### Seasonality and comparative analysis of small vs large mammal demography: revisiting Caughley and Krebs

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**Keywords:** Demography, forecasting, voles, modelling

More than 40 years ago, G Caughley and CJ Krebs asked if large mammals are simply small mammals writ large. They were mainly concerned with assessing ecological mechanisms of population regulation, less by what the demographic pathways are. Much progress was made since in understanding the patterns of variability of demographic rates, with some strong patterns such as demographic buffering (the inverse relationship between the variability of a demographic rate and its temporal variability) emerging, at least in large herbivorous mammals. Small mammals have played a much smaller role in our understanding of demographic patterns, partly because many populations are multivoltine with season-specific patterns. I will use some patterns observed in different populations of voles to explore how small mammals can be compared to large mammals, and revisit some of the questions posed by Caughley and Krebs. I will also discuss how our understanding of the demographic patterns impact our ability to forecast population dynamics.

## PLENARY TALK

### Using genomics to inform bat conservation under global change

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**Keywords:** Bats, conservation genomics, climate change, land-use change, ecological modelling

Within-species genetic variation is a fundamental component of biodiversity, contributing to ecosystem function, structure and resilience, and determining the capacity of populations to adapt to environmental changes. Yet, genetic/genomic data and approaches have not been widely applied in conservation management and decision making. In my talk I will explore the use of genetic and genomic approaches in bat research and conservation. I will introduce research carried out in my group, integrating genomic tools with ecological research and modelling approaches to assess and predict bat responses to climate and land-use changes and inform bat conservation.

## The recovery of large carnivores in Europe – what does it tell us about the future of coexistence with wildlife?

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**Keywords:** Large carnivores, coexistence, recovery, conflict

During the last decades there has been a dramatic expansion of large carnivores across Europe. Especially wolves have returned to areas from which they have been absent for centuries, but bears, wolverines and lynx have all made substantial recoveries in many regions. Together with the expansion of large herbivores we are now in a situation where large mammals have become integral parts of the wider European landscape. However, this conservation success has brought with it a whole set of challenges and conflicts. We are currently at a stage where there are major academic, public and political debates about how this recovery should be managed. Having averted extinction the question now becomes one of how to live with success? This presentation will outline the trends that have brought us to the present situation, discuss the various conflicts and alternative management options, and explore what these alternatives mean for the possibility of maintaining this recovery by transitioning to a sustainable coexistence. In conclusion the talk will unpack the question of what coexistence actually looks like!

## NextGen Mammal Collections: Key infrastructure for a changing planet

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**Keywords:** Holistic specimens, informatics, biodiversity infrastructure

Natural history collections are tremendous assets for teaching and research in mammalogy. Originally developed for studies focused on natural history, systematics, and biodiversity discovery, recent advancements in technology (e.g., genomics, high-resolution imaging, stable isotopes, viromics) can now exploit the vast taxonomic, temporal and spatial coverage represented by collections infrastructure. These new approaches are assessing critical societal questions, ranging from zoonotic pathogen emergence to environmental contaminants to biodiversity responses to climate disruption. Specimen digitisation has rapidly mobilised this biodiversity resource for bioinformatic studies ranging from genome-level analyses to large-scale GIS based assessments aimed at understanding how changing environmental conditions are reshaping species distributions. Nevertheless, significant opportunities (e.g., NEON, IsoBank) and challenges (e.g., permitting and sustainability) remain to fully develop, integrate, and exploit this resource. Now is an opportune time to evaluate whether 1) existing collections are robust to these challenges and 2) the methods we traditionally use to build collections infrastructure are sufficient to meet the demands of mammalogy in a time of rapid loss of diversity. Opportunities and limitations for investigating spatiotemporal changes in mammalian species and their communities are identified. A critical need exists for a comprehensive (shared) plan for sampling mammalian diversity now to stimulate mammalian research in the future.

# ***ORAL PRESENTATIONS***

*(Listed in alphabetical order per session, according to presenter's last name)*

# Behavioural Ecology

*(Z.Borowski & J.Eccard)*

### Avoidance vs. attraction: long-term changes in spatiotemporal interactions and dietary relationships between recolonising wolves and red foxes

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**Keywords:** Coexistence, facilitation, interactions, fox, wolf

Large carnivores are recovering across Europe. Significant changes are expected in trophic webs through restored interspecific interactions, but information on their outcome is fragmentary. Although apex predators have been generally reported to interfere with mesocarnivores, facilitative interactions may arise through prey carcasses, providing increased foraging opportunities to smaller carnivores. The potential for facilitative vs. suppressive interactions may vary spatiotemporally, but data combining multiple axes of the ecological niche along with the temporal variation of predator abundance is lacking. We assessed the changes in the spatiotemporal behaviour and food habits of the red fox *Vulpes vulpes* in a prey-rich (three ungulate species, >20 ind./km<sup>2</sup>), Mediterranean protected area recently recolonised by the wolf *Canis lupus*, throughout a six-year period during which wolf abundance increased from one to three packs. We considered interspecific spatiotemporal association (camera trapping: n=2619 wolf and n=26195 fox detections) and fox food habits (scat analyses: n=2849 and n=5150 wolf and fox scats, respectively). Seasonal interspecific temporal overlap remained high ( $\Delta=0.70-0.94$ , 0-1 scale) with an increasing trend throughout the study period. A positive spatial association occurred between fox and wolf detection rates. Occurrence of ungulates in the fox diet was c. 2 times greater than in wolf-absent periods, peaking in the early recolonisation phase and decreasing from c. 33% to c. 7% from the first to the last study year. The wolf diet was dominated by wild ungulates (occurrence: c. 85%), and fox hair was detected in only two wolf scats. Wolf recolonisation leads to increased foraging opportunities for foxes, with association prevailing over avoidance, supporting the great ungulate availability's role in reducing competitive interactions. Benefits decreased with increasing wolf abundance, suggesting a progressively reduced availability of leftovers for scavengers and emphasising the complex dynamics of interactions between carnivores.

### How does the risk of wolf predation affect deer foraging in forest ecosystems?

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**Keywords:** Predation risk, wolf, deer, foraging behaviour, browsing pressure

The optimal foraging theory suggests that the foraging decisions of large mammalian browsers, like deer, may be influenced by predation risk and the species composition of forest stands. While the role of apex predators in food webs is well established, little is known about how varying levels of predation risk influence plant associations on a specific plant species. In this study, we analysed the winter browsing behaviour of red and roe deer in a field experiment conducted in Poland, simulating predation risk from wolves using olfactory cues. We examined the top-down effect of wolves on deer foraging by assessing the proportion of browsing on two tree species: oak (preferred) and birch (intermediate preferred). Our results showed no evidence of associational resistance; the increasing presence of less preferred species did not significantly impact deer browsing on the target species (oak). Although the perceived predation risk reduced the browsing intensity of both tree species, it did not alter the overall pattern of tree selection by deer. We demonstrate that predation risk from pursuit predators, such as wolves, can reduce deer foraging and browsing pressure on forest regeneration. However, neither the risk of predation nor tree species composition affects associational effects. Our findings highlight the limitations of using tree species composition to predict foraging behaviour in mammalian browsers, especially in conservation, restoration, and forest management when browsing is a concern

## BEHAVIOURAL ECOLOGY

### How behaviour influences individual life-history trajectories in a changing world

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**Keywords:** Behaviour, fitness, survival, environment, reproduction

Understanding how populations respond to rapid and consistent environmental stress is one major theme in current biological research. For populations to adapt to fast-changing conditions, individuals first need to adjust their behaviour. Indeed, the first line of response towards environmental change is often individuals changing their behaviours, for example, their exploration, foraging and reproductive decisions, which in turn might influence population and species development. Therefore, a crucial first step towards understanding how adaptation to changes is focusing on the individual level. Here, we show that focusing at this level can inform us about processes and traits that could potentially influence a population as a whole. Specifically, we studied wild house mice (*Mus musculus domesticus*) in a seminatural context, a globally distributed species known to adapt to extreme conditions quickly. We focused on how differences in innovation ability, behaviour and reproductive decisions influence life-history traits such as growth, survival or fitness under different environmental conditions. Notably, by varying an important predictor of the environment, food quality, we were also able to understand if the traits are correlated in an environment-specific manner. We found that among-individual differences in innovation, such as problem-solving, behaviour and reproductive strategies, such as risk-taking, the timing of reproduction or the number of mates, can explain variation related to growth, survival and fitness. Crucially, the consequences of some life-history “decisions” of individuals were influenced by food quality. Since house mice are ecological opportunists often facing rapidly-changing environments and are a representative of many small mammals at the core of terrestrial food-webs, our results can be used to draw inferences about how the resource environment mediates the causes and consequences of traits such as reproductive behaviour in short-lived generalist species under environmental variation.

## BEHAVIOURAL ECOLOGY

### Animal behaviour has cascading effects on plant biodiversity

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**Keywords:** Foraging, landscape of fear, antipredatory, predator avoidance, interference, competition

Foraging decisions of animals can act as a biotic filtering mechanism for biodiversity on trophic level below, i.e. the community of resource species, by affecting abundance of single species and functional trait composition of the community of resource species. We use rodent systems and measure both giving-up density (GUD), i.e. when foragers quit exploiting a patch, as well as the diversity of food species left, when foragers leave the patch (DivGUD) in experimental landscapes with an assemblage of plant seeds. Patch residency of wild rodents decreases local  $\alpha$ -DivGUD (via elevated mortality of species with large seeds) and regional  $\gamma$ -DivGUD, while dissimilarity among patches in a landscape ( $\beta$ -DivGUD) increase. By linking theories of adaptive foraging behaviour with community ecology, quantifying DivGUD allows us to investigate indirect, cascading effects, e.g. the ecology-of-fear framework, feedbacks between functional trait composition of resource species and consumer communities, and effects of inter-individual differences among foragers on the biodiversity of resource communities. Here, we introduce the concept and discuss experimental results on rodent competition, rodent density, predator avoidance and individual choosiness.

## BEHAVIOURAL ECOLOGY

### Greater noctule bats embrace a low-risk, low-gain foraging strategy

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**Keywords:** Chiroptera, biosonar, biologging, bioacoustics

Insectivorous bats are widely distributed and play essential roles in e tagged 21 greater noctule bats at Doñana National Park (Spain) with high-resolution biologging tags. These tags, which weigh 2.6 g, are equipped with an ultrasonic microphone, an altimeter, three-axis accelerometers and magnetometers. The collected data spanned 22 foraging nights and revealed that the bats left their roosts shortly after sunset, spending several hours on the wing while foraging. During the instrumentation period, the bats attacked in total 609 prey items. These attacks were typically brief, involving few consecutive buzzes (95% included fewer than five buzzes, i.e., a series of high-repetition echolocation calls characteristic of prey capture attempts), short chases (95% lasting less than 10 seconds), and occurred at low altitudes, averaging 53 m above ground level. These attacks closely resembled those of most European insectivorous bats and were likely directed at small prey, as suggested by the short mastication duration of 11 seconds. The findings, therefore, indicate that, when not hunting passerines, endangered greater noctule bats adopt a low-risk, low-gain foraging strategy to meet their energy needs.

### Living under the scope – selection of human hunters for behavioural traits in a heavily harvested moose population

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**Keywords:** Hunting, moose, iSSA, survival, sex-specific-behaviour

The spatiotemporal behaviour of game species may play a crucial role in their survival throughout the hunting season. Where humans are the most dominant predator, avoiding landscape features that give hunters access to hunting grounds can be key to increasing survival. However, in Sweden there is limited knowledge about how hunters impact populations through a selection of behavioural traits. In this system, hunting pressure is generally high and approximately 30% of the population is harvested yearly. To test for differences in habitat selection in relation to survival under varying levels of hunting pressure we analysed 10 years of individual-based movement data of adult male and female moose (*Alces alces*) in southern Sweden. We used integrated Step Selection Functions to analyse habitat selection in four consecutive time periods (before the rutting season, during the rut, during the first three weeks of the hunting season, and the following three weeks). We matched the habitat selection coefficients of individual animals with their fate and tested for behavioural differences between harvested and non-harvested male and female moose in each period. Our findings indicate that hunters may select for sex-specific behavioural traits in habitat selection by adult moose. We found that hunters harvested male moose selected for higher NDVI during the rut, suggesting personality-driven hunting mortality in male moose. In contrast, in female moose, the mortality risk increased with selection for shorter distances to roads during the hunting season, suggesting selection for behavioural traits by hunters. Our findings indicate that current harvest practices for moose may result in a selection for sex-specific behavioural traits with increasingly shy female individuals. Our study highlights the complex survival dynamics in a long-lived species under high hunting pressure, revealing how sex-specific habitat selection may impact mortality risk by hunters and, in return, might influence population management.

### The social structure of a golden jackal group during one reproductive season in Samos

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**Keywords:** *Canis aureus*, network analysis, breeding

Golden jackals (*Canis aureus*) are undergoing a rapid range expansion across Europe. However, the discrete nature of the species makes them challenging to monitor. Insular populations like those on Samos Island, Greece, offer unique opportunities to study their behavioural ecology. This study investigated the social system of a golden jackal group on Samos using camera traps and non-invasive methods. We focused on three key components: social organisation, mating system, and social structure. We monitored group composition, dominance hierarchy, and social interactions through individual identification based on unique coat colouration patterns. Initially composed of seven members, the group experienced dispersal events and the birth of six pups, highlighting dynamic social organisation. Dominance analyses revealed a clear hierarchical structure led by the monogamous dominant pair. Social network analyses demonstrated the central role of the dominant pair and pups within the group and suggested cooperative care behaviour, with subordinate individuals acting as helpers. Interestingly, behavioural observations raised questions about potential allosuckling or pseudopregnancy in a subordinate female. Our findings provide new insights into golden jackal social behaviour, demonstrating the valuable roles of camera traps for monitoring these elusive carnivores. This study supports our understanding of golden jackal social systems and informs conservation strategies, emphasising the importance of non-invasive monitoring techniques – even for individual recognition. Future studies integrating genetic analyses and expanded camera networks are needed to further unravel the complex social dynamics of golden jackal populations.

### Activity of the endemic Martino's Dinaric Vole (*Dinaromys bogdanovi*) and Western Dinaric Vole (*Dinaromys longipedis*) in Croatia recorded on camera traps

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**Keywords:** Dinaric karst, Balkan glacial refugia, temporal niche, voles

An important facet of a species niche is its activity pattern, as it affects many aspects of animal life, including conspecific interactions, competitor or predator avoidance, habitat use and feeding behaviour. The Balkan snow vole, *Dinaromys bogdanovi* is an endemic rodent inhabiting the Eastern Adriatic Mountain range. It is listed as Vulnerable (VU) by IUCN, while in Croatia it is strictly protected, although classified as Data Deficient (DD). In addition, *D. bogdanovi* is on Appendix IV of EU habitat Directive. It is a habitat specialist, strongly associated with limestone karst with deep fissures, crevices, caves, and sinkholes. Two major phylogeographic lineages are now recognised as two distinct species: Martino's Dinaric Vole (*D. bogdanovi*), and the phylogenetically older Western Dinaric Vole (*D. longipedis*), both present in Croatia. The Republic of Croatia developed national monitoring programs for four strictly protected small mammal species, including the Balkan snow vole complex (*Dinaromys bogdanovi* s.l.). The monitoring was conducted primarily using camera traps positioned on the ground, targeting micro-locations where the activity of Balkan snow voles was expected. The recorded activity index of *D. bogdanovi* (15-minute intervals in which the species was observed, per deployed camera) was significantly higher than that of *D. longipedis*. Both species show predominantly a crepuscular and nocturnal activity pattern, however several observations were made during the day. This is the first study that compares activity patterns of these two recently recognised species but also highlights the rarity of the ancestral *D. longipedis* across its distribution area in Croatia.

### The portrait of a bandit: individual differences in innovative problem-solving of non-native raccoons

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**Keywords:** Innovation, cognition, invasion, novelty

Human activities have led to unprecedented alterations to environments worldwide, exposing wildlife to higher rates of change compared to those experienced in their evolutionary past. These novel ecological conditions include transfer to non-native habitats, both natural and modified. Behavioural flexibility can be an adaptive solution to such environmental variation, buffering animals against new or unpredictable situations, and allowing them to find innovative solutions to problems that threaten survival and reproduction. An integrative understanding of animals' successful adjustments to environmental change requires insights into which aspects of ecological novelty relate to specific behavioural and cognitive adjustments in wildlife, and which mechanisms underlie the variation between individuals in the performance of behavioural innovations. Here, we focused on non-native raccoons (*Procyon lotor*), which are currently expanding through rural and urban areas in Germany. We compared the innovative performance of free-living individuals using multiple-access puzzle boxes for repeated innovations. Results support the hypothesis that living in human-altered environments favours increased innovativeness, even for non-native animals. Among-individual variation in innovativeness might thus play a key role in individuals' successful coping with the current rapid expansion of human-altered environments and the challenges of colonising new habitats.

### Navigate among different risks of mortality – the role of experiencing a calf loss in a long-lived ungulate

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**Keywords:** Ungulate, offspring loss, learning, lifetime

The expression of anti-predator behaviour is an important behavioural component to enhance the survival and fitness of individuals. In long-lived species, experience may lead to behavioural changes during individuals' lifetime. Patterns in habitat and birth site selection under different risk scenarios can be a consequence of adjustments in anti-predator behaviour to a given mortality risk. In landscapes with natural predators, harvested prey species must account for the risk of mortality by natural predators and human harvest. For solitary prey species, there is limited knowledge of the degree to which predator presence and individual experience influence birth site selection, and which specific events related to hunting induce behavioural changes. In two separate studies, we used integrated step-selection functions on multi-year movement datasets of a long-lived female ungulate (moose *Alces alces*) and associated calf survival to test how predator presence (i.e. encounter risk) and females' individual experience of calf loss events affected their calving site selection and site fidelity in the following calving season. We also tested whether the loss of calves to hunters (i.e. harvest) induced behavioural changes that were evident during the following hunting season. Our results suggest two things. First, the presence of bears influences calving site selection in this solitary living ungulate. Second, the experience of calf loss to either natural predators or hunters leads to changes in habitat selection in the following year. We interpret the behavioural changes following the specific experience of a calf loss as potential learning effects in this female ungulate species.

### Diel activity patterns of forest dormouse (*Dryomys nitedula*) in northern Greece

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**Keywords:** Camera-trap, rodent, Greece, Macedonia, nocturnal

The forest dormouse (*Dryomys nitedula*), despite being widely distributed across Central and Eastern Europe, remains one of the least studied European dormouse species. Therefore, understanding its activity patterns is crucial for ecological research and conservation efforts. Between March and December 2024, we conducted an intensive survey at the field station of the Forest Research Institute (FRI) (Thessaloniki, Central Macedonia, Greece). A grid of 20 camera traps, positioned at different places in trees, was deployed, capturing 128,391 photographs and videos. The study aimed to describe the diel activity patterns of the forest dormouse and to examine the effects of environmental factors, including temperature, lunar phase, and the timing of sunrise and sunset. The findings confirmed that forest dormice are strictly nocturnal throughout their active period. Two distinct activity peaks were observed: one near midnight and the other approximately one to two hours before sunrise. This research highlights the effectiveness and value of camera trapping as a non-invasive method for studying arboreal small mammals. By minimising disturbance to the animals, camera traps provide reliable data that can enhance our understanding of elusive species like the forest dormouse and inform future conservation strategies.

### Interactions between the northern white breasted hedgehog *Erinaceus roumanicus* and the west European hedgehog *Erinaceus europaeus* in the Polish sympatry zone

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**Keywords:** Adaptation, interactions, competition, coexistence, hybridisation

The northern white-breasted hedgehog *Erinaceus roumanicus* and the west European hedgehog *E. europaeus* share similarities in ecology, diet and daily activity patterns. Therefore, in sympatric areas, they are expected to compete for food resources and space or develop mechanisms to reduce or avoid direct competition. It has been shown, however, that in the eastern European zone of sympatry, *E. roumanicus* and *E. europaeus* interbreed, forming hybrids; yet, hybridisation has not been confirmed in central Europe. The co-occurrence of these two hedgehog species in Wielkopolska (western Poland) makes this area suitable for comparative research. In our project, we will investigate: (1) the ecology and behaviour of both hedgehog species, including their regional distribution, seasonal and daily activity patterns, diets, habitat preferences, and intra- and interspecific interactions; (2) the level of interspecific competition and domination; (3) the reasons for the absence or very low level of interspecific hybridisation. Preliminary findings from the city of Poznań indicated that *E. roumanicus* is more numerous and widespread in the urban centre and displays a higher activity level than *E. europaeus*: *E. roumanicus* emerges from hibernation earlier (in April) and commences foraging at earlier hours in the evening. In contrast, *E. europaeus* only becomes active in the second half of June and forages mainly after midnight. These observations suggest that competition occurs between the species, with the more numerous *E. roumanicus* adapting rapidly to urban environments and dominating *E. europaeus*. On the other hand, the delay in seasonal and daily activity in *E. europaeus* may serve as a mechanism that limits its interactions with *E. roumanicus*, thereby reducing competition between the two species.

### Differences in prey preferences among four sympatric species of shrews (*Sorex* and *Neomys*) in cafeteria tests

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**Keywords:** Foraging, prey-preferences, prey-rejection, resource-competition, shrews

This study investigates prey preferences of four sympatric shrew species: the common shrew (*Sorex araneus*), the pygmy shrew (*Sorex minutus*), the Eurasian water shrew (*Neomys fodiens*) and the Mediterranean water shrew (*Neomys milleri*). Despite occupying overlapping habitats, these species display distinct ecological niches and foraging behaviours, likely driven by differences in body size, metabolic rate, and adaptations to terrestrial or semiaquatic lifestyles. A modified version of Rogers' method (incorporating area measurements under the accumulation curves) was applied to analyse prey preference and avoidance. Laboratory experiments involved wild-captured shrews during summer from sedge swamps. Each shrew underwent three 4-hour tests, during which their foraging behaviour was video-recorded. The shrews could choose from six live prey types: earthworms, mealworm larvae, fly larvae, snails, aquatic crustaceans and small fish. Preferences were assessed based on the order of prey taking (selection) in the consecutive quarters of tests, while rejection frequency quantified avoidance. Results revealed distinct interspecific differences. *Sorex minutus* strongly preferred small, high-energy prey like mealworms and fly larvae, reflecting its high metabolic demands and specialisation in small prey. In contrast, the larger *S. araneus* favoured larger prey, like earthworms and snails, though it also consumed fly larvae. Among water shrews, *N. milleri* showed a stronger preference for earthworms, while *N. fodiens* prioritised aquatic crustaceans, showcasing their adaptation to aquatic environments. Both water shrews favoured energetically profitable prey, yet *N. milleri* exhibited greater food specialisation compared to the opportunistic *N. fodiens*. Snails were the least preferred prey across all species. These findings emphasise how prey selection and rejection rates contribute to niche differentiation and minimise interspecies competition among sympatric species.

### Red deer and Bison fear the human “super predator” more than they fear wolves and lynx

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**Keywords:** Predator-Prey interactions, ecology of fear, human presence, large carnivores

Are humans the planet’s most frightening predator? Or do non-human predators create a stronger landscape of fear for their prey? We aimed to answer these questions to assess the ecological impacts of apex predators by conducting a playback experiment in Białowieża Forest (Poland). We used ABRs (Automated Behavioural Response systems: camera-trap activated speakers) to record the behavioural response of Red deer (*Cervus elaphus*) and Bison (*Bison bonasus*) to human, wolf (*Canis lupus*), Eurasian lynx (*Lynx lynx*) and control (bird) vocalisations. We measured fear response by estimating the probability of either running after being exposed to playbacks, we also investigated the potential cost of the fear response by estimating the probability of giving up foraging after being exposed to the playbacks. Red deer were 4 times more likely to run after hearing a human than after hearing the control, and they were 2.8 times more likely to run after hearing a lynx than after hearing the control. Bison were 23 times more likely to run after hearing a human than after hearing the control and 3.5 times more likely to run after hearing lynx than after hearing a control. Both Bison and Red deer were 9.4 times more likely to keep foraging after hearing the control than after hearing human. Our results suggest fear of humans prevails even in one of Europe’s premier Protected Areas (PAs); adding to the growing experimental evidence that paramount fear of the human “super predator” pervades the planet.

## BEHAVIOURAL ECOLOGY

### Behavioural study in white-beaked dolphins, mother-offspring pairs, with the use of Unoccupied Aerial Vehicles in Skjálfandi Bay, Iceland

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**Keywords:** Cetaceans, dolphins, Unoccupied Aerial Vehicles, UAV photogrammetry, behavioural lateralisation

Among odontocetes, stable social groups seem prevalent, with mother-offspring pairs exhibiting various forms of engagement. This study examined mother-offspring interactions in 88 pairs of white-beaked dolphins (*Lagenorhynchus albirostris*) in Skjálfandi Bay, Iceland, using Unoccupied Aerial Vehicle (UAV) focal follows. Specifically, we investigated (i) the amount of time the offspring spend away from their mothers, (ii) the preference of offspring for specific swimming positions (i.e., neonate, echelon, infant, and other), as mother-offspring pairs engage in dyadic swimming as a form of calf carrying, and (iii) their lateralisation, assessing whether offspring display a side preference—left or right—when swimming alongside their mother. Further, we examined whether the reproductive class of the offspring influences positioning preferences and whether these behaviours are influenced by the presence of other individuals around. The reproductive class of the offspring (i.e., neonate, calf or juvenile) was estimated by measuring their body length (expressed as % of maternal body length) using UAV photogrammetry. Multiple behaviours were then defined in an ethogram and later recorded through behavioural coding. Our findings revealed that the reproductive class significantly influenced the time spent away from the mother, the swimming positions, and the side preferences but no significant effect was found for the presence of other individuals. Our results showed that juveniles spend more time away from their mothers than calves. Additionally, calves primarily preferred the echelon position, while juveniles favoured the infant position. Regarding lateralisation, calves showed a slight left-side preference, while juveniles exhibited a right-side bias, with the difference being minimal. The use of UAVs in studying small cetaceans proved promising, offering an aerial perspective that provided valuable insights into the dynamics of mother-offspring pairs, particularly for a species whose behavioural patterns have not been extensively studied.

## BEHAVIOURAL ECOLOGY

### Stability in fertility – special adaptations of the Icelandic Arctic fox (*Vulpes lagopus*)

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**Keywords:** Arctic predator, fertility, population dynamics

Iceland is a relatively remote island in the North Atlantic Ocean, and its wildlife is characterised by a few species, mainly birds. The Arctic fox is the only native terrestrial mammal and serves as a top-predator in ecosystems, which can be divided into two main types: coastal and inland. Neither lemmings nor red foxes exist in Iceland and migrating birds constitute the most common food resource for the native Arctic fox. Despite considerable hunting efforts, the Icelandic Arctic fox population has varied between 1.300 and at least 9.000 individuals over the past 60 years. As a generalist, the Icelandic Arctic fox adapts to prey availability, by feeding on the most abundant and accessible prey at any given time and space. Indeed, the rise and fall of the Arctic fox has been related to changes in some bird populations that foxes are known to prey upon. Numerical responses to fluctuating prey are believed to result in variation in breeding effort through litter size, and this is known for the Arctic fox. In contrast to other countries, the fertility of Icelandic arctic fox vixens has been stable for the past 100 years, and thus, variation in litter size cannot explain the observed population dynamics in the Icelandic arctic fox. Indeed, it seems that the Icelandic Arctic fox has responded to variation in prey populations (carrying capacity) with plasticity in the number of litters instead. This long-term stability in litter size has not been observed in any other areas of the species' distributional range and can be regarded as the most interesting and unique adaptation of the Icelandic Arctic fox.

### Rather the enemy you know: Territorial behaviour of spotted hyaenas in fenced protected areas

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**Keywords:** Spotted hyaena, territory, defence

Fenced protected areas with high densities of wide-ranging social species such as spotted hyaenas, *Crocuta crocuta*, result in environments where these species must adapt to higher levels of intraguild competition compared to open systems. As spotted hyaena populations decrease in open landscapes and show evidence of increasing population densities in fenced protected areas, it is essential to understand how they coexist in a restricted space. Different species develop dietary, spatial and temporal niches to coexist, and within a species, territoriality forms an important part of coexistence. Our aim was to understand how spotted hyaenas from different clans utilised territorial behaviours to coexist in fenced protected areas by investigating the familiarity hypothesis and the effect of resource holding potential. We used audio playback experiments and generalised linear mixed models to assess behavioural responses to simulated intrusions from familiar and non-familiar clans and assessed response types in relation to group sizes. Spotted hyaenas elicited higher engaging behaviours (such as approaching, audio responses, scent marking) with familiar clan stimuli and reduced avoidance behaviours as group size increased. Thus, spotted hyaenas in fenced protected areas assess risk and defend resources against the immediate threat of familiar clans rather than non-familiar clans. This study adds to our understanding of coexistence tactics employed by spotted hyaenas in fenced protected areas where population densities are high. Further, this study contributes to the knowledge of intraspecific interactions between spotted hyaena clans.

### The impact of forest roads and tourist trails on the use of space by wild ungulates

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**Keywords:** Human pressure, nature-based tourism, stress

Roads can affect wild animals in various ways, influencing their movement, space use, foraging behaviour and mortality. Forest roads are attractive corridors that facilitate movement. On the other hand, humans often use them for recreation, which is why wild ungulates usually avoid them. This can lead to reduced browsing pressure from these herbivores near roads and increased browsing pressure from browsing damage in the forest interior. Avoidance of roads and their surroundings depends on the daily number of people using them, and these numbers can change throughout the year. This is particularly evident in tourist areas. Wild deer species avoid trails, especially during the tourist season, when the average number of daily users of these trails is much higher than in the off-season. Different ungulate species change their use of space near hiking trails and forest roads in various ways depending on the season. The level of stress hormones in ungulates is also higher during the high tourist season. The number of tourists worldwide is increasing yearly, and more and more people are seeking contact with nature. Areas close to nature, including protected areas, are therefore increasingly becoming attractive destinations. The conclusion is that a further increase in recreational use of natural areas may lead to increased stress levels and increased avoidance and, thus, a reduction in suitable habitat for wildlife in forests.

### Linking personality, space use and ectoparasite loads: insights from experimental parasite removal

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**Keywords:** Animal personality, space use, ectoparasites, *Apodemus flavicollis*, experiment

Animal personality is a well-documented phenomenon across many species, yet its role in shaping ecological processes, such as host-parasite interactions, remains poorly understood. For instance, animals exhibiting higher levels of exploration in ‘open-field tests’—commonly thought to reflect natural movement patterns—may be more exposed to parasites. To explore this hypothesis, we conducted live-trapping in a wild population of yellow-necked mice (*Apodemus flavicollis*), ran repeated behavioural tests, and extracted movement indices from trapping data. In addition, we carried out ectoparasite surveys and administered topical antiparasitic treatment. Our research revealed that the relationship between exploration in the open field and trapping-derived indices of space use was more complex than we initially predicted, although some of the space use metrics were repeatable and, thus, can also be treated as proxy of personality. The antiparasitic treatment effectively reduced ectoparasite abundance, but this reduction did not affect mouse behaviour, suggesting that it is mouse behavioural traits that drive ectoparasite abundance, and not the other way round. Our research underscores the importance of host personality in host-parasite interactions and highlights the need to critically validate the use of animal movement as a direct proxy for personality.

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# Conservation Biology

*(F. Mathews)*

## CONSERVATION BIOLOGY

### Towards a better understanding of area of greater conservation concerns for the critically endangered European Mink (*Mustela lutreola*) in France

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**Keywords:** Spatial ecology, habitat selection, conservation

The European mink (*Mustela lutreola*) is a critically endangered semi-aquatic mustelid species of priority conservation in Europe. In France, after a dramatic regression, the species is only present in 7 south-west departments, and the remaining populations are highly fragmented. Improving our knowledge of the species ecology is one of the primary key objectives to establish meaningful and highly needed conservation programmes over the species range. Spatial ecology is often analysed to provide relevant scale and area at which conservation actions should be carried out, including translocations. Moreover, habitat selection analysis provides mandatory results helping the conservation of a species, especially when it is specialised in one habitat such as flood plains for the European mink that deserve protection. However, such information is often lacking for highly endangered species mainly due to a lack of relevant data. To fulfil this gap of knowledge, we analysed radiotracking data of 17 individuals from two French areas in the Landes de Gascogne region collected from 1996 to 1999 and in the Charente basin from 2020 to 2022, using recent analytical approaches. We used a generalised additive model (GAM) in the framework of synoptic models of habitat use to model home range and habitat selection for the European mink by combining different types of variables (e.g. distance from a watercourse, the proportion of covered area, of open area, etc.) with VHF locations. Our results were used for mapping the occurrence probability of the species in all its present range, integrating both spatial and habitat linked variables. This map will provide information and tools for conserving the most suitable areas for the species and for the planned reintroductions.

### Movement patterns of wild and captive-bred Arctic foxes in Scandinavia

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**Keywords:** Arctic fox, fragmentation, connectivity, dispersal, Fennoscandia

Habitat fragmentation poses a significant threat to many species, rendering populations demographically and genetically vulnerable by restricting migration, reducing gene flow, and increasing inbreeding. This issue is especially pronounced in the naturally patchy arctic-alpine tundra of Fennoscandia. Moreover, this region is experiencing one of the fastest rates of climate change, which can exacerbate fragmentation and further decrease connectivity between subpopulations. For species like the arctic fox (*Vulpes lagopus*), a vulnerable keystone species, the persistence of viable populations depends on effective gene flow and dispersal. Understanding these processes is essential for developing long-term management strategies to protect arctic-alpine species facing increasing pressures, such as the arctic fox. Here, we aim to identify the dynamics and determinants of dispersal between subpopulations in Fennoscandia. Specifically, we investigate how dispersal is influenced by arctic fox origin (wild-born vs. captive-bred), sex, the phase of the rodent cycle, distance to the tree line (a proxy for predation), distance to human disturbance, and climate using long-term observational and genetic data series from ear-tagged arctic foxes in Sweden, Norway, and Finland. Using the Fennoscandian arctic fox as a model for arctic-alpine biodiversity at risk, we seek to contribute to the empirical foundation necessary to identify priority areas for conservation.

## CONSERVATION BIOLOGY

### From planning to impact: Using the Conservation Standards to achieve measurable and sustainable results for mammal conservation

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**Keywords:** Conservation standards, adaptive management, impact

Effective conservation requires robust project planning, monitoring, review and adaptive management to ensure a high conservation impact within the limitations of available resources. Strategic processes to help achieve project planning and delivery are common in other sectors; however, using a clearly defined systematic planning and review process within the conservation sector is less commonplace. Vincent Wildlife Trust (VWT) are a specialised mammal conservation organisation that implements and develops evidence-based conservation interventions and demonstrates best practices to act as a catalyst for change. In 2024, we began the process of adopting the Open Standards for the Practice of Conservation (Conservation Standards) to i) identify and implement theories of change that will help us reach our conservation goals and ii) allow us to define our impact on the conservation of our target species. Using examples from within our organisation, we will share how this approach is informing our current and future conservation actions, facilitating the measurement of short and long-term outcomes and enabling internal and external dissemination of best practices.

## CONSERVATION BIOLOGY

### 50 years of evidence-based carnivore conservation actions by Vincent Wildlife Trust

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**Keywords:** Mustelid, pine marten, citizen science, translocation, social science

For 50 years, Vincent Wildlife Trust (VWT) has played a leading role in the recovery of some of the more threatened mammals in Britain and Ireland, using robust data to guide conservation actions. This talk will highlight key research and interventions that have led to positive outcomes for species such as the European otter (*Lutra lutra*) and the Critically Endangered pine marten (*Martes martes*) in England and Wales. It will also showcase innovative monitoring methods, including Citizen Science, for small mustelids such as the European polecat (*Mustela putorius*), stoat (*M. erminea*), and weasel (*M. nivalis*). A major conservation success has been the programme of work on pine marten recovery, including the translocation of over 100 individuals in the past decade, seeding recolonisation in Wales and southern England. Central to this success is proactive engagement with local communities and other stakeholders, fostering coexistence and long-term sustainability. An integrated approach - combining empirical ecological research, landscape and population modelling, social science and community engagement - is now being applied to the conservation of two other Critically Endangered carnivores: the European wildcat (*Felis sylvestris*) in Britain and the European mink (*M. lutreola*) in Romania.

### Evaluating sustainable forest management practices for bat conservation

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**Keywords:** Bats, PAM, guilds, forest, conservation

Bats are essential to maintaining the health of temperate forest ecosystems, particularly through regulating insect populations and promoting biodiversity. Because their populations are sensitive to habitat changes and anthropic activities, identifying effective and sustainable forest management practices is critical. Within the LIFE SPAN project, we investigated the impact of three forest treatments - thinning, gap creation, and tree-related microhabitat creation - on bat communities in the Cansiglio Forest, located in the Carnic Prealps in northern Italy. Our study aimed to assess bat community composition using passive acoustic monitoring, evaluate the impact of forest treatments on bat activity, and inform management strategies to sustain bat populations and biodiversity. We used passive (ultrasonic) acoustic monitoring (PAM) to identify and monitor bat species. Acoustic data were recorded from June to July between 2022 and 2024 at eight sites, with three treatments applied at each site, and five untreated control sites. Through sonogram analysis, we identified at least 25 bat species and assigned them to trophic guilds based on foraging preferences. Statistical analyses were performed in R using a generalised linear mixed model. The best model, selected based on the Akaike Information Criterion, included guild, treatment, and year as fixed effects, while species and site were random effects. The results show gap creation was the most effective treatment for increasing bat activity, followed by tree-related microhabitat creation, while thinning had the least impact. Notably, bat responses varied by guild, with narrow foraging species more sensitive to thinning and less sensitive to gap creation, whereas open and edge foraging species showed a positive response to gaps. Significant variation in bat activity among species and sites was also observed. This study emphasizes the importance of considering species-specific responses when designing forest management interventions and demonstrates that sustainable forestry treatments can significantly improve bat conservation strategies.

### Automating camera-trap data reporting for wildlife monitoring

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**Keywords:** Camera traps, R package, automated reporting, EOW, wildlife conservation

Camera traps are vital for wildlife monitoring and biodiversity research, enabling continuous data collection across diverse ecosystems. However, processing, standardising and analysing these datasets can be challenging, as existing methods for data validation, interpretation and visualisation are often too complex for many end users. Simplifying these processes is crucial for enhancing biodiversity conservation efforts. To address these challenges, we developed an R package that automates the generation of informative reports from camera trap data, streamlining analysis and visualisation. The package provides a comprehensive suite of ecological analyses, including assessments of sampling efforts, species richness, species co-occurrence, spatial density, abundance distribution, community composition, habitat preference, activity patterns, population density, and spatial distribution mapping, all with interactive visualisations. Input data follows the Camtrap DP format from Agouti and TRAPPER. A quality assessment categorizes datasets as high, medium, or low, with only high- and medium-quality records analysed. The reporting system generates standardised outputs, presenting key ecological metrics in tabular and graphical formats across spatial and temporal scales. We demonstrate the package with data from the European Observatory of Wildlife (EOW), a large-scale collaborative network of wildlife monitoring across 73 study sites in Europe. By standardising data collection and analysis, the package enhances comparability, scalability, and reproducibility across protected areas. The package automates analyses and report generation, transforming raw camera trap data into structured ecological insights while facilitating efficient biodiversity trend detection and wildlife status assessment. This approach saves time, supports users of all programming skill levels and supports informed decision-making for conservation efforts.

### Bat colonies in Mediterranean Sea caves: research and conservation challenges

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**Keywords:** Sea caves, Chiroptera, Mediterranean, conservation

Most of Mediterranean Europe is covered by carbonate rocks with extensive karstification, forming numerous caves. The mainland's extensive coastline and the islands scattered across the Mediterranean are perforated by caves of karstic origin, in addition to mechanically formed caves created by wave action. The relatively high temperature of Mediterranean caves allows bats to form colonies, especially during summer, when calm sea conditions prevail. Several important bat nurseries and other colonies have been identified in Greece along the mainland coast and on numerous islands. The most commonly observed species in sea caves include *Miniopterus schreibersii*, *Myotis blythii*, *Myotis emarginatus*, and species of the genus *Rhinolophus*, forming colonies of up to several thousand individuals. Although new sea caves and bat colonies continue to be discovered, primarily by cavers and sea explorers, technical, financial, and logistical challenges limit the extensive study of these sites. Proper management of these fragile biotopes is further complicated by difficulties in patrolling, monitoring, and evaluating conservation efforts. The high tourist activity along the Mediterranean coast and the proposed offshore hydrocarbon drilling and windfarm installations pose significant threats to these important bat colonies, highlighting the need for research and conservation initiatives in Mediterranean sea caves.

### Conservation and recovery of the Balkan Lynx: Achievements, challenges, and future prospects of the Balkan Lynx Recovery Programme (BLRP)

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**Keywords:** Balkan lynx, conservation, recovery, transboundary

The Balkan lynx (*Lynx lynx balcanicus*) is the most endangered autochthonous population of the Eurasian lynx, distributed only in Albania, North Macedonia and Kosovo, but potentially Montenegro, Serbia and Greece are countries that host single individuals immigrating from the neighbouring range countries. According to the IUCN Red List, the Balkan lynx is classified as Critically Endangered (CR) under criterion D. The Balkan Lynx Recovery Programme (BLRP) started in 2006 as a transboundary project and has achieved several important milestones in the conservation of the Balkan lynx, including improved knowledge of the Balkan lynx status and conservation needs. It is strictly protected under the Bern Convention and has been added to Appendix I of the Convention on Migratory Species. New protected areas have been established in Albania and North Macedonia, and awareness of the lynx's critical status has been raised among local communities. Major threats to the survival of the Balkan lynx persist. These include poaching of lynx or its main prey (roe deer and chamois), and infrastructure developments destroying suitable lynx habitat. Lastly, intrinsic factors due to the long-term low population size of the Balkan lynx and the consequently low genetic variability have now come into focus. To recover the Balkan lynx population, BLRP works on three pillars: species conservation, habitat protection and human dimension. In 2024, the BLRP team is working on a new Red List assessment and a first Green Status assessment, which will inform and catalyse actions for the Balkan lynx conservations in the region. The programme is ongoing, with plans for a Regional Conservation Strategy and Action Plans for each country. The authorities will endorse these plans while we work on a sound feasibility and risk assessment study for reinforcement of the Balkan lynx.

### Are rare species truly rare? Possible causes of data deficiency for several bat species in Croatia

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**Keywords:** Chiroptera, survey bias, conservation actions, Croatia

Croatia hosts rich bat fauna, however data on several present species remains scarce. We analysed available data on bat research and records in Croatia in the last three decades to assess possible causes of data deficiency. Only records collected through mist netting and roost inspections were considered, as these methods yield reliable identifications at the species level. Data was used to calculate an average number of survey locations per per km<sup>2</sup>, average surveys conducted per km<sup>2</sup>, and species-specific catch rates across different altitudes and seasons. Several significant biases were noted – spatial, seasonal and methodological. Surveys were mostly focused on protected areas, with five times more conducted surveys per km<sup>2</sup>, especially up until the last decade when surveys were also focused on Natura 2000 sites. Additionally, significantly more research was conducted at altitudes below 1000 m (0,47 surveys per km<sup>2</sup>), suggesting that highland habitats, for which two rarely recorded species have shown clear preference (*Plecotus macrobullaris* and *Vespertilio murinus*), have been insufficiently surveyed (0,17 surveys per km<sup>2</sup>). Both mist netting and roost inspections were mostly conducted during summer months (87% and 63% of conducted surveys, respectively), while spring and autumn periods were far less sampled, which led to the underrepresentation of some migratory species, such as *Pipistrellus nathusii*. It was noted that there were very few to no tree roost inspections, which notably hampers data collection on forest-dwelling species, leading to data deficiency on roosting sites and colonies in trees. These identified biases emphasise the need to increase and focus research efforts on undersampled areas and seasons and target forest specialist species. In order to implement effective conservation actions, it is crucial to properly assess whether species considered rare are truly rare or if the research has been inadequate.

## CONSERVATION BIOLOGY

### Influence of habitat use and diet quality on reproductive performance of European bison across Europe

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**Keywords:** European bison, supplementary feeding, reproduction

The European bison (*Bison bonasus*) is the largest terrestrial mammal in Europe and has been reintroduced and managed in forest habitats following its extinction in the wild. However, the species is better adapted to more open habitats and has been recognised as a refugee species restricted to sub-optimal habitats. Maintaining refugee species in ecologically unsuitable environments can lower population fitness and densities, leading to inefficient and costly conservation efforts. A major limitation of the refugee species concept is the lack of evidence regarding their performance in optimal and marginal habitats. The diversity of occupied habitats and foraging conditions associated with management practices (including supplemental feeding) used in species conservation creates a natural field experiment. This makes the European bison an ideal model species for testing the influence of habitat structure and foraging conditions on their reproductive performance. Using a combination of field methods (fecal sampling, calf size measurements, fecundity assessment) and laboratory techniques (photogrammetry and fecal diet quality analysis), we investigated the effect of diet quality on reproductive rate and breeding synchrony of European bison populations across Europe. Our preliminary results suggest that herds living in more natural habitats experience a greater decline in body condition during winter, leading to reduced fecundity and more synchronised breeding. Conversely, herds that are supplementary fed in forest habitats or rely on winter rapeseed and cereal crops exhibit higher cow-calf ratios and less synchronised breeding. These findings suggest that increased winter access to non-natural food resources may significantly alter natural feeding patterns and reproductive processes, potentially influencing selective pressures and evolutionary pathways. The study was financed by the National Science Centre, Poland project no. 2021/41/B/NZ8/03904.

## CONSERVATION BIOLOGY

### How do we make a difference? Finding the purple bike

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**Keywords:** Community-based conservation, endangered species, collaboration

We all desire to maximize our impact and generate sustainable solutions to our grand challenges through the discovery and application of our efforts. Most often, this requires that we partner with others to create opportunities for win:win scenarios. Finding connections between mammal conservation and local prosperity are critical to the development of sustainable conservation strategies. I will discuss examples of win:win partnerships around the world where my research group and I have found ways to connect conservation efforts for mammals, ranging from squirrels to tigers, and local communities. I will relate these efforts to a purple bike in a remote village in Nepal that serves as a powerful metaphor for collaboration in conservation.

### Refugees among mammals

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**Keywords:** Refugee species, human impact, conservation

Refugee species are those that no longer have access to optimal habitat but are confined to suboptimal habitats by human pressures, resulting in reduced fitness and density and associated conservation risks. The concept was developed based on the European bison (*Bison bonasus*) - Europe's largest herbivore - which is adapted to open or mixed habitats but has been confined to suboptimal forest habitats for the last few thousand years, even being reintroduced into forests by captive survivors after being extirpated from the wild. Protecting populations or species in unsuitable environments is problematic, often ineffective and expensive. Refugee species can be challenging to detect in the absence of information on previous habitat use and fitness, and their observed ecology is constrained by the habitat limits imposed on them. This process is driven by human dominance of potentially optimal habitats (e.g. valley bottoms), forcing species into sub-optimal habitats (e.g. mountain landscapes). Since the publication of the concept, an increasing number of refugee species have been identified. The problem is widespread on all continents with permanent human settlements and typically affects larger species (such as large bovids), small species, such as mice, and even flagship conservation species, such as the giant panda and sea otter. Based on crude niche parameters, this problem is estimated to affect about 13% of extant mammal species. Identifying refugee species, characterising their environmental preferences before they became refugees, and restoring these populations to optimal habitats is urgent and crucial for their successful conservation. The importance of the concept of refugee species will increase in the face of increasing climate and environmental change.

### Comparative study of two brown bear (*Ursus arctos*) subpopulations in Pindos Mountain range with camera traps and bio-signs

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**Keywords:** Brown-bear, relative-abundance, habitat-suitability, Pindos, Greece

Pindos mountain range is an important stronghold of the western brown bear population nucleus in Greece. In the frame of two ongoing LIFE projects, we assessed the relative abundance of brown bears in two adjacent areas located in northern and central Pindos mountains using camera trapping. The first study area is under a full protection status (Northern Pindos National Park/NPNP, bear subpopulation size: 134 ind. - CI 95%), whereas the second study area (Meteora-Trikala/MT - bear subpopulation size: 99 ind. - CI 95%) is at a lower protection status. In NPNP, 72 cameras were used on a 10x10 km<sup>2</sup> grid with a 2-month rotation interval for a total of 3,529 trapping days spanning approximately 6 months. In MT area, 64 cameras were set following the same protocol for a total of 4,489 trapping days spanning approximately 8 months. We used N-mixture models to assess bear Relative Abundance (RA) in both study areas. RA values in NPNP ranged between 0.2 - 4.57, whereas in MT values ranged between 0.03 - 3.07. RA showed a continuum between the NPNP and the western part of the MT area. Moreover, we used bio-signs from a network of hair traps set in both study areas (NPNP n=264 and MT n=217). We processed and compared bear habitat suitability maps for the two study areas using both data sets separately (camera trapping events and bio-signs) in Rstudio and QGIS. Results from bio-signs showed similar suitability scores in both study areas compared to results from camera trapping. This outcome could be utilised in the Natura2000 official management plans underway to optimise conservation actions for the species in the targeted areas. Lastly, further research on gene flow between the two subpopulations would validate their functional connectivity.

## CONSERVATION BIOLOGY

### The current conservation status of the otter (*Lutra lutra*) in Ireland

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**Keywords:** Conservation assessment, survey, otter, population

The European otter (*Lutra lutra*) is listed as near threatened in Europe. Regular reporting of its conservation status is required under Article 17 of the EU Habitats and Species Directive. Five national otter surveys have been undertaken in Ireland dating back to 1980. The Standard Otter Survey method searches up to 600m of river bank, lake or coastline for field signs. In Ireland during 2023-24, a total of 1,063 sites were surveyed (919 in the Republic of Ireland and 144 in Northern Ireland). Otters were present at 65% [95%CI 62 - 68%] of sites in the Republic of Ireland with no change in incidence since the last survey in 2010-11 when occurrence was 63% [95%CI 60 - 66%]. This was highly comparable to Northern Ireland at 66% [95%CI 57 - 73%]. Despite species occurrence being down from ca. 90% in the 1980s and 1990s, records suggest the otter remains widespread throughout Ireland. Occurrence was negatively associated with site disturbance score that included maintenance such as cutting of riparian trees and shrubs (with which otters were positively associated), as well as canalisation or resectioning. Siltation was perceived as present at over half of sites and pollution at over a third (of which agricultural pollution was most common). These pressures, together with water abstraction and coniferous plantations, were at their highest recorded prevalence since surveys began in the 1980s. Nevertheless, the species remains ubiquitous (it can be found from the rivers and coastlines of major cities to remote mountain streams), there has been no change in occurrence since the last survey, and Ireland remains a stronghold for the species. The implications for the conservation status assessment of the species in both ROI and NI are discussed.

### Wolf and free-ranging livestock interactions in Northwestern Greece

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**Keywords:** Wolf, livestock, conflict, husbandry, socioeconomic

Livestock depredation is a major driver of wolf-human conflict globally, creating challenges for wolf conservation and impacting rural livelihoods. This study investigates the influence of husbandry practices on wolf depredation in Northwestern Greece, based on data from semi-structured interviews with 70 sheep/goat and 68 cattle farmers. Additionally, we explored the socio-economic challenges faced by farmers and other wolf-related interactions. Quantitative modelling identified three core preventive measures that significantly reduced depredation risk for both herd types: increased shepherd surveillance, systematic night confinement, and adequate numbers of livestock guardian dogs. For cattle herds, additional practices such as confining young livestock and avoiding carcass abandonment in pastures, proved critical. Our findings also revealed that while wolves pose challenges and reduce job satisfaction among livestock farmers, they are not the most critical issue in the sector. Economic, policy, and infrastructure issues can substantially impact farmers' livelihoods, particularly when coupled with low levels of specialised education. Our study provides evidence to inform the Common Agricultural Policy in the European Union, advocating for the subsidisation of effective preventive measures and the development of national wolf-livestock conflict mitigation strategies in Greece. We also emphasise the importance of educational initiatives to modernise farming practices and call for supportive policies, including fair pricing, improved infrastructure, financial aid, and grazing management plans, to ensure the long-term sustainability of livestock farming. Equally important is acknowledging farmers' concerns regarding wolves, implementing effective strategies to mitigate livestock depredation, and fair and efficient compensation systems. Our work contributes to pinpointing the real challenges in the livestock sector and guiding evidence-based policy decisions to promote coexistence between wolves and livestock farmers.

## CONSERVATION BIOLOGY

### National-scale monitoring of some widespread mammal species in the UK using citizen science: status, challenges and opportunities

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**Keywords:** Citizen science, national-scale monitoring

With the help of scientists, conservationists, landowners, and the general public, PTES is working to protect wildlife and ecosystems and to support conservation work underpinned by scientific evidence. In Britain, PTES coordinates national-scale citizen science surveys, which gather data on several mammal species and support research to better understand the status and needed actions for some species. This includes hazel dormouse (*Muscardinus avellenarius*), Western European hedgehogs (*Erinaceus europaeus*) and water voles (*Arvicola amphibius*), all of which have declined dramatically in abundance since at least the 1950s despite their great popularity with the public, with populations increasingly fragmented and many areas becoming unfavourable. The National Dormouse Monitoring Programme is a prime example of citizen science monitoring efforts, with over 35 years of data and 330 sites. Yet, current trend estimates remain hampered by the complexities of interactions between habitat conditions and dormice use of nest boxes. For hedgehogs, recent estimates indicate that populations might stabilise in urban areas but continue to decline significantly in the wider countryside. However, monitoring data suffers from survey biases and logistical issues relevant to other widespread species. Current pilot multi-partner integration of citizen science surveys with AI should provide the necessary tools to understand better population abundance and trends, particularly in farmland areas, with the benefit of simultaneously gathering abundance data for other, non-target, medium and large mammal species. Similarly, despite transformational innovative efforts in trapping invasive American mink (*Neogale vison*), water vole populations remain fragmented, and conservation efforts, including reintroductions, are challenging to coordinate effectively due to unclear distribution data. We discuss the current state of play for the national monitoring of these species, the lessons learned, and specific aims for future years using combined approaches to citizen science and automated systems.

### The conservation potential and pitfalls of woodland islands for tree-dwelling bats in conventional farmland

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**Keywords:** Bats, forest islands, forest management, noctule, roost selection

Agricultural expansion has often replaced lowland forests, leaving small remnants of previously extensive woodlands embedded within an intensive agricultural matrix. Despite their fragmentation, these forest remnants can be crucial in supporting biodiversity, with bats representing a notable example. In a northeastern Italian landscape, we documented mixed-species colonies of greater noctules (*Nyctalus lasiopterus*) and common noctules (*Nyctalus noctula*) roosting within a forest island surrounded by farmland. Preliminary GPS data indicate that this site may function as a key waypoint between seasonally occupied habitats in Eastern and Western Europe. Using non-invasive photographic techniques and direct observation, we characterised the presence and behaviour of noctule bats within their roosts, alongside a comparative analysis of tree characteristics to assess roost selection patterns. Our findings demonstrate that both species reside in the forest year-round and give birth there, with greater noctules also using the site for hibernation and likely mating, suggesting partial residency within this population. Roosting preferences were associated with aspen trees and cavity-rich trees in the forest interior, characterised by dense canopy cover and limited solar exposure. In contrast, bats largely avoided roosting near the forest periphery. In June 2023 and 2024, we observed the mortality of newborns during heatwaves, revealing a previously undocumented impact of climate change on forest-roosting bats in temperate regions. The preference for closed-canopy sites away from forest edges likely represents a behavioural strategy to mitigate heat-shock-induced fatalities. Furthermore, contrary to assumptions that winter forestry operations pose minimal risk to bats, tree felling during this period can lead to significant mortality, as both common and greater noctules use these roosts for hibernation. While our study underscores the potential conservation value of forest islands within agricultural landscapes, it also highlights their role as ecological traps, emphasising the need for targeted management to mitigate associated risks.

### Human-wildlife interactions: Cultural sensitivities and perspectives influence the conservation of the Philippine brown deer (*Rusa marianna* Desmarest, 1822)

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**Keywords:** Aliwagwag, biodiversity, culture, Mandaya, Philippines

Philippine brown deer (*Rusa marianna* Desmarest, 1822) is a true deer species increasingly threatened by hunting and habitat loss. It is endemic to the Philippine archipelago, now Endangered under the Philippine Red List and Vulnerable in the IUCN Red List. This study examined the cultural sensitivities and perspectives of the Mandaya Indigenous peoples through in-depth interviews with 24 Indigenous experts and community observations from Davao Oriental, Philippines. In Mandaya cosmology, the deer is “Yatag ni Magbabaya”, or a gift from the Creator, and is regarded as an integral part of the Mandaya culture and the ancestral lands. The deer is a sacred species, an indigenous food source, and its hunting is a Mandaya tradition passed across generations. Anthropogenic disturbances remain the leading threats against the deer, including forest clearing and indiscriminate hunting. Poverty is also a critical driver of hunting pressures, inducing many community members to depend on forest resources and products. The causal layered analysis (CLA) revealed that human-deer interactions shape local perspectives on conservation, providing insights into the effectiveness of national protection policies. In addition, the future triangle envisions a sustainable deer population to address food security and economic challenges. The research findings call for culturally sensitive conservation strategies and contextualised community education that align with the Mandaya’s traditions and values. Their engagement ensures that conservation goals are met while the socio-economic needs of the community are addressed. This study also emphasizes the urgent need to reassess the deer conservation status to guide protection and management decisions.

### Assessing the population density and feeding ecology of Tswalu Kalahari Reserve's elusive carnivore species

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**Keywords:** Carnivores, density, ecology, monitoring, conservation

Arid regions, such as the Northern Cape, are vital for biodiversity conservation yet remain significantly understudied. Large carnivores play an essential role in maintaining ecosystem functionality; however, their elusive nature and wide-ranging behaviour present substantial challenges for monitoring, particularly in fenced reserves. This study provides the first population density estimates of leopards (*Panthera pardus*), brown hyaenas (*Parahyaena brunnea*), and spotted hyaenas (*Crocuta crocuta*) within Tswalu Kalahari Reserve (hereafter Tswalu), one of South Africa's largest private conservation areas. Using camera trapping in conjunction with spatial capture-recapture (SCR) modelling, we establish baseline density estimates for these three cryptic carnivores in a semi-arid ecosystem. In addition to density assessments, this research focuses on the diet of spotted hyaenas using faecal DNA metabarcoding to analyse prey preferences and assess their potential impact on declining prey species, such as springbok (*Antidorcas marsupialis*) and red hartebeest (*Alcelaphus buselaphus caama*). By integrating robust population density estimates with dietary data, this study provides critical insights into the ecological role of spotted hyaenas and predator-prey dynamics within Tswalu. This research addresses a significant knowledge gap in large carnivore monitoring within the Northern Cape and contributes to understanding their ecological functions in arid environments. The findings will inform evidence-based management strategies to ensure the long-term sustainability of predator and prey populations while preserving the ecological integrity of the Kalahari.

# Disease and Parasite Ecology

*(H. Henttonen & F. Ecke)*

### Gastrointestinal parasites in rodents from Five Himas in Lebanon

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**Keywords:** Endoparasites, Rodents, Zoonosis, Himas, Lebanon

Rodents and their parasites are reliable indicators of ecosystem health, playing a critical role in understanding the structure of ecological communities. Consequently, comprehending the diversity of intestinal parasites and the factors influencing their prevalence is of primary importance. This study investigates the diversity of gastrointestinal parasites in wild rodents in Lebanon. Fieldwork was conducted during the spring and fall of 2022, encompassing 2,500 trapping nights across five Himas in Lebanon. A total of 205 rodents, including *Apodemus mystacinus*, *Apodemus flavicollis*, *Apodemus hermonensis*, *Microtus guentheri*, *Rattus rattus*, and *Mus musculus*, were captured and examined for intestinal parasites. Nine species of intestinal parasites were identified: one cestode species, *Hymenolepis diminuta* (11.7%), and eight nematode species, including *Ascaris lumbricoides* (31.7%), *Trichuris muris* (7.8%), *Aspicularis tetraptera* (7.3%), *Heligmosomoides polygyrus* (6.8%), *Syphacia muris* (3.9%), *Syphacia obvelata* (3.4%), *Capillaria spp.* (2.4%), and *Physaloptera spp.* (0.5%). The species and sex of rodents did not significantly influence infection rates. However, seasonal variations affected the prevalence of *A. lumbricoides* and *T. muris* which exhibited increased occurrence during the spring season, while *S. muris* showed a rise in prevalence during the Fall. Additionally, the trapping site influenced the infection rates of *H. diminuta* and *A. lumbricoides*. Among the identified parasites, *A. lumbricoides*, *H. diminuta*, and *S. obvelata* are considered zoonotic, posing potential health risks to humans. The study highlights the importance of environmental stability in maintaining parasite-host dynamics and biological cycles. Its findings contribute to a deeper understanding of rodent parasite ecology and provide a foundation for future research on endoparasites in Lebanon and the broader region

### Mouse in the House – Citizen science data on indoor movement of a common rodent in rainy winters explain zoonotic risk

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**Keywords:** Bank vole, *Clethrionomys glareolus*, nephropathia epidemica, Sweden, synanthropy

The tendency to occasionally live in or near human dwellings is an important trait of reservoir rodents. Knowledge on triggers and timing of synanthropy would be valuable in early-warning systems alerting the public of imminent zoonotic risk. Here, we tested if Swedish citizen science data on rodents observed indoors and reported in an app (Mouse in the House) can be used in surveillance of rodent-borne diseases. The app data spanned roughly a complete vole cycle and included 4216 observations, comprising recordings on mice, rats, and voles. This includes the occasionally synanthropic bank vole (*Clethrionomys glareolus*), the host of the etiologic and horizontally transmitted agent (*Orthohantavirus puumalaense*) of *nephropathia epidemica* (NE, vole fever). We related these data to population dynamics of sylvatic small rodents, number of rainy days per month, and human incidence of three notifiable diseases: NE, tularemia and tick-borne encephalitis (TBE). We predicted that a) indoor observations are related to the incidence of rodent-borne diseases with contact (including aerosols; here NE) but not vector transmission (tularemia and TBE), and b) the combination of rainy winters and high vole population densities poses the highest risk. App reports on voles and mice were highest in winter and especially the winter following the vole peak. With a 1-2 months time lag, the peak in vole reports was followed by a peak in incidence of NE. No such relationship was found for the other diseases. The high number of indoor observations of voles during the winter of the peak year of the vole cycle was preceded by rainy instead of snowy months. Our results suggest that rainy winters might be forcing wild living rodents to move indoors and thereby, if infected, posing zoonotic risk. The citizen science data proved valuable in predicting NE incidence and hence provide an important tool in disease surveillance.

### Lymphocytic Choriomeningitis Virus (LCMV) in Bulgaria: Spillover and public health implications

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**Keywords:** LCMV, Bulgaria, mouse, spillover, *macedonicus*

Lymphocytic choriomeningitis virus (LCMV), a bisegmented RNA virus, is primarily hosted by the house mouse (*Mus musculus*), but the wood mouse (*Apodemus sylvaticus*) and other rodents also serve as reservoirs. The virus poses significant risks to human health, especially in immunocompromised individuals and congenital infections. Previous studies suggest that the main divisions of the LCMV phylogenetic tree correspond to mouse subspecies, with the wood mouse virus forming two distinct basal clades. In October 2023, we sampled 340 small mammals in Bulgaria, a region where two house mouse subspecies (*M. m. musculus* and *M. m. domesticus*) meet and are in sympatry with a wild mouse (*Mus macedonicus*). Serum samples were screened by ELISA for LCMV antibodies and lung samples were tested for the presence of LCMV RNA. LCMV antibodies were detected in both house mouse subspecies, as well as in the Macedonian mouse. Genetic screening confirmed the presence of LCMV in *M. m. domesticus* and *M. macedonicus*. Macedonian mice showed higher LCMV prevalence (11%) than domestic mice (4.2%). Genomic characterisation and phylogenetic analyses of the complete L and S segments showed that all Bulgarian samples cluster with the LCMV strain Bulgaria, suspected to be the first isolate obtained from a case-patient with confirmed lymphocytic choriomeningitis in Bulgaria in 1956. This clustering includes the two LCMV strains originating from house mice, which were expected to cluster within the *M. m. domesticus* clade in the LCMV phylogenetic tree. The Bulgarian clade is a sister group of *M. m. musculus* LCMV. Our results suggest that infections in domestic mice are likely a spillover from *M. macedonicus*. This finding along with our field observations of Macedonian mice in close contact with domestic mice, could have significant consequences regarding public health risks in Bulgaria and in the whole distribution range of *M. macedonicus*.

### Biome specific epidemiologies

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**Keywords:** Disease ecology, biome specific epidemiologies

Disease ecology/ecoepidemiology has become a popular field of science. New molecular methods have advanced approaches that were earlier laborous or impossible to perform. Still, a lot of this work is done by scientists not very well aware of the ecological backgrounds of the dynamical patterns and differences between systems. Even within the same host-pathogen system disease ecology can be quite different geographically. We call this biome specific epidemiologies. It is easy to suppose that a specific host pathogen system behaves similarly in a fixed way even though there can be, and usually is, a lot geographic biome specific variation. Dynamical patterns are defined by climate, seasonality, host / guild diversity, etc. Understanding the dynamics of zoonotic hosts and zoonotic pathogens in their reservoir host populations is a prerequisite for predicting and preventing disease epidemics. I will compare these biome specific patterns by examples from orthohantavirus and tularemia studies.

### Identification of the missing links in ectoparasite-small mammal networks using the dark diversity concept

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**Keywords:** dark diversity, mammals, ectoparasites

Dark diversity (DD) is represented by species that may potentially inhabit a locality but are absent. We applied this approach to identify missing links in the interaction networks of fleas and gamasid mites with small mammals and asked whether the probability of an interaction to be missing is associated with the host and/or the parasite traits. The values of the probability of interaction to belong to DD were similar (=repeatable) within host and flea, but not mite, species. The probability of a flea-host and a mite-host interaction being missing was higher if social hosts with complex shelter had low population densities but large geographic ranges. The probability of a flea-host interaction being missing was higher if a flea species was not abundant and preferred to spend most of its life on either the body or nest of its host but not both. In conclusion, we propose a relatively simple way to apply the dark diversity concept to assess the number of missing links in parasite-host networks, identify these links, and relate the probability of a link to be missing with parasite and/or host traits.

### Wild boars at the northern edge: movement patterns and impacts

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**Keywords:** GPS, crop-damage, nest-predation, border, ASF

In Finland, wild boars (*Sus scrofa*) have recently and naturally settled at the northernmost edge of their global distribution. As a large mammal, it is a notable addition to wildlife and game species communities, but it also raises concerns due to the risk of African swine fever, agricultural and traffic damage, and potential ecological impacts. This study examines their movement patterns, agricultural impacts and potential effects on natural communities. A satellite telemetry study showed that wild boar movements vary seasonally. In summer, wild boars are more active, with an average home range of 87 km<sup>2</sup>, which is larger than those observed in southern populations, probably due to resource scarcity and low population density. In winter, activity decreases, and movements are mainly restricted to areas between shelters and supplementary feeding sites, which may support survival in harsh conditions. According to our survey, farmer-reported agricultural damages in southeastern Finland are relatively modest, with 44% of surveyed farmers experiencing losses averaging 224 € per year. However, individual cases report damages of up to 20,000 € in areas with the highest wild boar densities. Farmers' attitudes toward wild boars are divided, ranging from viewing them as harmful pests to valuable game species, while some express mixed concerns. Nest predation experiments using camera traps indicate that, at current low densities, wild boar appear to play a minor role as nest predators. Some evidence suggests wild boar presence may deter other mammalian predators, although no overall positive effect on nest survival was found. This research provides an important baseline for understanding the ecological and economic implications, particularly as wild boar are expected to increase and spread with climate-induced milder winters.

### Movement ecology of golden jackals (*Canis aureus*) and its implications for endoparasite spread: a step selection analysis approach

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**Keywords:** Golden jackals, movement modelling, zoonoses

The golden jackal is a highly adaptive mesocarnivore currently expanding in population and range across Europe. The species has been shown to host a variety of parasite species, partly due to its opportunistic feeding, while overlapping space use with humans and domestic animals facilitates parasite transmission. To investigate possible parasite transmission patterns, the movement behaviour of golden jackals in Serbia was analysed with respect to different land cover variables (agriculture, pastures, built up areas and forests) as well as proximity to water bodies and roads. Golden jackals (n = 9) were captured, fitted with GPS collars and tracked from 2023 to 2025 in a mixed forest-agricultural landscape. Fixes were recorded every 1-3 h, and derived steps were analysed using integrated step selection functions (iSSF) to assess movement preferences. The overall results showed that jackals strongly preferred forested areas, pastures and agricultural plots, and proximity to water bodies in their movement patterns while deliberately avoiding roads. Interestingly, land cover interactions revealed that jackals are less likely to traverse through forests and agricultural plots as the proximity to water bodies increases. Cumulatively, these findings show that jackal movement corridors are aligned with water bodies and may also indicate a preference for habitats near water. As the Sava and Danube rivers surround Belgrade, these preliminary results raise important One Health concerns regarding the transmission of environmentally resistant forms (eggs, cysts, oocysts) of various parasite species hosted by the golden jackal, which may be additionally spread over a much greater territory by river water. These findings highlight that movement ecology is vital for mitigating potential public health risks posed by expanding jackal populations.

### *Toxoplasma gondii* infection in the golden jackal (*Canis aureus*)

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**Keywords:** Golden jackals, *Toxoplasma gondii*, Serbia

Serbia hosts one of the largest resident populations of golden jackals (*Canis aureus*) in Europe. This species is known for its adaptability to different habitats, opportunistic feeding behaviour and flexible social organisation, which contribute to its role as a host for a wide range of parasite species. Given its distribution across the entire country, the jackal serves as an excellent sentinel for *Toxoplasma gondii* in various environments. To explore this potential and the distribution of the parasite, total DNA was extracted from the heart apex of legally hunted jackals, collected during 2023 and 2024. Heart samples from 75 jackals were analysed, of which 36 individuals came from the wider Belgrade (capital) area. Real-time PCR was performed to detect the parasite targeting the 529 bp repetitive element in the *T. gondii* genome. Overall, 40% of the animals (n=30) examined were found to be infected with *T. gondii*. Notably, infection prevalence was higher in jackals from the Belgrade area (44.4%) compared to those from other areas (35.9%). These findings suggest greater environmental exposure to the parasite in urban and peri-urban settings, raising potential public health concerns. Ongoing work includes expanding the sample size to cover different habitats within the jackal distribution in Serbia and the processing of archived samples. Genotyping of *T. gondii* isolates using microsatellite markers will be conducted on positive samples to further investigate the genetic diversity of this parasite among jackals in Serbia.

### Modelling the transmission dynamics of EBLV-2: Insights from the first serological evidence in *Myotis myotis* bats

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**Keywords:** Compartmental model, lyssavirus, bats

First identified in a Pond bat (*Myotis dasycneme*) in the Netherlands but primarily associated with Daubenton's bats (*Myotis daubentonii*), European Bat Lyssavirus Type 2 (EBLV-2) is considered enzootic within Daubenton's bat populations. However, our understanding of its persistence and demographic impact on bat populations is hindered by a scarcity of data from wild bat populations, experimental studies, and mechanistic modelling approaches. This may result from minimal public health concerns due to its negligible transmission risk to humans or livestock despite its role in two fatal human cases in Europe. We present the first serological evidence of EBLV-2 circulation in France (Brittany) and within a new host species, the greater mouse-eared bat (*Myotis myotis*), through active surveillance. Notably, EBLV-2 has not yet been isolated in France despite the presence of both Pond and Daubenton's bats. Using an 8-year dataset (2010–2018) of serological samples collected from a metapopulation of individually marked *M. myotis* bats in Brittany, we inferred key epidemiological parameters. Through compartmental modelling within a Bayesian framework, we explored the transmission dynamics of the lyssavirus within these colonies and its demographic impact on bat populations. Our findings suggest that sustained virus persistence within a closed population is unlikely. However, contact with infectious individuals during critical phases of the bat life cycle accounts for fluctuations in observed prevalence. Specifically, we identify the swarming period, when bats aggregate in large numbers during autumn for mating, as a crucial mechanism supporting the dynamics of EBLV-2 among maternity colonies. While EBLV-2 infection contributes to additional mortality in *M. myotis*, it does not pose a significant threat to the conservation of the species.

### Consequences of repeated sarcoptic mange outbreaks in an endangered mammal population

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**Keywords:** Conservation biology, sarcoptic mange, wildlife disease, *Sarcoptes scabiei*

Diseases and parasites are key drivers of population dynamics in wild mammal populations. Small and endangered populations that overlap with larger reservoir populations are particularly vulnerable to diseases and parasites, especially in ecosystems heavily influenced by climate change. Sarcoptic mange, caused by the parasitic mite *Sarcoptes scabiei*, poses a severe threat to many wildlife populations and is now considered a panzootic. The arctic fox (*Vulpes lagopus*) in Fennoscandia, already endangered due to fragmented distribution, prey scarcity, red fox (*Vulpes vulpes*) expansion, and inbreeding depression, faces additional threats from recurrent sarcoptic mange outbreaks. These outbreaks, likely spread by red foxes, were first documented in 2013 and have since reoccurred in 2014, 2017, 2019, 2020, and 2021. Using field inventories and wildlife cameras, we tracked the development of sarcoptic mange in this arctic fox subpopulation, focusing on disease transmission and its impact on reproductive output. In 2013–2014, approximately 30% of the population exhibited visual symptoms of mange. Despite medical treatment, demographic consequences included plateaued litter production and reduced litter size following the introduction of *S. scabiei*. Additionally, we found evidence of disease transmission likely facilitated by a few individuals traveling between multiple dens, acting as “super-spreaders”. This study underscores sarcoptic mange as a critical threat to small populations, with the potential to jeopardise the survival of the entire Scandinavian arctic fox population.



# Ecological Modelling

*(Ch. Astaras)*

### Greening the land? Multi-scalar methods for designing green corridors in Greece

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**Keywords:** Corridors, Natura 2000, large mammals, Greece

Ecological corridors are areas that connect isolated patches of natural habitat, enabling wildlife to move through fragmented, human-dominated landscapes. We present the results of a multi-scalar modelling exercise to map current levels of ecological connectivity in Greece. Specifically, we mapped ecological corridors at (a) the national level, using the Natura 2000 protected area network, and (b) the regional level, at a selected area for each of three large mammal flagship species (brown bear *Ursus arctos*, red deer *Cervus elaphus*, chamois *Rupicapra rupicapra*). At the national scale, the Natura 2000 network connectivity was assessed using Corine Land Cover and Open Street Map road network data to produce movement suitability maps, assigning scores to each category based on its impact – as inferred from literature – on large mammal connectivity. We applied the Least Cost Path methodology to identify optimal routes, and high- and low-suitability zones for corridors. Field surveys in critical areas validated infrastructure suitability, strengthening our results. Moreover, we applied the same analysis – at a higher resolution and focused on the brown bear – in the Amynteo region (Florina Prefecture). For the red deer, we assessed the connectivity of the isolated population at Mt. Parnitha to surrounding mountain ranges in the region of Attica and Voiotia. For the chamois, we examined the connectivity of the southernmost Mt. Vardousia population with the species' core range in Pindus mountain range. In both cases, we used expert input and literature to develop resistance surfaces incorporating environmental and anthropogenic variables and then run the Least Cost Path and Circuit Models. At all levels, highways and settlements are the primary barriers to wildlife movement, requiring the targeted development of green bridges and underpasses network to mitigate their effect on wildlife connectivity. We conclude by discussing the legal frameworks at the national, EU, and international levels for establishing ecological corridors

### Socio-economic variables improve accuracy and change spatial predictions in species distribution models

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**Keywords:** Biodiversity, wildlife, socioeconomy, SDMs

In an era marked by increasing anthropogenic pressure, understanding the relations between human activities and wildlife is crucial for understanding ecological patterns, effective conservation, and management strategies. Here, we explore the potential and usefulness of socio-economic variables in species distribution modelling (SDM), focusing on their impact on the occurrence of wild mammals in Poland. Beyond the environmental factors commonly considered in SDM, like land-use, the study tests the importance of socio-economic characteristics of local human societies, such as age, income, working sector, gender, education, and village characteristics, for explaining the distribution of diverse mammalian groups, including carnivores, ungulates, rodents, soricids, and bats. The study revealed that incorporating socio-economic variables enhances the predictive power for >60 % of species and overall for most groups, with the exception being carnivores. For all the species combined, among the 10 predictors with the highest predictive power, six belong to socio-economic group. In contrast, for specific species groups, socio-economic variables had similar predictive power as environmental variables. Furthermore, spatial predictions of species occurrence underwent changes when socio-economic variables were included in the model, resulting in a substantial mismatch between environment-only models and models containing socio-economic variables. We conclude that socio-economic data has the potential to be useful predictors that increase the accuracy of prediction of wildlife occurrence and recommend its wider usage. Further, to our knowledge, this is the first study on such a big scale for terrestrial mammals, which evaluates performance based on the presence or absence of socioeconomic predictors in the model. We recognise the need for a more comprehensive approach in SDMs, and that bridging the gap between human socio-economic dynamics and ecological processes may contribute to understanding the factors influencing biodiversity.

### Ecologically relevant predictions to improve species distribution models for European bat research

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**Keywords:** Bats, modelling, SDMs, Chiroptera, nocturnal

Species distribution models (SDMs) are important statistical tools with which to identify areas of high environmental suitability, predict species' occurrence and understand how their ranges may respond to global environmental change. This is particularly valuable for bats (order Chiroptera), whose nocturnal behaviour and flight frequently leads to incomplete detection. SDMs, especially those predicting occurrence over large scales, often utilise multiple general environmental predictors, including bioclimatic variables and landcover. Whilst this may be a reasonable approach for some mammal species, bats are unique in that they require both suitable roost sites and high-quality foraging habitat within close proximity, can have very large ranges, and are nocturnal. In this study, we aimed to improve predictions of the environmental suitability for six bat species (*Miniopterus schreibersii*, *Rhinolophus ferrumequinum*, *Rhinolophus hipposideros*, *Eptesicus serotinus*, *Pipistrellus pipistrellus*, *Pipistrellus kuhlii*) across Europe by incorporating more biologically relevant predictors of occurrence in SDMs. In particular, we focused on the influence of including night-time temperature data, derived from AVHRR satellite imagery, and proxies for the availability of potential roost locations, derived from OpenStreetMap data and geological layers, on SDM performance and predictions. We found that SDM performance (from cross-validation) was higher in models that included night-time temperatures and roost location proxies. However, the importance of these variables in model predictions varied substantially between species. Across all species, their predicted distribution was more conservative when night-time temperatures and roost proxies were used in SDMs, suggesting that these factors may be important in restricting species' ranges. Overall, these results emphasise the need to consider the specific ecological requirements of different taxonomic groups in order to generate a more accurate picture of their distributions for conservation research and practice.

### Spot the cat! Modelling and mapping the European wildcat occurrence in Northern Greece

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**Keywords:** Meso-carnivore, Greece, camera-trapping, *Felis silvestris*

The European wildcat (*Felis silvestris*) exhibits considerable plasticity in its habitat requirements across its distribution, with differences increasing along a continental-scale latitudinal gradient. Range-wide conservation efforts will benefit from incorporating knowledge generated by robust regional ecological models. We used data from a large camera-trap grid (n=292 stations) spanning across nine wildcat associated habitats in northern Greece from the Pindus mountain range to the west to the Evros River delta to the east, to understand the regional ecological parameters affecting the species' habitat selection. We analysed the data using single-season density induced detection heterogeneity occupancy (Royle-Nichols) models, considering 12 environmental and anthropogenic parameters (1 km resolution). Royle-Nichols models estimate abundance (N), interpreted as relative abundance, with occupancy being a derived parameter. Using the Akaike Information Criterion for model selection, we removed uninformative parameters compared to the baseline model and the least informative parameter among correlated pairs. The global model's goodness of fit was high ( $p=0.9$ ). Since there was no support for a single best model, we calculated the average coefficients of the top models, accounting for each model's weight. Elevation and percent forest cover were significantly negatively related to wildcat relative abundance. More moderate but significant were the positive relations of proximity to freshwater bodies and human settlements. We used the model average coefficients to generate a predictive map of wildcat (relative) abundance across northern Greece (Thrace, Macedonia and Epirus regions), identifying 42,519 km<sup>2</sup> of potential wildcat habitat. Assuming 0.1–0.3 individuals/km<sup>2</sup> in areas with predicted low, medium and high relative wildcat abundance, we estimate the wildcat population in northern Greece to exceed 7,000 individuals. The findings, which vary from ecological models of the species in northern Europe, show the need for regional models and the importance of Greece and the Balkan peninsula for the European wildcat..

# Genetics and Genomics in Mammalogy

*(E. Bužan, J. Bryja, A. Frantz & F. Zachos)*

### Unveiling the genetics of the Eurasian Lynx (*Lynx lynx*): Insights for conservation of Jura and Alpine populations in France

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**Keywords:** Endangered species, non-invasive sampling

At the beginning of the 20th century, the Eurasian lynx (*Lynx lynx*) was extirpated from France due to human persecution, deforestation and the rarefaction of ungulate prey. Restoration of more suitable habitats and reintroduction programs in Switzerland in the 1970s made its return to the French territory possible. Nowadays, the species is still facing significant threats, including traffic collisions, illegal killing and habitat fragmentation. Low population densities, large home ranges, and elusive behaviour make monitoring the Eurasian lynx challenging. In 2022, a National Action Plan was implemented in France to restore the species to a favourable conservation status. Genetic diversity among French lynx populations has been poorly studied, although low levels are characteristic of other European-reintroduced lynx populations. With a putative founder effect, current threats will likely reduce genetic diversity. This study aims to assess the genetic diversity and the structure of the Jura and Alpine lynx populations to determine whether they are at risk of genetic isolation and/or inbreeding depression. A unique aspect of this study is the use of non-invasively collected samples (i.e., faeces) provided by over 200 volunteer collectors.

### That's so last season: Unravelling the genomic cost of fur farming in Arctic Foxes (*Vulpes lagopus*)

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**Keywords:** Domestication, inbreeding, demography, genome

Humans have utilised animal fur for centuries, but large-scale fur farming only emerged in the mid-19th century. The incipient domestication process in fur farming involves complex genomic factors, including founder effects, population bottlenecks, and small effective population sizes. Combined with intense artificial selection, these factors can lead to reduced genetic diversity and fitness due to inbreeding and a limited gene pool. The Arctic fox (*Vulpes lagopus*) has been intensively farmed since the early 20th century, primarily selected for specific economic phenotypes. We investigated the origins and genomic impacts of intensive farming by comparing whole genomes of farmed and wild Arctic fox populations across their range. Our findings reveal a recent history of inbreeding, characterised by extensive Runs of Homozygosity and reduced genomic variation in farmed foxes compared to their wild counterparts. Genomic analyses identified a coastal ecotype origin for all farmed foxes, placing them phylogenetically close to wild Icelandic populations rather than the inland lemming ecotype. These patterns of reduced heterozygosity and increased recent inbreeding highlight the significant genomic consequences of fur farming and the demographic history of human-driven selection. Our study emphasises the importance of expanded genomic investigations into fur farm populations better to understand the domestication process and its evolutionary costs. Importantly, our findings underscore the need for management strategies to prevent genetic introgression from escaped farmed foxes, which could impact wild populations. Such measures are crucial for conserving the genetic integrity of wild Arctic foxes in the face of ongoing human influence.

### Quantifying the genetic load and recent inbreeding levels of the critically endangered Balkan lynx (*Lynx lynx balcanicus*)

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**Keywords:** Conservation genomics, lynx, genetic rescue

The Balkan lynx (*Lynx lynx balcanicus*), one of the earliest diverged and the most endangered Eurasian lynx subspecies, faces critical threats, with fewer than 50 mature individuals surviving in the mountain range of the western Balkan Peninsula. In addition to the other conventional threats, such as habitat loss and illegal killing, recent genomic studies reveal alarming trends, indicating the lowest genetic diversity and highest inbreeding coefficient among all Eurasian lynx populations. Using whole genome resequencing data from 10 Balkan lynx and 48 individuals from five other populations, along with a novel high-quality Eurasian lynx reference genome, we show that the Balkan lynx has accumulated acutely steep levels of inbreeding ( $F_{ROH}=0.471$ ) over the last 32 generations. Compared to the other populations, it also displays significantly higher levels of both drift and inbreeding genetic load, as well as a higher fixation rate for putatively deleterious mutations. Contrary to our expectations, no signs of genetic purging were detected, as we observed the same trends even for the most deleterious categories of mutations, where purging is typically anticipated. Our results are alluding to lowered fitness, endorsing the urgent need for human-assisted gene flow to counteract the potential inbreeding depression and avert extinction. By addressing the genetic health of this critically endangered subspecies, our study plays a pivotal role in guiding targeted and effective conservation actions, supporting the Balkan lynx's long-term survival in human-dominated landscapes.

### Intraspecific epigenomics divergence in brown bears (*Ursus arctos*): insights from genome-wide DNA methylation patterns

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**Keywords:** RRBS, methylome, non-model, populations

Brown bears (*Ursus arctos*) in Europe are distributed in several large and fragmented populations, exhibiting phenotypic traits that vary among them. These differences may reflect local adaptation and potential isolation. Notably, individuals in central Italy's relict population display markedly differentiated skull shape and behaviour. Epigenetic mechanisms, such as DNA methylation, might facilitate phenotypic novelties and adaptations to local environments, which regulate gene expression in response to selective pressures. However, epigenomic studies in wildlife are not routinely performed, causing a lack of knowledge on the real impact of methylation in population differentiation. Here, we used reduced representation bisulfite sequencing (RRBS) to compare methylation profiles of wild-caught brown bears from the Central Italian, Northern Italian, and Scandinavian populations. Using blood and muscle samples, we aimed to identify the most suitable tissue for detecting methylation differences and assess whether these differences are related to local factors. To minimise sex-related biases, our analyses focused on autosomes but were extended to the X chromosome separately. Our findings reveal that: i) methylation patterns differ significantly between study areas in both tissues, reflecting clear epigenetic signatures at the population level. This same population-specific pattern was also observed for the X chromosome; ii) blood samples yielded a higher number of differentially methylated regions (DMRs) compared to muscle samples, demonstrating its greater suitability for such studies; iii) the identified DMRs were predominantly associated with cellular and anatomical development, likely contributing to the distinctive morphological traits observed in the Central Italian population. While the functional significance of the observed epigenetic differences remains to be elucidated, our results underscore the importance of methylation analyses in studying adaptation and differentiation in non-model species. Moreover, this approach also offers valuable insights for identifying evolutionary significant units (ESUs) essential for effective conservation planning.

## GENETICS AND GENOMICS IN MAMMALOGY

### Escaping doom for 10,000 generations of complete isolation

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**Keywords:** *Microtus arvalis*, deleterious variation, demography

Human activities have led to the fragmentation of populations of many species and the introduction of organisms to new, geographically-isolated areas. Theoretical predictions for the future of isolated populations are typically grim but empirical studies of the effects of long-term isolation under natural conditions are limited. Here, we analysed the genomic consequences of more than 5000 years of isolation experienced by common voles (*Microtus arvalis*), introduced to the Orkney archipelago of Scotland by Neolithic settlers from continental Europe. We sequenced dozens of full genomes of common voles and a sibling species sampled throughout the distribution range, including individuals from all inhabited Orkney islands. We show that Orkney voles derive from individuals originating at the northern coast of France or Belgium and have remained isolated since without detectable gene flow. Despite having large modern population sizes, Orkney vole genomes retained only 8-29% of the heterozygosity of continental conspecifics. Homozygosity of deleterious variation accumulated to a dramatic degree, particularly in populations on smaller Orkney islands. Genetic drift processes have dominated, particularly the earlier history of Orkney voles. Comparative genome scans showed that their extraordinary big size ("island syndrome") is instead the consequence of the absence of selection for small size that continental populations experience. This natural system shows that extremely long isolation may lead to all the potentially negative consequences expected from population genetics theory. Yet, the long-term demographic success of Orkney voles suggests that doom can be avoided even in complete isolation, and the particular life history of rodents likely plays a crucial role in this success story.

### Conservation genomic status of Neotropical cats compared to felids globally

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**Keywords:** Felidae, Neotropics, conservation genomics, phylogenomics

The Neotropical realm supports a diverse assemblage of wild cat species, most of which are small, spotted species in the genus *Leopardus*. We use whole-genome resequencing data and phylogenomic methods to obtain a genomic perspective on the ongoing taxonomic discussions centred around two species complexes: the tiger cat (*L. tigrinus* sensu lato) and the pampas cat (*L. colocola* sensu lato). We demonstrate how rapid and cryptic speciation, coupled with frequent hybridisation, led to a complex evolutionary history in the genus, effectively rendering the genome a mosaic of distinct phylogenies, resulting in a confused taxonomy. Our estimates of genomic diversity measures (heterozygosity), inbreeding (ROH), and demographic history highlight the vastly different demographic trajectories observed in *Leopardus* species over the past one million years. Climatological and anthropogenic changes in the Neotropics have affected each species differently, depending on their ecology. These factors are reflected in the contemporary genetic diversity of *Leopardus* species. To provide context, we expand our data set to a global comparison of heterozygosity across nearly all extant species of Felidae. Perhaps surprisingly, we find that our estimates of genetic diversity are best explained by a (sub)species' geographic range and population density rather than its census size or threat status. Among felids, the species with the highest natural levels of genetic diversity appears to be the ocelot (*L. pardalis*), a generalist species with a vast range across the Neotropics, often found at high local densities. Conversely, the congeneric Andean cat (*L. jacobita*), an endangered and exceedingly rare highland specialist, ranks among the species with the lowest diversity in cats. We show that phylogenomic methods are essential for resolving complex taxonomic uncertainty. Conservation genomic measures in cats may be used as predictors of range and density (and vice versa), conforming with neutral theory.

**Bottleneck and selection effects on MHC variability in relict and reintroduced Eurasian Beaver populations**

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**Keywords:** Beaver, *Castor*, MHC, selection, bottleneck

MHC genes form a crucial part of vertebrate adaptive immunity. They are usually highly polymorphic, and selection pressure strongly influences their evolution. However, in some species, MHC variability is significantly reduced due to genetic drift during population bottlenecks. From this perspective, the Eurasian beaver (*Castor fiber*) is an interesting model. It underwent a recent dramatic bottleneck, which almost led to its extinction, followed by a phenomenal re-expansion supported by multiple reintroductions. We found significantly reduced MHC diversity in the Eurasian beaver. The entire Eurasian beaver gene pool contains a comparable number of alleles as a single population of its sister species, the American beaver (*C. canadensis*). However, we found clear signs of selection shaping MHC diversity in pre-bottleneck times. Beavers of various origins meet and mix in contemporary populations. We focused on these mixed populations and found they contain a mixture of alleles from the parental relict populations and exhibit higher diversity than their original sources.

## GENETICS AND GENOMICS IN MAMMALOLOGY

### Inbreeding depression in the Swedish arctic fox – the role of strongly deleterious mutations

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**Keywords:** Inbreeding, genetic rescue, mutational load

Inbreeding depression is a key process in conservation biology and has been documented in several threatened mammal species. The underlying mechanisms are, however, challenging to identify, and little is known regarding the link between deleterious variation and fitness in wild populations. The Scandinavian arctic fox (*Vulpes lagopus*) declined severely in the 19th century and was on the verge of extinction in the 1990s. Through conservation actions, the population has started to recover, but inbreeding and genomic erosion are still threatening long-term persistence. Using a long-term individual-based data set combined with whole genome sequence data, we explore how inbreeding levels and deleterious variation influence fitness in a bottlenecked Swedish arctic fox subpopulation. Furthermore, we show how gene flow from a captive breeding project can introduce new deleterious variation and elevate the strength of inbreeding depression.

## GENETICS AND GENOMICS IN MAMMALOGY

### Unravelling the secrets of two gerbil genera: Distribution and genetic structure on the Sahara's edge amid climate shifts

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**Keywords:** SDM, genetic structure, climate change

Unravelling the secrets of two gerbil genera: Distribution and genetic structure on the Sahara's edge amid climate shifts African mammals' distribution and the genetic structure of their populations have become increasingly crucial for understanding the evolutionary histories of the continent's ecosystems. While research has focused mainly on lowlands, mountain forests, and open systems like savannahs, deserts, and other arid regions, it remains understudied. These environments present extreme conditions that test species' physiological limits, providing unique insights into adaptation and survival. This study investigates the genetic structure and evolutionary histories of two gerbil species from poorly known monotypic genera: *Pachyuromys duprasi*, inhabiting the northern Sahara, and *Desmodilliscus braueri*, living at its southern margins. Both represent deeply divergent lineages of gerbils (Muridae: Gerbillinae). Genetic structure was analysed using mitochondrial markers CYTB and COI to assess phylogenetic relationships and distribution of genetic clades. The most comprehensive distributional data based on genetically confirmed records were then used to construct species distribution models. Phylogeographic analysis of *Desmodilliscus braueri* suggests that geographical barriers significantly shaped its genetic structure, consistent with findings from other small mammal taxa in the Sahelo-Sudanian region. For *Pachyuromys duprasi*, populations from Egypt were genetically distinct, but the rest of the North African populations showed no spatial genetic structure. Species distribution models were constructed for three temporal scenarios: present, past (Last Glacial Maximum and mid-Holocene), and future (to 2100 under varying climate scenarios). These models highlight shifts in potential habitats in response to historical and projected climatic changes, illustrating species' responses to varying environmental pressures. This study underscores the significance of arid ecosystems in evolutionary studies and the need for further exploration of species adaptations to extreme environments.

### Evolutionary history of the red fox (*Vulpes vulpes*) in the Anatolian Peninsula

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**Keywords:** Anatolian Diagonal, genomics, ecological modelling

The red fox (*Vulpes vulpes*) is a highly ecological plastic species widely distributed across the northern hemisphere. Although extensively studied, knowledge gaps remain regarding its evolutionary history in certain parts of its range, particularly in biogeographically significant regions such as the Anatolian Peninsula. This region, located at the junction of Europe, the Middle East, and Asia, has played a crucial role as a refugium during the Quaternary ice ages and a key corridor for postglacial expansions across the Palearctic. To investigate whether the genetic diversity of the contemporary red fox populations in the Anatolian Peninsula was shaped during the Last Glacial Maximum (LGM), we performed a genome-wide analysis of 86 red foxes sampled across this region and assessed species' past potential distribution. We found a signal of population differentiation coincident with the Anatolian diagonal, a significant biogeographic barrier that dissects Central Anatolian from the northeast to the southwest. Additionally, by exploring the demographic history, we found population decline coincident with the LGM and the Heinrich Event 1, suggesting that the geophysical and climatic changes during this period played an important role in shaping the intraspecific genetic structure of red foxes. Despite this differentiation, admixture between populations on either side of the Anatolian diagonal was detected, reflecting the permeability of this barrier during the postglacial period following the LGM. The extent of suitable habitat decreased over time, particularly in eastern Turkey, reaching its minimum around 17 thousand years ago. Our findings highlight the complex evolutionary history of this biogeographically important region.

### Overlooked diversity of the putatively monotypic smallest rodent genus from the largest tropical island

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**Keywords:** *Lorentzimys*, Hydromyini, New Guinea, elevation

The Long-footed Tree Mouse (*Lorentzimys nouhuysi* Jentink, 1911; Muridae: Murinae: Hydromyini) is the smallest rodent (10-23 g) in the Oceanian zoogeographic region. This monotypic genus is endemic to the island of New Guinea, associated with primary forests across a broad elevational extent (80-3200 m asl). Despite its distribution across the whole island, its representation in world museum collections is rather limited. Using pitfall trapping, we were able to sample a robust collection of *Lorentzimys* in north-eastern New Guinea. We sampled three different areas, including two rainforest gradients (Mt. Wilhelm in the Central Cordillera and the outlying Saruwaged Mts. in the Huon Peninsula; 200-3700 masl). Using phylogenomic methods and morphological comparisons, we found that *Lorentzimys* is not monotypic but comprises two divergent subgenera with five candidate new species (some occurring in sympatry) from this region of the island alone. Interestingly, we recognised a potential elevational clustering along the gradients within the genus, with each studied area hosting both subgenera and two to three species with distinct elevational segregation. Application of similar techniques to samples collected from throughout New Guinea is likely to show that true taxonomic and ecomorphological diversity is considerable in *Lorentzimys*.

# Invasive and Alien Species

*(S. Bertolino)*

## INVASIVE AND ALIEN SPECIES

### How can integrated efficient management of the European rabbit in Chile be approached?

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**Keywords:** *Oryctolagus cuniculus*, dynamics, management, myxoma

The European rabbit causes significant damage to several Chilean ecosystems. However, critical gaps such as epidemiology, ecology, and economic impacts still need to be addressed to manage the rabbits efficiently. The most harmful effects of rabbits have been reported in Chilean islands and the continental sclerophyllous forest. We study the population size, diseases, and drivers of rabbit dynamics better to predict their spread and outbreaks and food web impacts on Chilean natural ecosystems. We employed population models and weather and biotic drivers to understand triggers. Moreover, we built the food webs in several Chilean ecosystems to evaluate the interactions and likely short-term mechanisms after a rabbit extinction simulation. Population increase was best explained by low evaporation in summer, high cumulative winter rainfall, and abundance of eagles from autumn to winter. Besides, after extinction simulations, the rabbit was the most connected node, showing a possible release of herbivory pressure on plants and release competition for herbivores. Some predators could face a reduction in their trophic width and could intensify predation on alternative prey. Considering ecosystem approaches, these results should be helpful for efficiently managing the European rabbit in Chile. Still, the severe negative impacts caused by European rabbits during the last 150 years in Chile have been addressed chiefly from a community-ecological perspective with some theoretical bias. Applied research is lacking to improve public policies and efficiently manage this invader. It now becomes urgent to determine the geographical distribution and hotspots, understand their impacts on Chilean productive systems and natural ecosystems to value them economically, and research the presence of pathogens such as Myxoma, determining their distribution, prevalence and possibly virulence.

## INVASIVE AND ALIEN SPECIES

### The timid invasion: Why are native wood mice in Ireland displaced by invasive but shy bank voles?

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**Keywords:** Invasive forest rodent, spatial sorting, shyness

There is only one species of forest rodent in Ireland, the native wood mouse (*Apodemus sylvaticus*). For a century, continental bank voles (*Myodes glareolus*) are invading hedges and forest patches, displacing native wood mice. The invasion showed spatial behaviour sorting, with voles being shyer at the invasion edge than at established ranges (Eccard et al. 2023, PRSLB, Mazza & Eccard 2023 Curr Zool). We further investigated behavioural differences between the two species, comparing six invasion and pre-invasion sites with camera traps (360 trap nights). Bank voles fed more efficiently than wood mice; wood mice did not prolong their activity pattern in response to the increased resource pressure through the bank voles. However, bank voles were not found displacing wood mice via aggression from good feeding sites. Our results indicate that wood mice have not evolved a flexible response to resource competition by bank voles, contributing to their massive decline in areas invaded by bank voles.

### Alien mammals in Italy: pathways of entry and the EICAT assessment of impacts

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**Keywords:** Alien species, mammals, introduction pathways, environmental impacts, EICAT

Developing effective strategies to mitigate the negative impacts of alien species requires a thorough understanding of introduction pathways and the impacts they cause. This study aims to review the introduction pathways of alien mammals into Italy and assess their impacts using the standardised EICAT framework. We compiled a comprehensive list of mammals introduced into Italy. To gain deeper insight into the drivers of mammal introductions, we also evaluated the translocation pathways of native species within Italy. Published studies were systematically reviewed using Scopus, Web of Science, and Google Scholar. Each impact was assessed and categorised using the EICAT classification framework. We collected data on 24 species: 10 Rodentia, six terrestrial Cetartiodactyla, 5 Carnivora, 3 Lagomorpha. Six species are included in the Union list (EU Regulation 1143/2014). We collected data on 50 introduction pathways: 17 releases (34.0%), 17 escapes (34.0%), 10 stowaways (20.0%), and six unaided (12.0%). Examining the second level of the pathway (subclasses), we found a primary escape or release by private or zoos (9 introductions, 18.2%), hunting (8, 16.0%), fauna improvement (6, 12.0%), natural dispersal across borders (6, 12.0%). Regarding translocations of native species (23 cases), the main pathways included hitchhiking on ships/boats (7 cases, 30.4%), and hunting (4, 17.4%). *Ammotragus lervia*, *Callosciurus erythraeus*, *Cervus nippon*, *Dama dama*, *Mus domesticus*, *Neovison vison*, *Rattus rattus*, *Sciurus carolinensis*, emerged as the species with the highest recorded impact categories. This study highlights the significant presence of alien mammals in Italy, primarily introduced through voluntary releases or escapes. Past introductions were primarily driven by hunting management, while recent cases are largely associated with the escape of captive individuals. Effective mitigation efforts should prioritise the enforcement of pet trade regulations and minimising the risk of escapes.

## INVASIVE AND ALIEN SPECIES

### Managing alien squirrels in Italy: an update on presence, impacts, and the European context

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**Keywords:** Emergency teams, interspecies competition mechanisms, invasive squirrels, management challenges

Invasive alien species (IAS) represent a critical global threat to biodiversity, and Italy faces increasing conservation challenges from non-native squirrel species. The Eastern grey squirrel (*Sciurus carolinensis*), introduced to northern regions, is well-documented for its role in the decline of the native Eurasian red squirrels (*Sciurus vulgaris*). Similarly, the Pallas's squirrel (*Callosciurus erythraeus*) in northern Italy and the Finlayson's squirrel (*Callosciurus finlaysonii*) in the south are emerging threats, with the latter significantly endangering the endemic Calabrian black squirrel (*Sciurus meridionalis*). These invasions lead to resource competition, habitat displacement, and the transmission of novel diseases and parasites, further exacerbating the vulnerability of native species. This presentation examines the current status and trends of alien squirrel populations in Italy, contextualising the issue within the broader context of the European Union's Regulation 1143/2014 and highlighting cross-border risks of further spread. Particular focus is given to the mechanisms driving interspecies competition and ecological disruption, particularly in southern Italy, where the endemic Calabrian black squirrel faces heightened threats. Additionally, we highlight the role of the Alien Squirrel Emergency Team (ASET) in supporting local conservation agencies through targeted management interventions, including population control and public awareness campaigns. By examining these complex ecological dynamics and the associated management challenges, this study aims to provide actionable insights into preserving biodiversity from the threat posed by IAS. The lessons learned from Italy's experience with invasive squirrels contribute to developing broader strategies for preventing the spread of IAS across Europe and mitigating their impacts on native ecosystems

## INVASIVE AND ALIEN SPECIES

### Accidental eradication of American mink: a gamechanger for European mink?

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**Keywords:** American mink, European mink, Systematic control

The European mink is the most endangered carnivore of Europe. The larger and more competitive American mink plays a major role in the challenging survival of the European mink. During the Covid pandemic, all fur farms with American mink were closed due to risks to public health. By this action, the annual number of reports from muskrat trappers catching American mink as bycatch dropped from over 100 to 3. This makes us believe that in the Netherlands, the American mink was eradicated by accident due to large scale systematic control of invasive species and we believe the Netherlands are the best place to actively start a large population of European mink to bring it back from the brink of extinction.

## INVASIVE AND ALIEN SPECIES

### The first Atlas of Mammals in Italy: an updated overview of native and introduced species

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**Keywords:** Italy, distribution maps

The effective management of invasive alien species requires a thorough understanding of their distribution. National atlases help track population trends and identify invasion hotspots by mapping native and alien species. The first Atlas of Mammals in Italy, due in early 2025 in Italian and English, started in 2022 under the aegis of the Italian Mammal Society (ATIt - Associazione Teriologica Italia). The Atlas is based on over one million records collected over a period of time from 2000 to 2021, either through expert citizen science initiatives promoted and/or funded by ATIt, made available by public institutions, available on international portals (GBIF and iNaturalist), or provided by the authors. The 120 authors, all ATIt members, validated occurrence data as of 2021, provided the species accounts and contributed the ATIt databank with original occurrence data. Species distribution maps were rendered along 9,441 10x10 km grid cells covering the national territory and the marine waters belonging to the Italian Exclusive Economic Zone. Each species account provides the distribution map, conservation status, regulatory context under national, European and international legislation, and information on taxonomy, distribution, habitat and ecology. The Atlas covers 140 terrestrial and marine species belonging to 5 orders and 28 families. Out of 124 terrestrial species, 18 are introduced. Among these, six are of Union Concern according to the EU regulation 1143/2014. The Atlas provides the most up-to-date snapshot of the current knowledge on Italy's mammal fauna, offering valuable insights for managers and conservationists regarding conservation priorities and management needs. For instance, areas where native and alien squirrels overlap highlight potential competition hotspots, while regions where the American mink coexists with the native Italian water vole are critical for the latter's survival. Additionally, the Atlas serves as a key reference for meeting reporting obligations under European Regulation 1143/2014 on IAS.

## INVASIVE AND ALIEN SPECIES

### Adaptations of an invasive alien species to urban areas: the grey squirrel in Italy

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**Keywords:** Morphology, personality, physiology, squirrel, urbanisation

Invasive alien species are one of the major problems for the conservation of biodiversity. Often introduced in urban environments, these species tend to thrive in cities. Here, we investigated how an invasive alien mammal species responds to the challenges posed by urbanisation to inform on the strategies used to persist in these environments. Our study examined personality traits, physiological stress response, body size and mass of Eastern grey squirrels (*Sciurus carolinensis*) in Northern Italy using a pseudo-experimental design along a rural-urban gradient. We measured hind foot length (a proxy for body size) and body mass of individuals and collected fresh faecal samples to determine the concentrations of faecal glucocorticoid metabolites, a non-invasive measure of physiological stress. Activity, exploration and sociability expressions were estimated using Open Field and Mirror Image Stimulation tests. We found that squirrels were heavier and slightly larger in urban than in suburban and rural sites. Physiological stress did not vary with conspecific density nor differed along the rural-urban gradient, suggesting a pre-adaptation of this trait that could aid in coping with urban challenges. Additionally, squirrels were more active in urban than other area types and behaved more socially in urban than suburban sites. Exploration did not significantly differ between populations along the gradient. Overall, we documented shifts in morphology and personality that could allow invasive squirrels to thrive in cities. This study helps to understand which traits can favour the success of invasive alien species in urban environments and helps to shed light on the complex process of invasion.

## INVASIVE AND ALIEN SPECIES

### Searching For Shrews: A citizen science approach to tracking the spread and impact of non-native small mammals

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**Keywords:** Invasive, shrew, citizen science, owl pellets, dispersion analysis

*Searching for Shrews* is a citizen science initiative led by The Mammal Society, aiming to track the spread of the greater white-toothed shrew (*Crocidura russula*, GWTS) and assess its ecological impact on native small mammals in the UK. In its first year, with the help of 94 volunteers / groups, 564 barn owl (*Tyto alba*) pellets were dissected, identifying 3,912 prey items from 112 sites. GWTS were detected at 13 of these sites, with 76 individuals recorded. To evaluate whether GWTS presence and abundance influence small mammal community composition, a Principle Coordinate Analysis (PCoA) based on Bray-Curtis dissimilarities was conducted, followed by PERMANOVA testing. The results indicated that GWTS presence had a marginal effect on community structure (PERMANOVA,  $R^2 = 2.7\%$ ,  $p = 0.057$ ), while GWTS abundance had a significant, though small, effect (PERMANOVA,  $R^2 = 3.3\%$ ,  $p = 0.038$ ). Dispersion analysis revealed that sites with higher GWTS abundance exhibited significantly greater variability in species composition ( $F = 2.8753$ ,  $p = 0.0083$ ), suggesting localised or site-specific impacts. The PCoA further showed a subtle gradient in species composition associated with increasing GWTS abundance. These early findings suggest that the ecological impact of GWTS is primarily driven by its abundance rather than just its presence. The increased variability highlights non-uniform impacts across sites, likely due to localised environmental conditions or competitive interactions, and raises further questions about how these factors mediate the impact of GWTS on native small mammal communities. This study demonstrates the value of citizen science in generating large-scale data needed to understand the ecological implications of non-native species on native biodiversity. Genetic analysis suggests these populations were derived from continental European introductions, but not from Ireland where this non-native species has been present since at least 2007. Further investigation to identify the source and point of origin will continue.

# Landscape and Spatial Ecology

*(F. Cagnacci)*

### Monotonic decline in bat diversity is ubiquitous along elevational gradients

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**Keywords:** Chiroptera, diversity pattern, altitude, global

Bats are distributed latitudinally across the globe, except on the Poles, and altitudinally from the sea level to heights beyond the timberline. Patterns of bat diversity vary along elevational gradients depending on various environmental conditions across mountains. While the completeness of an elevational gradient is important in reflecting the true diversity pattern of organisms, including bats, studies often neglect it. By examining over 50 years of published work that covered 50 mountain gradients across 20 countries from the tropics to the temperate regions, our results showed that the declining diversity pattern is ubiquitous in bats. Our study also showed that 'Habitat Disturbance' (along the transect) and 'Transect Completeness' (i.e., sampling efforts covering the lowlands to the timberline) are important predictors of  $\alpha$ -diversity patterns. Studies that skipped these two predictors generally showed a mid-peak or a low-plateau,  $\alpha$ -diversity pattern (other than a declining pattern). Our study points to the fact that there is only one diversity pattern for bats occurring along complete elevational forest gradients – a declining diversity pattern. This finding is also supported by regional and global datasets.

### Mapping the world's largest land migration: Antelope in South Sudan

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**Keywords:** Migration, white-eared kob, tiang, corridors

The Great Nile Migration, involving over 5 million white-eared kob (*Kobus kob leucotis*) and 400,000 tiang (*Damaliscus lunatus tiang*), spans an area exceeding 100,000 km<sup>2</sup> across South Sudan and Ethiopia's Gambella National Park. This phenomenon represents the largest terrestrial migrations that occur on Earth, surpassing the Serengeti wildebeest migration in scale. Tracking data reveal complex migratory patterns driven by seasonal flooding and human activity, with kob moving between Badingilo and Boma National Parks and tiang traversing the Jonglei plains, Sudd wetlands, and adjacent landscapes. Migration maps, built from tracking data, reveal the spatial dynamics and ecological drivers of these movements, offering a framework to prioritise conservation planning. Human-induced pressures increasingly threaten this migration. Illegal hunting, exacerbated by South Sudan's humanitarian crisis and artisanal gold mining along the Akobo River, has intensified in recent years.

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Infrastructure projects further threaten to fragment migratory pathways and disrupt population dynamics. Activities such as resource extraction, road construction, and agricultural expansion disrupt access to key seasonal ranges, placing the migration at risk of collapse. These maps highlight the importance of raising awareness of migration dynamics to guide sustainable development and conservation strategies. Migration maps provide critical tools to mitigate the impacts of human activity by identifying essential corridors or movement routes and enabling proactive planning. Preserving these movements is not only vital for the survival of keystone species but also for maintaining ecosystem integrity and biodiversity. Collaborative, transboundary conservation initiatives are essential to safeguard these migrations and ensure they continue to function as a cornerstone of the region's ecological and cultural heritage.

### Moving in busy mountains: migration and spatial responses of large mammals in the Alps

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**Keywords:** Movement ecology, plasticity, deer, Alpine ibex, anthropogenic impact, habitat selection

While the niche theory illustrates that animals depend on abiotic constraints and seek for resources in presence of competitors, anthropogenic pressure has heavily shaped the realised niche of Alpine species in the last decades. Large mammals make no exception. By moving along a continuum of tactics and operating selective choices at different spatio-temporal scales, they plastically respond to the multi-dimensional threats imposed by humans in an already limiting environment. Consequences of climate change are intertwined with infrastructural barriers and human activity in driving mammal species seasonal distribution and migration, local movements, use of resources, escape from instantaneous threats. By showcasing examples from chiefly Alpine (Alpine ibex *Ibex ibex*) and generalist (Red deer *Cervus elaphus*, roe deer *Capreolus capreolus*) ungulate species, and the brown bear (*Ursus arctos*), primarily drawn from movement ecology studies, we outline a theoretical framework that upgrades the niche concept disentangling the multi-levelled roles played by humans. While large mammals 'still find their place' in increasingly busy mountains, it is of paramount importance to continue monitoring acute and long-term responses, identifying possible ecological traps and suggesting mitigatory actions.

### Mapping out a future for ungulate migrations

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**Keywords:** Ungulate, conservation, barriers, migration, mapping

The migratory movements of ungulates link ecosystems, economies, and communities around the world, contributing to global biodiversity and sustaining important ecological processes. Yet, migrations are disappearing at an unprecedented rate. Linear infrastructure in the form of fences, roads, and railroads are a common threat in addition to changing habitats brought about by climate change. To address the threats facing the world's remaining ungulate migrations, a team of international biologists founded the Global Initiative on Ungulate Migration (GIUM), which launched in 2020. The GIUM is being implemented under the auspices of the Convention on the Conservation of Migratory Species of Wild Animals (CMS), an environmental treaty of the United Nations. In September 2024, GIUM launched the Atlas of Ungulate Migration, the world's first living compendium of ungulate migration maps. The initial release of the atlas contains a geographic and taxonomic diversity of mapped migrations (n=20) - from the guanaco (*Lama guanicoe*) in the Argentine Patagonia and the wild forest reindeer (*Rangifer tarandus fennicus*) in Finland, to Mongolian gazelle (*Procapra gutturosa*) moving vast distances across the Mongolian steppe. This online, growing database represents the collaborative efforts of over 80 researchers, cartographers and wildlife managers who

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have partnered to make corridor maps derived from tracking data publicly available to conservation planners, development banks, and policymakers. Mapping of the first 20 migratory populations has revealed challenges to the conservation of migration worldwide, such as the ubiquity of linear infrastructure, and the growing need to leverage animal behavioural studies to inform barrier mitigation (i.e., design of road and railway crossing structures). Our work also shows how actionable maps can overcome data constraints. Finally, we discuss the challenges in moving from science to effective policy, and how empirically driven maps can meaningfully inform both large- and small-scale landscape connectivity projects, conservation solutions, and infrastructure development.

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### Eurasian lynx (*Lynx lynx*) site-use probability in winter is higher in the presence of reindeer despite potential risks

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**Keywords:** Carnivore, predator-prey, occupancy model

Large carnivore management in northern Sweden aims to reduce the conflict with reindeer husbandry, an important cultural and economic activity of the indigenous Sámi people. Eurasian lynx (*Lynx lynx*) occurring in the area predominantly prey upon semi-domesticated reindeer (*Rangifer tarandus*) in winter, although they might also select smaller natural prey. As there might be an increased risk involved in hunting for semi-domesticated reindeer in winter, due to high human presence around the reindeer, we hypothesised that lynx avoid spatial overlap with reindeer in favour of natural prey. In this study, we used camera traps to investigate the co-occurrence of lynx, and reindeer in four study areas in northern Sweden and Norway. Cameras were deployed in 364 grid cells of 50 km<sup>2</sup> from November to April during five deployments between 2014 and 2024 to coincide with the annual monitoring season for lynx. We placed one camera per grid cell in different microsites thought to be frequented by lynx based on expert knowledge. The co-occurrence of lynx and reindeer were modelled using a co-occurrence occupancy model, and due to the fact that the same lynx could occur at multiple camera sites, we interpret occupancy probability as site use. Site-use probability for lynx was conditional on the occurrence of reindeer, and higher in the presence of reindeer (0.23, 95% CI: 0.10 to 0.52) compared to when reindeer were absent (0.090, 95% CI: 0.030 to 0.22). Unfortunately, we had too few records of natural prey to include them in the model. However, there was very little spatial overlap between reindeer and natural prey in our observations. This suggests that lynx preferentially use sites where reindeer are present, likely preferring reindeer over natural prey despite the potential risks involved.

### Shrewing around: Notes on sampling, distribution and ecology of the family Soricidae in Greece

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**Keywords:** *Crocidura*, *Neomys*, *Sorex*, *Suncus*, SDM

Shrews are abundant in terrestrial ecosystems, yet they remain one of the most elusive mammal families of Europe. From the smallest mammal to the most speciose mammalian genus to an Endangered insular endemic species surviving since the Pleistocene, Greece hosts unique shrew communities due to its geographical heterogeneity and complex geological history. Yet the information on the distribution of shrew species was sparse until recently. This is mainly due to the difficulty in sampling shrews through trapping, along with the small sampling effort hitherto. We discuss issues regarding sampling and implications on the study of the distribution and ecology of shrews. With the new data collected and presented here, the hitherto available presence data from the literature are increased fourfold, covering the largest part of Greece. We increased the geographical range of some species in Greece and included several new localities representing the major island complexes. These data were derived from *Tyto alba* pellet analysis, as well as pitfall and live traps from the collection of the Natural History Museum of Crete. We produced species distribution models for four common species (*Crocidura gueldenstedtii*, *C. leucodon*, *Neomys milleri*, *Suncus etruscus*) of continental Greece using a combination of algorithms. Additionally, we produced climatic and land cover models to investigate the current, past and future distribution of the Endangered endemic Cretan shrew, *Crocidura zimmermanni*. Research funded by Prasino Tameio.

### Habitat complexity or prey abundance? Decoding the Eurasian Lynx's habitat selection in Finland

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**Keywords:** Ambush predator, Forest, Habitat complexity

Boreal forests cover 75% of Finland. However, intensive management has significantly impacted their ecological integrity, reducing old-growth forest coverage and decaying wood while increasing the prevalence of clear-cut and young forests. These changes pose challenges for mammalian species that prefer forest habitats with more natural characteristics. In this study, we examined how forest quality and prey abundance affect habitat selection by the Eurasian lynx (*Lynx lynx*), an apex predator whose ambush hunting depends on specific forest features, making it a valuable indicator of forest health. Using snow track data collected from 2016 to 2020 across central and southern Finland, we analysed lynx spatial behaviour relative to key forest characteristics and prey abundance through the Hierarchical Modelling of Species Communities framework. Our findings highlight the importance of structurally diverse, mature forests in lynx habitat selection, especially in fragmented areas where prey availability fluctuates. This study is the first to highlight the critical role of forest structural complexity—not merely forest extent—in supporting lynx populations in Finland, emphasising the need for sustainable forestry practices that also consider forest structural complexity.

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### Protection of threatened migrating ungulates - overlap between mapped ungulate migration corridors and protected areas

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**Keywords:** Movement ecology, ecological connectivity, mapping

Anthropogenic disturbance and linear infrastructure are increasing at a dramatic rate at the global level and are key threats for many migratory species. Especially terrestrial and far-ranging animal taxa such as ungulates, are strongly affected by the increasing fragmentation of the remaining permeable landscapes. Several studies have illustrated the negative effects of human activity on complex migratory movements and our first results underline that all migratory populations we have mapped are facing threats, with negative effects of linear infrastructure (20 of 22) and climate change (18 of 22) playing the key role. As a first step to assess the level of protection of ungulate migrations we overlaid the identified migration corridors with local protected areas. We found that the majority of the first 22 mapped migrations largely occur outside of protected areas and found a limited spatial overlap between corridors and protected areas for many migrations. Our results highlight that migratory ungulates are facing a large variety of threats and that globally common key threats as

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climate change and linear infrastructure are of highest concern. The limited overlap between migration corridors and protected areas illustrates that ungulate migrations are only in rare occasions occurring completely inside of protected areas e.g. wildebeest and zebra migration in Serengeti National Park, but most migrations are spatially too extensive to be covered by most protected areas. The high level of threat and low level of protection emphasizes the necessity to think outside of protected areas to conserve ungulate migrations, keeping landscapes permeable and conserve the connectivity of landscapes and especially between protected areas should be considered key goals for conservation of ungulate migration.

### Crossing the line – partial migration in a transboundary red deer population

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**Keywords:** Density distributions, migration determinants, movement, migration drivers

The European red deer (*Cervus elaphus*) is a valued game species and ecosystem engineer. At the same time, it may cause damage to managed forests and agriculture. Therefore, knowledge on the spatio-temporal distribution of red deer is especially important in areas where its populations are shared by multiple administrative units or even occur in transboundary ecosystems. The red deer population in the Bohemian Forest ecosystem forms a contiguous population along the Czech-German border. Ongoing climatic changes and increasing forest disturbances alter their space use. Therefore, local managers on both sides of the border have been seeking information about the status of the population. With the aim to first characterise population size, sex ratio and seasonal changes thereof in a 1081-km<sup>2</sup> study area, we applied traditional methods such as counts at feeding sites and innovative approaches including spatial capture-recapture (SECR) modelling based on faecal DNA-sampling and camera trapping. Next, we assessed the drivers for spatio-temporal changes in red deer distribution and abundance using again SECR modelling and telemetry data. Overall, we estimated 2851 red deer (95% CI = 2609–3119) in the study area during the sampling period, with a relatively even overall sex ratio (1406 females, 95% CI = 1229–1612 and 1445 males, 95% CI = 1288–1626). Density patterns and sex ratios suggested strong gradients between administrative units due to partial migration. Migration rates strongly differed between the national parks (36% Bavarian Forest NP and 43% Sumava NP) and the managed state forest (79%). Camera trap data confirmed density changes throughout the year. Shifts in red deer density and partial migration were mainly explained by effects of forest disturbance. Our results on the relationship of migration and shifts in local population density underline that population-level monitoring will become even more important as both wildlife and global change transcend administrative boundaries

### Harvesting the power of remote-sensing technologies to investigate the spatiotemporal dynamics of insular vertebrates and their interspecific interactions

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**Keywords:** Bioacoustics, camera traps, bats, Macaronesia

Remote-sensing based technologies such as camera traps and acoustic recorders are increasingly used in ecology and conservation. They have an enormous potential to provide critical information on the state of, and pressures on, biological diversity and ecosystem services, at multiple spatial and temporal scales. Using examples from Macaronesia and the Gulf of Guinean oceanic islands we will showcase how low-cost acoustic detectors and camera traps can be used to investigate multiple dimensions of the spatiotemporal dynamics of native and non-native island vertebrates and their interactions. For instance, we will report on how we have used AudioMoth detectors to investigate how bats on Madeira Island are affected by human-induced land-use change and orography. We obtained > 63,000 bat passes across 216 sites and found species-specific and scale-dependent responses to land-use cover. The activity of *Pipistrellus maderensis*, the most common species, was positively associated with landscape-scale shrubland, cropland and Laurisilva (primary forest) cover. In contrast, the activity of the rarer *Nyctalus leisleri* and *Plecotus austriacus* were negatively influenced by Laurisilva and cropland cover, respectively. Furthermore, altitude had a negative effect on the activity of *Nyctalus leisleri verrucosus* and *Plecotus austriacus* but did not seem to influence the activity of *Pipistrellus maderensis*. On a similar survey, but using camera traps instead of acoustic detectors, we found that *Crocidura fungus*, an IUCN Data Deficient shrew endemic to Príncipe Island (Western Central Africa), seems to have an island-wide distribution, inhabiting both primary forest and humanised habitats. Camera trap data revealed that the species is nocturnal mainly and exhibits a considerable spatiotemporal overlap with introduced mammals such as civets, cats and rats. The combination of low-cost acoustic detectors and camera traps offers excellent potential for island-wide vertebrate surveys in small- to medium-sized islands and can provide much-needed data for the evidence-based management of island biodiversity.

### Species body mass and habitat modulate spatio-temporal responses of mammals to human outdoor activity

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**Keywords:** Outdoor recreation, overtourism, coexistence, camera-trapping

Many large mammals have seen an increase in distribution and abundance in Europe, especially in mountainous areas, following land abandonment, decrease in agricultural activities and re-expansion of forests. At the same time, natural areas are increasingly being visited for outdoor recreation, raising new challenges for harmonising wildlife conservation and recreational ecosystem services. In 2020 we systematically sampled with camera-traps four Italian protected areas and assessed the responses of 16 species of mammals to human outdoor activity in terms of site use during diurnal, crepuscular and nocturnal hours. We evaluated responses at community and species levels using Generalised Additive Mixed Models. One of these study areas has been systematically monitored since 2015, allowing the estimation of long-term trends in occupancy and trap rate. We found that responses of mammals to human activity were mediated by species body mass, with smaller species being generally more nocturnal and showing an increase in site use at more disturbed sites. Larger species tended to be more diurnal when exposed to low levels of human activity, and they decreased diurnal and crepuscular site use where recreation was more intense. Habitat also played a role: a higher presence of open areas resulted in decreased diurnal site use at the meta-community level, consistent with the human super-predator hypothesis. In the study area monitored since 2015, we found that even though recreation increased, mammals' occupancy was stable or even on the rise. Our results give grounds for optimism for the long-term conservation of mammals in areas with intense human frequentation, but at the same time, highlight marked behavioural changes of wildlife in response to human activities even within protected areas. Increased nocturnality in the whole community and spatio-temporal avoidance of humans by large-sized species can imply physiological and fitness costs and altered inter-specific interactions, such as predation and herbivory.

### Occurrence and diet of the Eurasian Otter (*Lutra lutra*) in protected areas of NW-W Peloponnese, Greece

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**Keywords:** Spraint analysis, prey composition, wetlands, Mugilidae, Cyprinidae

The management of large predators is closely linked to understanding their dietary habits, as prey abundance often plays a crucial role in determining their extent of occurrence. Data on the distribution and feeding behaviour of the Eurasian otter (*Lutra lutra*) in the Peloponnese, the southernmost limit of its range in Greece, remains limited. Thus, this study aims to assess otter occurrence in the northern Peloponnese and to analyse its diet within the study area. Fieldwork was conducted at 134 sites in protected areas under the jurisdiction of the 'Management Unit of Strofylia Wetlands National Park and Protected Areas of Western Peloponnese' and the 'Management Unit of Chelmos – Vouraikos National Park and Protected Areas of the Northern Peloponnese'. At each site, transects of 600 meters were carried out where possible, and otter presence was confirmed through bio-indicative signs. In particular, otter presence was confirmed at 73 sites, 54 of which were new positive records. In addition, more than 500 spraints were collected and analysed. Prey remains in the spraints were cleaned, identified and categorised to the lowest possible taxonomic level. Prey importance was assessed based on prey item counts and relative frequency of occurrence (RFO). Across all samples, 18 prey types were identified. Fish, particularly from the families Cyprinidae and Mugilidae constituted the primary prey group, followed by frogs (family Ranidae), water snakes (*Natrix sp.*) and birds, depending on local abundance and ease of capture. Despite variations in season and habitat characteristics, fish consistently dominated the otter's diet. These findings enhance our understanding of the otter's feeding ecology and distribution in southern Greece, contributing to developing effective conservation strategies.

### Small terrestrial mammal's diversity across the arid ecosystems of the Atacama Region, northern Chile

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**Keywords:** Atacama, Andes, desert, diversity

The Atacama Region in northern Chile holds several arid ecosystems, including part of the driest place in the world, the "Atacama Desert". These ecosystems contain a unique biodiversity, but we still scarcely know about the diversity of small mammals. In this study, we assessed the diversity of small terrestrial mammals along this region, analysing its geographical and morphological variation from the coastal desert to the high Andean environments. Fieldwork was carried out during the spring of 2024 in four National Parks of the region. Small mammals were captured with Sherman traps baited with oat and vanilla, arranged in transects of 25 traps active during 2-3 nights. Captured specimens were prepared as "voucher specimens" and were deposited in the Faculty of Natural Sciences, Atacama University, as part of a scientific collection. This study is under the permission of the Chilean authorities SAG and CONAF, and the approval of the Scientific Etic Committee (CEC) of the Atacama University. For all trapped specimens, standard body measurements were taken. In the coastal range, we captured *Phyllotis darwin*, an endemic species to Chile, and *Abrothrix olivacea*, which is considered one of the most common rodents in the country. In the Andean range, we captured *P. xanthopygus* and *A. andina*. Species were different in the colour and density of the pelage when both ranges were compared. This study represents the most recent effort to update the list of small mammals' diversity in the Atacama Region based on fieldwork, providing critical information on the conservation of the biota of arid environments. As this study is currently in progress, new data may be provided later.

# Mammals and Climate Change

*(A. Angerbjörn & M. da Luz Mathias)*

## MAMMALS AND CLIMATE CHANGE

The arctic fox under pressure in Arctic areas due to both direct and indirect consequences of climate change

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**Keywords:** Arctic fox, Scandinavia, lemmings, conservation

There is currently a strong climate warming that is especially pronounced in Arctic areas. This has also implications on the ecological life in these Arctic regions with direct and indirect effects. The arctic fox has a circumpolar distribution in all Arctic areas. Since it is evolved in the Arctic environment it is a specialist on survival in these harsh habitats. There are two colour morphs in the arctic fox, white and blue. In the white morph the moult goes from white, as a camouflage against the snow, to brown as a camouflage against the ground in summer. In the blue morph the moult goes from blue or black to brown or black. So the white fur is a perfect camouflage against the snow and the dark fur against a ground with out snow. In the warming landscape the snowmelt is earlier in the spring and the snow fall is coming later in the autumn. This creates a strong mismatch in arctic foxes and a selection against the white morph and we see an increase in the blue morph. With a warmer climate, we also see an increase of red foxes with both predation and competition for dens and food. The main food for arctic foxes is lemming and voles, but these are also affected by climate warming, with severe consequences for the arctic fox. So there are direct effects with changing snow layers and indirect effects of increased mesopredators such as red fox and decreased primary food such as lemmings.

### Keeping Track of Prespa's Bats, Albania

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**Keywords:** Bats, monitoring, roost, Prespa, Albania

With 33 sites visited, this article represents an important contribution to the continuous documentation of bats in the Albanian part of Prespa Lakes. Throughout these surveys conducted in four seasons, from 2023 to 2024, various locations such as caves, tunnels, bunkers, buildings, forested areas and bridges were monitored. This effort led to identifying 13 bat species, some rarely seen in this region. These species include *Hypsugo savii*, *Miniopterus schreibersii*, *Myotis bechsteinii*, *Myotis daubentoni*, *Myotis mystacinus*, *Myotis nattereri/emarginatus*, *Myotis capaccinii*, *Nyctalus leisleri*, *Pipistrellus nathusii*, *Pipistrellus pipistrellus*, *Rhinolophus ferrumequinum*, *Rhinolophus hipposideros*, *Rhinolophus euryale*, and possibly other medium-sized *Rhinolophus* species. The data collected highlight the high diversity of bat species and roosting sites in this part of the country. Notably, significant colonies of *M. schreibersii*, *M. capaccinii*, *Rh. hipposideros*, *Rh. ferrumequinum*, and medium-sized *Rhinolophus* were discovered. A combination of visual observations and mist netting was used. This study identified 17 sites showing current or previous signs of bat presence, with up to 8 different species observed at one site and more than 3,140 bat specimens counted in a single season, shedding light on the most significant roosting sites and hibernacula in the area. Furthermore, the research presents data on the existing threats to bats and their habitats, along with recommendations for future conservation efforts.

## MAMMALS AND CLIMATE CHANGE

### Changes in the range of moose (*Alces alces*) and suitable areas for the species since the Late Pleistocene in Eurasia

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**Keywords:** Climatic oscillations, Holocene, Last Glacial Maximum, summer temperature, ungulates

Climate change is one of the most important factors influencing the distribution of different species on Earth. Large mammals adapted to cold climates are particularly vulnerable to extinction because of climate warming. In our study, we investigated whether temperature increase since the Late Pleistocene and environmental niche contraction during the Holocene were the main factors contributing to the range decline of the European moose (*Alces alces*). We analysed environmental conditions at the sites of 655 subfossil and modern moose occurrences over the last 50,000 years in Eurasia. We found that the most limiting climatic factor for moose distribution since the Late Pleistocene was summer temperature. Almost all moose records were found in areas where the mean summer temperature was below 19°C, with July temperatures showing a more than three times narrower interquartile range than January temperatures. We found significant differences in environmental conditions between the areas inhabited by European and Asian moose. In Europe, the species was found in regions with milder climates, higher primary productivity, and more often in forest biomes than in Asian individuals. During the Holocene climate warming in Europe, the moose's range shifted more in a west-east direction than in a south-north direction. We concluded that although the area of suitable moose habitat has increased since 12-8 ka BP, as shown by environmental niche modelling, the decline of *A. alces* in much of Europe was likely caused by anthropogenic landscape change (e.g. deforestation) and over-hunting by humans during the late Holocene, rather than by climate warming during the Pleistocene-Holocene transition.

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### Body mass changes in mustelids in Europe and North America during the Anthropocene

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**Keywords:** Climate change, body mass, mustelids

Human-induced climatic and environmental changes drive behavioural responses and morphological adaptations that help species cope with shifting conditions. One key trait influenced by these changes is body size, which plays a crucial role in various aspects of animal life and population dynamics, including reproductive success and survival under different biotic and abiotic conditions. In many species, body mass decreases with latitude, suggesting a potential reduction in size due to climate warming. However, mustelids do not follow this pattern, as their body mass appears to change in the

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opposite direction and is shaped by a complex interplay of factors. To investigate this phenomenon, we conducted a comprehensive analysis of body mass changes in six mustelid species—the pine marten (*Martes martes*), stone marten (*M. foina*), American marten (*M. americana*), polecat (*Mustela putorius*), stoat (*M. erminea*), and weasel (*M. nivalis*)—across two continents over the past century. Our results show that trends in body mass vary between species, with increases varying in magnitude depending on latitude and rate of climate change. This highlights the need to consider species-specific responses when studying animal adaptation to changing climatic and environmental conditions.

# New Methodologies in Mammal Research

*(F. Iannarilli)*

Ballad of the Shrews: Vocals of the Cretan endemic *Crocidura zimmermanni* and its partially sympatric congeneric *C. gueldenstaedtii*

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**Keywords:** Bioacoustic, Soricidae, acoustic signals

*Crocidura zimmermanni* is an insectivore mammal of the family Soricidae and the sole endemic mammal of Greece, exclusively found in the uplands of Crete. It is listed as endangered (EN-IUCN), mainly due to climate change and the human-aided introduction of *C. gueldenstaedtii* in historical times. The challenging capturing, high mortality rates during sampling with live traps, along with the fact that shrews are cryptic species, highlight the need for developing alternative sampling techniques in order to study and monitor the species. Bioacoustic practices are non-invasive, eliminate the need for live trapping and may offer ease of species identification. The aim of this study lies in exploring the vocals of the Cretan shrew and compare to Gldenstdt's shrew vocals in order to differentiate the species based on acoustic signals. Recordings from captured individuals, identified through morphology and molecular analysis, were made using Audiomoth devices and analysed with Kaleidoscope software. For the first time, acoustic signals of *C. zimmermanni* were recorded, along with records from its partially sympatric competitor *C. gueldenstaedtii*. Distinctive calls between the two species and different types of vocals were identified, spanning in audible and ultrasonic spectrum, alongside description of the physical parameters of their ballads. These findings will enable further tests for the use of bioacoustics as an alternative technique to facilitate non-invasive monitoring and support conservation efforts for this endangered and unique mammal.

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### Decoding rodent diets: multi-marker metabarcoding on three syntopic species in a Mediterranean oak forest

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**Keywords:** Wood mouse, bank vole, NGS

The diet of wildlife species can have profound effects not only at individual and population levels but also on the ecosystem structure and function. Rodents, in particular, serve as key prey for higher trophic levels and are significant seed dispersers and consumers, playing thus a crucial role in shaping habitats such as oak forests. In this study, we examined the diet of a guild of forest- and ground-dwelling rodent species (*Apodemus flavicollis*, *Apodemus sylvaticus*, and *Clethrionomys glareolus*) in a Mediterranean deciduous oak forest of central Italy. Through a three-year intensive live-trapping survey, we caught 326 individuals and collected 412 faecal samples over the three species. By applying a multi-marker metabarcoding approach (three plant markers, one fungal marker, and one arthropod marker) we explored the dietary diversity, breadth, composition and overlap among these rodents. Our findings revealed that the dietary taxonomic richness and diversity were similar among all three rodent species, with *C. glareolus* having the narrowest food niche breadth. Plants constituted the main dietary component for all rodents, with a predominant presence of Fagaceae (especially *Quercus spp.*) in *Apodemus* mice and of Rosaceae (such as *Rubus spp.*) in *C. glareolus*. Epigeal and hypogean fungi accounted for approximately a quarter of the diet of rodents, while arthropods such as lepidopteran and dipteran insects constituted the least frequent diet fraction. A significant dietary overlap was observed among rodents, especially within *Apodemus* genus for tree species and, secondly, between *A. sylvaticus* and *C. glareolus* for herbaceous and semi-shrub species. Nevertheless, the diet of each species exhibited peculiar features, suggesting a partial niche partitioning. Our findings provide a novel insight into the mechanisms underpinning the coexistence of ecologically similar rodent species in a shared habitat and underscore the utility of molecular approaches in unravelling ecological interactions in complex ecosystems.

## NEW METHODOLOGIES IN MAMMAL RESEARCH

### Species-specific soil eDNA survey of the lesser blind mole rat – a game changer for biodiversity monitoring of terrestrial mammals

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**Keywords:** Cryptic, ddPCR, environmental, *Nannospalax*, non-invasive

Conserving the biodiversity of endangered mammal species with specific lifestyles often requires unconventional monitoring techniques, preferably with non-invasive sampling whenever possible. Environmental DNA (eDNA) has the potential to be a faster, non-invasive and highly effective tool for biodiversity monitoring. The European lesser blind mole rat (BMR) *Nannospalax leucodon* supersp. is characterised by a particular underground lifestyle. It comprises more than 20 chromosomal forms, seven declared cryptic species. Two of the five cryptic species distributed in Serbia with reduced and fragmented habitats are threatened with extinction, mainly due to anthropological impacts. Since capturing these strictly protected mammals is particularly challenging and sampling is not possible without stressing the animals, there is an urgent need for new, non-invasive methods that allow rapid data collection across wide geographical regions. Here, we present a new monitoring method that enables the detection of each of the five cryptic species of BMR from soil eDNA using droplet digital polymerase chain reaction (ddPCR) – an advanced technology with high sensitivity and precision in detecting low-abundance DNA targets. To our knowledge, this is the first study with species-specific *in situ* detection of mammal species from soil eDNA using ddPCR. Soil samples were collected from the walls of active tunnels where BMRs leave biological traces (saliva, epidermal cells, urine, faeces, etc.) while digging with their lower incisors. For eDNA extraction, we used the Qiagen PowerSoil kit. Species-specific primers and probes were designed based on our mitochondrial *cytb* gene library. Optimised primer/probe assays for five cryptic species yielded approximately 90% positive results for all soil samples analysed, which is considered a high performance for eDNA analysis. This non-invasive approach, which can also be applied to other terrestrial species of interest, enables quick and easy sampling of many locations across broad areas, providing essential data for conservation management.

## NEW METHODOLOGIES IN MAMMAL RESEARCH

### Bats surf storm fronts during spring migration

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**Keywords:** *Nyctalus noctula*, IoT, wind support

Long-distance migration, common in passerine birds, is rare and poorly studied in bats. Piloting a 1.2-gram IoT (Internet of Things) tag with onboard processing, we tracked the daily location, temperature, and activity of female common noctules (*Nyctalus noctula*) during spring migration across central Europe up to 1116 kilometres. Over 3 years, 71 bats migrated tens to hundreds of kilometres per night, predominantly with incoming warm fronts, which provided them with wind support. Bats also showed unexpected flexibility in their ability to migrate across a wide range of conditions if needed. However, females leaving toward the end of the season showed higher total activity per distance travelled, a possible cost for their flexible migration timing.

### Zooming on urban predators: Domestic cats and their interactions with mammal and bird communities in urban areas

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**Keywords:** Urban wildlife, species interactions

Pressures from human activities often force wild species to modify their behaviour to adapt and survive under novel conditions. Among these pressures, those exerted by species closely associated with humans, such as domestic animals, play a special role. In particular, domestic cats (*Felis catus*) have been described as a major anthropogenic cause of species loss for small reptiles, birds, and mammals in insular and continental ecosystems. Despite this strong impact, little is known about the behavioural responses of potential prey to the presence of domestic cats and studies of the fine-scale behaviour of this predator are still rare. Here, we combined state-of-the-art high-resolution GPS tracking of domestic cats with camera trapping in urban areas to provide a new and close-up perspective on the impacts of cats on urban and suburban mammal and bird populations. High-resolution data on the movement and behaviour of free-ranging domestic cats provided information on their patterns of space use. Camera trap data allowed us to assess the density of the entire population of free-roaming cats using a given area – beyond the individuals tracked – and their spatio-temporal overlap with potential prey in mammal and bird communities in urban areas. This framework combines information on when each cat was detected (from the camera trap data) with a measure of how far the cats moved (from the telemetry data). Together, the information from the telemetry and camera trap study quantifies the cumulative impact of domestic cats on urban and suburban wildlife and informs future land use policies near urban areas and areas of conservation importance for mammals and birds.

### Estimating densities of unmarked prey and predator species with camera traps and Random Encounter Models

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**Keywords:** REM, deer, wolf, genetics, Mt. Parnitha

Camera traps have been widely used recently to estimate population densities of wild terrestrial mammals without individual identification (unmarked), most often using Random encounter models (REM) to analyse the data. While the key REM assumption of random camera trap placement can be met for abundant species such as ungulates, it cannot be easily met for carnivores due to their low detection probability that calls for non-random camera placement (e.g. at trails, roads). We estimated red deer (*Cervus elaphus*) and wolf (*Canis lupus*) densities in Parnitha National Park, Greece, using REM models. For red deer density estimates, 25 camera traps were deployed randomly within a 2.5 x 2.5 km grid from November 2022 - January 2023. For wolf density estimates, 35 camera traps were deployed along forest roads and paths to increase detection probability from July to September 2022, with an average distance among cameras of 2.15 km. To adjust REM wolf density estimates for the non-random placement of the cameras, we used a correction factor calculated from available wolf GPS telemetry data. We compared the REM wolf density to the density from individual identification of wolves from genetic analysis of 124 fresh fecal samples collected concurrently – the “golden standard” for carnivore density estimates. Using 20 microsatellite loci, 35 unique wolf genotypes were identified in 46 fecal samples with good quality DNA. Using the CAPWIRE software and capture-recapture analysis, the wolf population was calculated to be 69 individuals (50-90, 95% CI). Red deer density was estimated to be 2.28 ( $\pm$  0.77 SE) individuals/km<sup>2</sup> and the total population size to 356 individuals for the surveyed area.

### Uncovering temporal patterns of wildlife activity, habitat use and habitat preference from camera-trap data

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**Keywords:** Activity pattern, activity level, migration, recreation, Hoge Veluwe National Park

(1) Habitat use and habitat preference are commonly measured by tracking individuals in space and time using biologging. In principle, camera trap data also contains information about habitat use and preference, however, because motion-triggered cameras capture only active animals, the raw rates of capture in different habitats give us an indication of habitat use by active animals only, missing patterns of use and preference by inactive individuals. Furthermore, capture rates are readily confounded by imbalanced survey effort (either by design or by accident), and by habitat-related variation in other determinants of trap rate (animal speed and camera sensitivity). (2) Here, we show how camera traps can be used to infer whole-population activity patterns, habitat use and habitat preference from camera-trap surveys, especially when stratified by habitat. The method uses the principles of the random encounter model to extract underlying patterns of population activity and distribution across habitats by controlling for confounding variables. (3) Using simulation, we show how this method allows partitioning activity by habitat class even when sampling was stratified, infer the distribution of activity and habitat use, and calculate preference. The method is minimally biased when the underlying assumption of a single underlying activity pattern is met but can otherwise be moderately biased. It also understandably fails to provide reliable information for parts of the day when there is little or no activity, working best for populations that are at least partly active throughout the day. (4) We demonstrate the use of the method by applying it to eight years of springtime data on eight mammal populations from a habitat-stratified camera-trap monitoring in Hoge Veluwe National Park, the Netherlands. The method recovered credible daily activity patterns in all species, and credible habitat use and preference across the day in all but one strictly nocturnal species, and credible habitat-specific activity levels. The method uncovers hidden diurnal migration patterns between habitats, including preference for resource-rich habitat, risk avoidance during public opening hours, and spatio-temporal segregation in some species. (5) The new method allows analysis of habitat relationships for entire communities of larger mammals without the need for trapping and tagging.

### New red deer STR markers for population monitoring: application in the Romanian Carpathians using faecal pellets

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**Keywords:** Red deer, microsatellites, high-throughput sequencing

Genetic tools have become indispensable for providing ecological data for research and management of wildlife. However, practical applications have been limited by drawbacks associated to the traditional method used for genotyping, typically based on fragment analysis of microsatellites (short tandem repeats - STR). Subjective allele calling, difficulties in data sharing between laboratories, and labour intensive and expensive analyses have hampered the use of STR in large, managed populations of large herbivores. This is particularly true for red deer (*Cervus elaphus*), a species of considerable management interest, for which population-level studies using noninvasive genetic sampling are still rare. One main reason for this is that noninvasive analysis often involves thousands of samples. Here, we aimed to overcome these limitations by developing a new STR marker system for genotyping-by-sequencing, which also shows improved scorability of alleles and genotyping accuracy. Using a bioinformatic pipeline and existing red deer genomes, we designed over 100 STR and five sex-ID markers. STR amplicons were sequenced on an Illumina platform, analysed using a bioinformatic pipeline and screened based on amplification performance and polymorphism. The final marker set consisted of a single multiplex of 15 STR and 2 sex-ID loci optimised for amplicon sequencing. We tested the approach on 63 red deer faecal samples collected in 2023 in the Romanian Carpathians and achieved 88% genotyping success rate for individual identification. We then scaled-up and automated the protocol in the laboratory for application in a large-scale genotyping study (506 samples collected in 2024, analysis in process). Our protocol offers a novel tool for cost-effective large-scale genetic monitoring of red deer that will enable efficient collection of key ecological data, including estimates of demographic and genetic parameters. The approach can be easily adapted to other large herbivore species to contribute to more effective monitoring and management of their populations.

### Can flies help us map bears? Expanding the ecological application of iDNA for monitoring terrestrial mammals

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**Keywords:** eDNA, invertebrate-derived DNA, brown bear, occupancy modelling

A resurgence in brown bear (*Ursus arctos*) populations in Greece has resulted in the recolonisation of areas previously unoccupied for decades. Large carnivore recolonisation often threatens hard-established human-wildlife coexistence efforts, thus, the necessity for monitoring and predicting bear presence and movements is increasingly important. Here we describe the use of an innovative non-invasive genetic monitoring technique, invertebrate-derived DNA (iDNA), for surveying this species in the field. Using an optimised qPCR protocol, iDNA methods were used to assess the presence of bears in central northern Greece and compared to the results of standard scat surveys. Species distribution was subsequently predicted from each dataset using occupancy modelling. We found excellent agreement between the SDMs produced independently from the iDNA and scat data. Our results demonstrate that iDNA can serve as an effective monitoring tool for species presence, facilitating its use in occupancy modelling. This approach represents a valuable and complementary tool for assessing brown bear distribution and has the potential to support monitoring efforts for other bear species.

## NEW METHODOLOGIES IN MAMMAL RESEARCH

### Multi-disciplinary approach to understanding emerging ecological interactions in an Alpine mammal community

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**Keywords:** Multi-methodological, quasi-experimental, interspecific relationships, ungulates

Human-induced environmental changes are placing unprecedented pressures on ecosystems worldwide, driving biodiversity losses that threaten ecosystem functioning and resilience. Among the most critical yet understudied consequences of these losses is the disruption or rapid modification of ecological interactions between species. However, investigating such interactions requires disentangling multiple co-occurring and interrelated factors within complex pathways that can often not be addressed with single approaches. Here, we present a case study focusing on emerging ecological interactions within a large mammal community in the Alps, spurred by decades of anthropogenic influences, including increased human disturbance, climate and land-use changes, and the ongoing natural recolonisation by wolves. To address these complexities, we designed a comprehensive, systematic field study with a quasi-experimental approach, integrating diverse state-of-the-art methodologies along a temporal gradient since wolf recolonisation, including animal movement and space use (bio-logging), activity patterns (camera-trapping), diet composition (genetic metabarcoding), gut microbiota profiles (genomic metataxonomics), ecosystem element tracking (stable isotope analysis), and vegetational surveys (field sampling). Through this multi-disciplinary framework, we unravel complementary aspects of horizontal and vertical interactions between large mammals, at various scales: spatiotemporal activity overlaps, behavioural avoidance, antipredator responses, resource partitioning, differential nutrient pathways, digestive capacities, and even potential cascading effects on other trophic levels. This integrated approach offers valuable insights into the mechanisms driving ecological relationships between mammals and their responses to ongoing environmental change and anthropogenic disturbance, with implications for biodiversity conservation and ecosystem management.

# New Trends in Mammal Taxonomy

*(B. Kryštufek)*

## NEW TRENDS IN MAMMAL TAXONOMY

### The evolutionary history of the field vole species complex revealed by modern and ancient genomes

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**Keywords:** gene flow, speciation, interglacials, paleogenomes

The field vole, an abundant and widespread microtine rodent, is a complex comprising three cryptic species. The short-tailed field vole (*Microtus agrestis*) is present over much of Eurasia, the Mediterranean field vole (*Microtus lavernedii*) in southern Europe, and the Portuguese field vole

## NEW TRENDS IN MAMMAL TAXONOMY

*Microtus rozianus* is limited to western Spain and Portugal. Previous research has shown high genomic differentiation of these three lineages; however, the details of the process underlying their divergence remain unknown. We analysed 46 mitogenomes and 16 nuclear genomes of modern specimens and 75 mitogenomes and 12 nuclear genomes of ancient specimens spanning the last 75 thousand years to investigate the evolutionary history of this species complex. We estimated the divergence of Portuguese from short-tailed and Mediterranean field voles to be ca. 220 ka ago and of the latter to be ca. 110 ka ago, earlier than previous estimates involving only modern sequences. The divergence times we obtained match those between major mitochondrial lineages of cold-adapted and steppe rodents in Europe. We found signatures of gene flow within and between field vole lineages, with some analyses suggesting a hybrid origin of the Mediterranean lineage. Ancient specimens from the Italian Peninsula revealed a previously unrecognised lineage that showed evidence of genetic exchange with other populations. The pattern of genetic variation in the field vole species complex demonstrates the impact of stadial-interstadial cycles in generating recurrent episodes of allopatry and connectivity of populations, a situation which could only be revealed by our dense genomic sampling over time.

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## NEW TRENDS IN MAMMAL TAXONOMY

### DNA barcoding of African rodents: advantages and pitfalls in taxonomy

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**Keywords:** Africa, Rodentia, species delimitation, MOTU

DNA barcoding, i.e. sequencing of a short (mitochondrial) DNA fragment and its comparison with sequences from taxonomically correctly identified species, is a very useful approach for biodiversity description, including discoveries of new taxa. This can be true even in well-known animal groups like mammals, where some groups (e.g. rodents) and geographical areas (e.g. sub-Saharan Africa) are still relatively poorly studied. However, DNA barcoding usually relies on a single genetic marker with non-Mendelian inheritance, so its ability to delimit species is limited. Here, we present the largest available dataset of DNA barcodes of African rodents, composed of tens of thousands of mitochondrial cytochrome b sequences. We show its practical advantages for the description of biodiversity in poorly explored regions with low levels of research infrastructure, which is the case in many African countries. By comparison with genomic and morphological data in selected clades, we assess how correctly the DNA barcodes reflect species delimited by an integrative taxonomic approach, i.e. how biased estimates of species richness they can provide.

## NEW TRENDS IN MAMMAL TAXONOMY

### Population genomics of *Talpa europaea* reveals distinct lineages and adaptive divergence in a widespread subterranean mammal

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**Keywords:** Evolution, genome, secondary contact, selection

The European mole (*Talpa europaea*), with its wide distribution and peculiar subterranean lifestyle, provides a unique opportunity to explore the interaction between population structure, historical demography, lineage diversification, and local adaptation in mammals inhabiting extreme environments. Using a genome-wide SNP dataset, we examined the population genomic architecture of *T. europaea*. Our analysis identified two main lineages consistent with previous studies based on mtDNA: European and Italian. Notably, South Tyrol, northern Italy's population emerged as an admixed group, likely representing a past secondary contact zone between these lineages. Historical demographic reconstructions highlighted the significant role of the last glaciation in shaping patterns of genetic diversity and lineage divergence. The European lineage underwent a post-glacial expansion, indicating a recolonisation process following the glacial retreat. The Italian lineage showed signatures of rapid population growth that preceded what was observed for the European lineage, occurring before the onset of the LGM. Interestingly, despite evidence of demographic expansion and historical secondary contact in South Tyrol, no gene flow was re-established between the two lineages. This could suggest ongoing differentiation between the European and Italian lineages. Selection analyses identified lineage-specific fixed alleles under positive selection, highlighting local adaptation to distinct ecological conditions within the species' range. These adaptations likely reflect the challenges posed by subterranean life and varying environmental pressures across Europe and Italy. This study underscores the role of glaciation in shaping the distribution and evolutionary history of *T. europaea*, demonstrating how past climatic fluctuations drove lineage divergence, secondary contact, and local adaptation. Our findings provide valuable insights into subterranean mammals' evolutionary processes, enhancing our understanding of environmental factors that trigger lineage diversification and speciation.

### Taxonomic uncertainty in the vole world

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**Keywords:** Rodents, *Microtus*, phylogeny, speciation, genomics

Integrative taxonomy promotes the use of all available datatypes for making taxonomic decisions. While this often leads to more stable assignment of units, it is not free of difficulty for traditionally difficult decisions on rapidly evolving systems. I will illustrate the practical consequences of this rather trivial insight with concrete examples from our work on one of the most speciose group of mammals, voles in the genus *Microtus*. Based on paleontological inferences, *Microtus* voles have undergone extensive diversification into around 65 species within less than two million years. However, little morphological variation and taxonomic trends have led to the waxing and waning of taxa throughout the last century, and consolidation of results from different data sources is still ongoing. Full-genome data provide strong support for deeper splits in the diversification history of *Microtus*. Genomic scans showed that apart from genes involved in immunity and metabolism functions, olfaction-related genes (mostly olfactory receptors and vomeronasal receptors) are particularly fast evolving in the genus. Remarkably, Olfr 1019 (“fear response”) exhibited a general signature across the analysed *Microtus* species. However, these signals of particularly fast evolution extend also into the most recently diverged taxa. For example, genomically defined evolutionary lineages within *Microtus arvalis* showed very similar patterns of fast divergence. Our detailed analyses of hybrid zones between these intraspecific lineages support partial reproductive isolation despite lack of morphological distinction. Taken together, this points to the importance of incorporating olfaction at the signal and receptor level in functional analyses of the divergence of taxonomically “difficult” rodent taxa. Overall, critical (re-)consideration of all available evidence is likely to continue to challenge and improve our understanding particularly for groups like *Microtus* and other rapidly evolving mammals.

## NEW TRENDS IN MAMMAL TAXONOMY

### Are five cryptic species of the lesser blind mole rat *Nannospalax leucodon* morphologically uniform or not?

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**Keywords:** Cranium, geometric morphometrics, shape, size

Cryptic species are defined as morphologically uniform but phylogenetically distinct species. The superspecies of the European lesser blind mole rat *Nannospalax leucodon* (Spalacidae, Rodentia) is characterised by a pronounced karyotypic variability, representing a complex of more than 20 chromosomal forms. For seven reproductively isolated and genetically distinct, a classification as cryptic species has been proposed, although the literature on their morphological similarities/differences is not particularly extensive. We investigated variation in the ventral and dorsal cranial views of five cryptic *N. leucodon* subspecies (*N. l. hungaricus*, *N. l. serbicus*, *N. l. montanoserbicus*, *N. l. syrmiensis*, *N. l. makedonicus*) by applying two-dimensional geometric morphometric methods and found statistically significant size and shape differences in both cranial views. However, as there is also significant sexual size and shape dimorphism, interspecific comparisons were performed separately for each sex. Statistically significant size differences were observed between the males of the different cryptic species in both cranial views but not between the females. Statistically significant shape differences were found among the cryptic species in both sexes and in both cranial views. However, after the pairwise post-hoc tests, only the dorsal cranium remained informative in terms of shape variation between the cryptic species. In males, only two pairwise comparisons (*N. l. montanoserbicus-hungaricus*, *N. l. montanoserbicus-syrmiensis*) were statistically significant, whereas in females all but three pairwise comparisons (*N. l. serbicus-hungaricus*, *N. l. serbicus-makedonicus*, *N. l. serbicus-syrmiensis*) were statistically significant. We found that most of the cryptic *N. leucodon* subspecies examined here are not morphologically indistinguishable. Moreover, the phenetic relationships among them, inferred from variation in dorsal cranial shape, are largely consistent with their phylogenetic relationships. This also suggests that different parts of the skull exhibit different degrees of morphological variability and lability, i.e. the tendency of morphological structure to evolve.

### Phylogenomic relationships of Afrotropical crocidurine shrews: An overview of diversity and distribution

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**Keywords:** Afrotropical, Crocidurinae, phylogenetics, UCE, diversity

The distribution of biodiversity across Africa is shaped by dynamic processes, including climatic oscillations, migration barriers, and habitat shifts, which have driven genetic divergence and taxonomic complexity. Among small mammals, Afrotropical crocidurine shrews stand out as one of the most diverse and taxonomically intricate groups, comprising six genera and 136 described species. Among these, the genus *Crocidura* is the most speciose, with 109 species documented in sub-Saharan Africa. Despite advancements in molecular studies, many phylogenetic relationships within this genus remain unresolved. Here, we present an updated phylogeny of Afrotropical crocidurine shrews, using over 4000 mitochondrial cytochrome b (cytb) sequences to delineate evolutionary clades. Representatives from these clades were subsequently analysed using Ultra-conserved Elements (UCE) sequencing, enabling a comprehensive exploration of genomic diversity. Our UCE-based phylogeny achieved robust resolution across major clades and provided high branch support within the most complex species groups. Remarkably, our findings revealed paraphyly and unexpected phylogenetic relationships among *Suncus* and *Sylvisorex* species, highlighting the need for taxonomic revision. Within *Crocidura*, UCE data showed high overall congruence with cytb-based subclade delimitation while delivering improved resolution for problematic nodes. By combining a well-supported UCE phylogeny with numerous georeferenced cytb-barcoded specimens spanning sub-Saharan Africa, we provide novel insights into the diversity, biogeography, and evolutionary history of crocidurine shrews. These findings highlight the need for integrative taxonomic approaches to resolve the evolutionary relationships of these common yet understudied mammals. The clarified taxonomy and distributional framework will serve as a foundation for future biogeographic, ecological, and conservation-focused studies of Afrotropical biodiversity.

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## NEW TRENDS IN MAMMAL TAXONOMY

### Mammalian species delimitation in historical perspective

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Species refer to discontinuity of the organic variation and are believed to be one of the fundamental units of biological organisation. The process by which species are determined is a task of taxonomy and goes back to the earliest days of biological science. As the taxonomic delimitation between species is based on science, it is expected to be objective. On the other hand, the number of species is final within a given time window, which gives good hope to an expectation that this total can be estimated from the asymptotic accumulation curve of accepted mammalian species over time. This however is not necessarily the case. I will address changes in the number of taxonomically recognised species of European mammals over the last hundred years. This number was high at the start of the century and dropped sharply around 1950 during the period denounced as “taxonomic inertia”. I will show that this step was unavoidable given the tools available to taxonomists of that time. Besides, the inertia had positive effect on further taxonomic progress which brought our understanding of mammalian taxonomic diversity to the present level. The rate of taxonomic progress was therefore not steady but oscillated as a result of factors which I will address.

## NEW TRENDS IN MAMMAL TAXONOMY

### Taxonomy and introgression: a case of *Mus*

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**Keywords:** Introgression, mouse, reproductive isolation

Until recently, zoologists considered hybridisation an unnatural or aberrant breakdown of reproductive barriers, often caused by species range changes and/or habitat disturbance, mostly as a result of human habitat alteration. This view was particularly fueled by the influence of Ernst Mayr and his biological species concept based on reproductive isolation between distinct species. Recent estimates show that hybridisation occurs in at least 10% of animal species. However, with the accumulation of molecular data, it is becoming evident that the exchange of genetic material is widespread. Here, we use a newly developed polarisation software to show that introgression is frequent even between “good” mouse species, the house mouse and the Algerian mouse, which diverged ca. 2 Mya. Then we show that the European house mouse hybrid zone harbours the same processes, only the species barrier strength is lower. Using the two species as examples, we conclude that species barriers are rarely infinite.

## NEW TRENDS IN MAMMAL TAXONOMY

### Penial morphology of moles (genus *Talpa*, Eulipotyphla) – a useful tool for species delimitation

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**Keywords:** Moles, Talpidae, penial morphology

Moles (genus *Talpa*) are strictly subterranean insectivores, distributed in the Western Palearctic, mostly allopatrically or parapatrically. Most species are endemic and restricted to small areas (for instance peninsulas in southern Europe). In the last 20 years, mole species (genus *Talpa*) diversity has increased astonishingly, with a 78% rise to 16 species. This is primarily due to the development and extensive use of DNA methods. However, progress in species delimitation within *Talpa* has been limited. The uniformity of their external morphology, resulting from strong selective pressure in their fossorial lifestyle, makes their identification difficult. Here we studied penial morphology (external and os penis) from 42 vouchers of 9 mole species - all European moles - *T. europaea* (France, Italy, Bosnia and Herzegovina, Montenegro, North Macedonia, Bulgaria), *T. aquitania* (Spain and France), *T. occidentalis* (Spain), *T. romana* (Italy), *T. caeca* (Italy and Montenegro), *T. stankovici* (Montenegro, North Macedonia), *T. martinorum* (Bulgaria), and two from Asia – *T. levantis dogramacii* and *T. davidiana davidiana* (Anatolia, Turkey). The shape of the penis and baculum (os penis) of moles exhibited species-specific characteristics and can be a useful tool for species delimitation. The penial morphology of a specimen of the Balkan mole from Ulcinj (Montenegro), previously described as *T. s. montenegrina*, showed greater similarity to *T. caeca* than to *T. s. stankovici* from the type locality of the Pelister Mountain (North Macedonia). *T. europaea* from northern Italy differs from all other *T. europaea* specimens we studied (from France to the Balkans). This difference has been previously observed in skull morphology and DNA, suggesting it might represent another cryptic species within the *T. europaea* group, within which a few new species have been described recently.

### Evolution of habitat niches in Palearctic Arvicolinae rodents

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**Keywords:** Arvicolinae, rodents, phylogenetic niche conservatism

Grinnelian niche is defined as a set of environmental variables related to the species' coarse-scale ecological and geographic properties. Thus, parameters of ecological niches can be considered as eco-physiological properties of a species that can be used for species delineation in a similar way as the morphological features. Two components can characterise the niche, the position of the centroid and the variability around this centroid (niche breadth) and can be decomposed into components analogous to the  $\alpha$ ,  $\beta$ , and  $\gamma$  components of species diversity. We analysed the evolution of habitat niches of 45 Palearctic Arvicolinae rodents. Environmental data for niche position and width estimation included climate, relief, and vegetation variables. Niche position and breadth were estimated in the space of the first two principal components of environmental variables (explaining 70.6% of variance) using kernel smoothing of densities of species occurrence points and correction for uneven habitat resource distributions. We found a strong phylogenetic signal for the breadth and direction of habitat specialisation of the  $\gamma$ -niche. The shape of the phylogenetic correlogram supports the hypothesis of phylogenetic niche conservatism, which predicts that niches differ little at or around the time of speciation events, whereas niche differences accumulate later. For  $\beta$ -niche, we found a moderate phylogenetic signal for the shift in habitat niche position. For  $\alpha$ -niche, we found only a weak phylogenetic signal for the direction of habitat specialisation. The absence of phylogenetic signal for  $\alpha$ - and  $\beta$ -niche breadth can result from species' reaction to local variation expressed in the negative correlation of local niche breadth with the distance from the centre of geographic range (in 22 of 45 studied species) and in a positive correlation of local niche breadth with altitude (in 21 of 45 species).

### Genome-wide phylogeny of subterranean blind mole rats Spalacinae (Gray 1821)

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**Keywords:** *Spalax*, RAD, mtDNA, Anatolia, SNP

The large- and small-bodied subterranean blind mole rats (BMRs) of the subfamily Spalacinae are known for their remarkable geographic chromosomal diversity and cryptic speciation, but the phylogenetic history of the group remains obscure. We used partial mtDNA and genome-wide SNP markers obtained by ddRAD-seq to reconstruct a robust phylogeny that extends over the entire BMR geographic range, including multiple populations for which the molecular data were obtained for the first time. A conservative species delimitation approach was applied hierarchically, starting at the level of subfamily and then at each Molecular Taxonomic Unit (MOTU) revealed henceforth. This confirmed the monophyly of the genus *Spalax*, the ‘species complexes’ *Nanospalax ehrenbergi* and *N. leucodon*, but not the *N. xanthodon* complex, which included two ancient Anatolian lineages, one of them (*N. cilicicus* Méhelÿ 1909) predating the divergence of the European *N. leucodon*. The inference of biogeographic history and dating based on the molecular clock pointed to Southern Anatolia and the Northern Levant as the most likely areas of the earliest divergence within the small-bodied BMR at the beginning of Pleistocene. The *Spalax-Nanospalax* split occurred in mid-late Pliocene. The two main emerging phylogeographic patterns in BMR were (1) high degree of relictualism of most lineages, which currently possess small fragmented ranges and high levels of genetic polymorphism and (2) more recent expansion of a fewer lineages that have large continuous ranges but show low levels of genetic variation.

## NEW TRENDS IN MAMMAL TAXONOMY

Mammals and the species problem – grey areas in taxonomy and why they are here to stay

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**Keywords:** Grey area, speciation, grouping, ranking

Mammalian taxonomy has been hotly debated for a long time. Over the last 20 or so years, the number of (more or less) officially accepted mammal species has increased from around 5,400 to more than 6,700, with the large majority of these „new“ species due to splitting of already known species. This is a general phenomenon across mammalian groups, although some of the particularly iconic cases like those of African elephants, orangutans or, most recently, giraffes have been disproportionately covered in the literature. Why is there so much disagreement when it comes to the species level when arguably taxonomy is a hypothesis-driven scientific discipline? In my presentation, I will address the fundamental nature of taxonomy, which comprises both the description and quantification of biodiversity and its translation into taxonomic categories like species or subspecies. While the first part, which is used for grouping, is as scientific as it gets, the second part, ranking, necessarily includes executive decisions. In the grey area of speciation, there is no simple right or wrong when it comes to the question of one or two species, which makes many of these discussions futile and means that taxonomic disorder is here to stay. I will also briefly address the consequences of this insight for studies in comparative biology and conservation.

# Paleontology

*(G. Iliopoulos)*

### Biogeographic history of the European small hamsters (subfamily Cricetinae) during the Late Pleistocene

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**Keywords:** Steppe, Late Pleistocene, expansion, cricetids, Europe

The commonly accepted paleobiogeographic hypothesis assumes that during the Pleistocene steppe and tundra steppe, taxa now occurring in Central Asia may have expanded to Europe during glacials when open environments were present. However, we showed that European narrow-headed voles (*Stenocranius anglicus*) diverged from their Asiatic counterparts at least 200 thousand years ago. Thus, they must have survived at least one interglacial period in refugia somewhere in Europe. To check whether this was just an exception to the rule or a more common phenomenon, we generated mitochondrial genomes of 34 Late Pleistocene and Holocene remains of small hamsters (subfamily Cricetinae) from Central Europe, the Balkans and Anatolia. Late Pleistocene European small cricetids are usually assigned to the grey dwarf hamster (*Nothocricetulus migratorius*), an extant species inhabiting Western and Central Asia and Eastern Europe. Instead, among the 16 samples from Late Pleistocene Central and Western Europe, the only species found was the Dzhungarian Hamster (*Phodopus sungorus*) inhabiting now northern Kazakhstan and southern Russia. Our phylogenetic reconstruction revealed one major lineage composed of all modern and some Late Pleistocene samples which coalesce around 25 thousand years ago, while older samples were located outside this clade. Such a topology suggests multiple expansions of the Dzhungarian Hamster to Europe, with the most recent one occurring after the Last Glacial Maximum. In the Balkans, we found that the Late Pleistocene grey dwarf hamsters formed a distinct sister clade to the lineage formed by the population from the Qurama Mountains in Uzbekistan and not related to modern samples from Southeastern Europe. In contrast, the Anatolian Holocene samples clustered with an extant species population from the same region. Our results indicate that steppe species, despite broadly similar ecological niches, respond to past climatic and environmental changes in an individualistic manner, and generalisations regarding their evolutionary histories are not justified.

### The Pleistocene fossiliferous mammal localities of Peloponnese, Greece, and their fauna

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**Keywords:** Late Pleistocene, middle Pleistocene, Villafranchian, refugium

The Peloponnese peninsula, at the southern edge of the Balkans, hosts an exceptional array of Pleistocene fossiliferous mammal localities. This study presents key findings highlighting the region's response to significant climatic fluctuations, faunal diversity, and early human activity during this transformative epoch. Pleistocene climate oscillations, characterised by glacial and interglacial cycles, reshaped ecosystems, influencing sea levels, species distributions and adaptations. The Lower Pleistocene localities reveal a typical Villafranchian mammal fauna, including gazelles, giraffes, rhinos and evidence of a rare primate, *Paradolichopithecus sp.*, highlighting the area's ecological richness. Middle Pleistocene localities, such as those in Megalopolis Basin, stand out for their exceptionally preserved assemblages of large herbivores and carnivores, including elephants (*Palaeoloxodon antiquus*), bison, rhinoceroses, monkeys, alongside diverse carnivores, highlighting the role of Peloponnese as a glacial refugium and emphasising the ecological importance of the area, which enabled the persistence and migration of key species during adverse climatic phases. The discovery of Homo species remains in Megalopoli and Apidima underscores the evolutionary and migratory significance of the region during this epoch. Upper Pleistocene localities, particularly in Mani Peninsula, document interactions between anatomically modern humans and Neanderthals and their adaptations to environmental changes. These assemblages showcase ecological impacts driven by humans, and evidence the Broad-Spectrum Revolution, highlighting expanded dietary adaptations that included smaller prey and plant resources, fundamentally transforming human survival strategies. This research underscores the dynamic interplay between climate fluctuations, ecosystems, and human evolution in southeastern Europe, positioning Peloponnese as a key region for understanding Pleistocene biodiversity and anthropological developments. The Peloponnese's fossil record not only provides a comprehensive account of faunal and ecological transitions but also emphasises the role of southeastern Europe as a critical corridor for species migration dispersal. By integrating biostratigraphic and paleoecological evidence, this research sheds light on the transformative processes that defined the Pleistocene.

### Beyond systematics: how can the study of small mammals contribute to a better understanding of the Upper Pleistocene palaeocommunities of Greece

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**Keywords:** Rodentia, Eulipotyphla, taphonomy, palaeoenvironment, morphometrics

In the present work, a series of case studies from different Pleistocene localities of Greece will be presented, exploring the potential of terrestrial small- mammal studies in palaeontology, beyond systematics. Considering their limited mobility in space and their dependency on specific types of habitats, the importance of small mammals in palaeoenvironmental studies becomes apparent. By calculating the Taxonomic Habitat Index (THI) based on data from two Upper Pleistocene cave sites in Mani Peninsula (Kalamakia and Melitzia caves), we will present our interpretations on the region's past climate conditions during times of intense climate alterations. Small mammals are also known to be the prey of many terrestrial and avian predators. These ecological relationships, along with alterations caused by post- depositional processes, have been investigated through the taphonomical study of micromammalian assemblages from two different cave sites (Panthera cave, Kythros islet, Lefkada and Kalamakia cave, Mani Peninsula). Indices traditionally used by palaeontologists and additional indices and ratios used to uncover the taphonomical history of the studied sites were calculated and the results of these thorough taphonomical analyses will be presented, along with their implications on the studied fossilised assemblages' abundance and diversity. Finally, because of the large numbers in which micromammalian fossils might be retrieved, the researcher can perform multiple analyses with statistical safety. The results of such analyses will be presented, having used geometric morphometrics techniques on *Apodemus* molars from different sites (fossil and modern) of Central Greece and the Peloponnese, to investigate possible adaptations of the species' morphological features to different ecological conditions. All these tools, especially if used complementarily, could lead to a rather successful representation of a locality' s or species' history, taking into account that palaeocommunities share the complexity of modern communities in terms of palaeoenvironmental conditions and palaeoecological relationships.

# Population Dynamics

*(J. Sundell)*

## POPULATION DYNAMICS

### Water deficit inhibits induction of silicon-based anti-herbivory defence in wetland ecosystems

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**Keywords:** Vole, population density, groundwater level, plant defence, silica

Silicon (Si) accumulation in grasses is considered as a plant defensive mechanism against herbivory. However, grass Si production is affected by abiotic and biotic factors and their interactions, making it difficult to isolate these factors in field studies. In this study, we investigated the effect of the interaction of vole herbivory and water level on Si concentration in tussock sedges. Additionally, to assess the significance of hydrological dynamics, we compared the Si content data in sedges with the long-term (15-year) fluctuations in water levels. Our findings revealed that high vole densities substantially diminished plant integrity. However, despite the evident intense herbivory pressure exerted by voles, the sedges did not exhibit increased Si concentrations in their leaves or rhizomes across the two dry study seasons. Interestingly, we found a strong positive correlation between the Si content in sedges and water levels. As water levels increased, Si concentrations in the sedges also increased significantly, with water levels accounting for more than 50% of the observed variation. Our findings suggest that intense herbivory by voles in wetland ecosystems cannot stimulate Si accumulation in sedges. Instead, the primary factor appears to be water availability during spring, which enables plants to induce Si as a defence response to heavy grazing. This implies that the observed climate change, resulting in water deficits in vulnerable wetland habitats, may prevent plants from mounting this defensive response, potentially leading to severe herbivore damage. In a broader context, increasing drought conditions may have negative physiological effects on plants and exacerbate the detrimental impacts of herbivory by reducing plants' capacity to develop protective Si-based defences.

## POPULATION DYNAMICS

### The legacy of wolf extirpation now engraved in the bones

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**Keywords:** Morphology, *Canis lupus*, cranial shape

The global history of wolves is marked by extensive persecution, leading not only to severe population declines in many regions but also to significant genetic and phenotypic changes in surviving populations as a result of extirpation, founder effects, population bottlenecks, and population replacements. In addition to direct persecution, human-driven landscape modifications and alterations in prey composition have further contributed to phenotypic changes. Our research examines these phenotypic changes, focusing on the near-complete replacement of wolves across Northern Europe by analysing wolf skull morphology. Utilising 3D landmark-based geometric morphometrics, we illustrate the morphological changes resulting from this population replacement.

## POPULATION DYNAMICS

### Mammals of the world's youngest desert "Aralkum"

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**Keywords:** Aralkum desert, mammals, fauna, isolation

The Aral Sea, once a vast inland body of water, has suffered a catastrophic decline due to unsustainable water usage for agriculture. The resulting desiccation has created the Aralkum Desert and significantly impacted the region's biodiversity. A comprehensive study of the mammalian fauna in the region revealed 25 species (3 insectivores, 3 bats, 1 lagomorph, 9 rodents, 7 carnivores, and 2 ungulates). *Vulpes corsac*, *Caracal caracal*, *Saiga tatarica* and *Paraechinus hypomelas* are threatened according to the Uzbekistan Red Data Book. The mammalian fauna primarily consists of species adapted to arid environments, including clay semi-deserts (e.g., *Spermophilus fulvus*, *Allactaga elater*, *A. severtzovi*, *Pygeretmus pumilio*, *Meriones tamariscinus*), sandy deserts (e.g., *Meriones meridianus*), and wetlands (e.g., *Canis aureus*, *Meles leucurus*, *Sus scrofa*). Additionally, some species can adapt to various desert habitats (e.g., *Hemiechinus auritus*, *Paraechinus hypomelas*, *Lepus totai*, *Meriones libycus*, *Vulpes vulpes*, *Felis sylvestris ornate*). Synanthropic species (e.g. *Pipistrellus pipistrellus*, *Mus musculus*) have also been recorded. The most abundant species are tolai hare, long-eared hedgehog, gerbils, red fox and Asiatic wildcat. Golden jackal migrated from the mainland across the dried-up seabed. The saiga antelope of Aralkum desert represents a unique, 400 years isolated population. The mammalian fauna of the Aralkum is closely related to that of the Ustyurt Plateau. However, compared to the mainland, the fauna of the former Aral Sea is less diverse, which is typical of island faunas. Despite this, some species, such as hares, foxes, and desert rodents, have relatively high numbers. Conversely, species dominant in the Ustyurt, like *Rhombomys opimus* and *Ellobius talpinus*, are absent. The presence of hydrophilic mammals (wild boar, jackal, badger) suggests an exchange between the island populations and the terrestrial communities of the Aral Sea region.

## POPULATION DYNAMICS

### A decade of monitoring the Critically Endangered Balkan Lynx in its core area: Insights from Spatial Capture Recapture Models

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**Keywords:** Camera-traps, *Lynx lynx balcanicus*, density estimation, SCR

Monitoring the status of endangered species is essential to guide conservation and management measures, especially for populations facing isolation and small numbers. The Balkan lynx (*Lynx lynx balcanicus*), the most endangered subspecies of the Eurasian lynx, survives in the southwestern Balkans with fewer than 50 mature individuals. Obtaining accurate population estimates is challenging for such a rare, wide-ranging and elusive species. We used camera-trapping and Spatial Capture-Recapture (SCR) modelling to provide the first reliable density estimates of the Balkan lynx in its core area, Mavrovo National Park and surroundings over a decade-long monitoring period. Across five sessions, we recorded 176 detections over 9439 realised camera trap nights, identifying a maximum of 10 individuals per session. Despite a low number of recaptures, our multisession analyses reveal a decline in density over the past decade, from approximately 2.5 lynx per 100 km<sup>2</sup> of suitable habitat in 2013 to 1.2 in 2023. We compared densities estimated independently for each session or as a trend, with and without excluding unsuitable habitats. These findings provide the first robust density estimates for the critically endangered Balkan lynx and confirm concerns about the state of the population. Our results underscore the value of long-term, systematic monitoring to detect changes in population density. While density estimates are comparable to other lynx populations in Europe, the observed decline, combined with the genetic state of the population, highlights the urgent need for enhanced conservation efforts.

## POPULATION DYNAMICS

### Ecology of sympatric bank and red voles, *Clethrionomys glareolus* and *C. rutilus*, in northern Finland

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**Keywords:** Arvicolline dynamics, cycles, competition, taiga

In Europe, the bank vole, *Clethrionomys glareolus*, is widely spread while red vole, *C. rutilus*, is a northern species. In the northern part of the Fennoscandian taiga both species occur in sympatry; this overlap zone is 100 – 150 km north - south wide. These species are closely related, they can even hybridize, but ecologically they are different. The habitat selection is more restricted in *rutilus*, the food selection in winter is different, and the litter size of *C. rutilus* is higher than in *C. glareolus*. I have monitored the population dynamics of these species in a multispecies arvicoline community (8 species) at Pallasjärvi, northern Finnish taiga since 1970. Population dynamics during this period have been characterised both by strong population cycles, but also by a long, more stable “noncyclic” period. The multiannual dynamics of these two species are synchronous. However, clear interspecific competition occurs between *glareolus* and *rutilus*. Breeding females of *Clethrionomys* species (including *Craseomys rufocanus*) have clear exclusive territories, and this territoriality occurs also between breeding females of different species. Neither the breeding males seem to overlap very much, even if they do not have totally exclusive territories, rather variable home ranges. Based on field experiments, *C. glareolus* dominates over *C. rutilus*. Removal of *C. rutilus* does not affect the density of *C. glareolus*, while removal of *C. glareolus* results in higher densities of *C. rutilus*. However, the nonbreeding, docile/nonterritorial subadults seem to overlap extensively. Maturation of *Clethrionomys* species is strongly density-dependent. In the *glareolus-rutilus* system density dependence takes place at the whole community level. Therefore, summer maturation of young *rutilus* is regulated by total density of *C. glareolus+rutilus*. Disappearance of cycles has been discussed in recent years. Community level analyses (8 arvicoline species at Pallasjärvi) help to distinguish between species and community level regulating factors.

# Reintroductions and Wildlife Management in Changing Ecosystems

*(A. Sallay & L. Schley)*

### Hair-raising insights: Estimating badger densities in Ireland using non-invasive genetic methods to inform bTB management efforts

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**Keywords:** Badger, non-invasive, population estimates, bTB

The European Badger (*Meles meles*) is a charismatic species and an integral part of Irish biodiversity. It is also considered to be an important host species for bovine tuberculosis (bTB) and are associated with the transmission of bTB infection to and from cattle. Under the current national bTB eradication plan, there has been a movement away from badger culling to prevent bTB transmission via wildlife and a movement towards badger vaccination. For the national vaccination programme to be successful, reliable estimates of badger abundance on both a local and a national scale are vital, with current methods relying on indirect data or 'expert' opinion. We aim to directly estimate local badger densities in two locations in the south and west of Ireland with different topographies, using spatial capture-recapture models derived from non-invasively collected samples. Samples were collected in 2024 over two sampling periods (January-March/November- December) via three non-invasive hair sampling techniques (i.e., barbed wire, tension mounted spring traps and glue traps) and directly from latrines. This yielded n=126 non-invasively collected samples (hair and faeces) from a 36 km<sup>2</sup> area in Co. Waterford and n=70 samples from a 24 km<sup>2</sup> area in Co. Galway. DNA quality and sex were identified for each non-invasively obtained sample using quantitative PCR (qPCR), with the highest quality samples brought forward for genotyping using a panel of 16 microsatellite primers. Going forward, genotyped individuals will be used as part of a spatial capture-recapture model, so that accurate estimates of the population size can be determined, creating a 'genetic toolbox' for vaccine delivery and bTB management in Ireland.

### March or get infected: influence of winter ranging shaped by supplementary feeding on the spread of non-native nematode *Ashworthius sidemi* in European bison populations

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**Keywords:** Blood-sucking nematode, conservation management

Parasitic infections in wildlife are influenced by numerous factors, including those related to wildlife management. One such factor is supplementary feeding, used widely for a number of reasons and for a number of ungulates, including European bison. We analysed the influence of supplementary feeding and winter ranging of European bison herds on the dynamics, prevalence and infection severity of the blood-sucking nematode *Ashworthius sidemi* in two areas in NE Poland: the Knyszyn Forest (KF) and the Białowieża Primeval Forest (BPF), with diversified management strategies. We found significant differences in *A. sidemi* abundance and intensity between European bison groups; supplementary fed European bison from the BPF had higher parasitic load (3020 parasites, on average), than non-fed individuals from the KF (1400) and from the BPF (770). The prevalence was relatively high in all groups (93-96%). In the KF the highest infection rate was observed 9 years after the first appearance of *A. sidemi*, with a maximum value of 8,620 nematodes, while in the BPF, after just 6 years a maximal load of up to 44,310 *A. sidemi* was reached. The most plausible mechanism behind the observed pattern is probably the winter-ranging behaviour of differently managed herds. We found that an increase in winter home range size of European bison was associated with a significant reduction in the abundance of *A. sidemi*. Our study shows that different management strategies may have an impact on animal spatial behaviour and associated spread and dynamics of pathogens in mammalian populations, thus, stressing the importance of adaptive management for reducing threats to wildlife.

The study was financed by the National Science Centre project no. 2012/07/B/NZ8/00066 and LIFE Nature project „BISON LAND – European Bison Conservation in the Białowieża Forest, Poland”.

### Using public-sourced photos to track changes in moose antlers size during a 20-year hunting ban

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**Keywords:** Moose, antler size, citizen science

Hunting directly impacts the population dynamics of ungulates and can have a significant effect on the quality of phenotypic traits such as horns or antlers. In Poland, following a demographic collapse in the 1990s and the introduction of a hunting ban in 2001, the population of moose (*Alces alces*) has increased from 1,800 to over 20,000 individuals, recolonising its former range. As the moose is a charismatic species and a popular subject for nature photography, we analysed changes in antler size and shape in this cervid between 2005 and 2021 based on photos of male moose and antler casts provided by photographers or available in social media. Our findings indicate that during the hunting ban, the probability of observing the cervina antler type significantly decreased over time, from 47% in 2012 to 28% in 2021. Meanwhile, the probability of observing the intermediate and palmate antler types significantly increased from 44% to 53% and from 9% to 19%, respectively. The mean number of tines significantly increased from 3.2 in 2005 to 4.7 in 2021, and the antler size index significantly increased from 3.4 to 3.9. The most likely mechanism behind the observed changes could be the ageing of the population released from hunting pressure. We also observed regional variation in antler size, which is likely related to differences in environmental conditions. Our study serves as an example of how passive citizen science can contribute to our understanding of ecological trends and the quantification of population patterns. It also has important implications for management of species affected by trophy hunting.

## REINTRODUCTIONS AND WILDLIFE MANAGEMENT IN CHANGING ECOSYSTEMS

Wolves in the highly populated Netherlands – what could possibly go wrong?

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**Keywords:** Bold wolves, urbanised landscape, management

Wolves were exterminated from the Netherlands in the early 19th century but have recolonised parts of this small country (43.000 km<sup>2</sup>). However, nowadays the Netherlands have a huge human population (on average 523 people per km<sup>2</sup>). Interactions between wolves and humans are frequent and not always positive. In this presentation, I will reflect on the ups and downs of the comeback of wolves to the Netherlands out of my experience as the national coordinator for wolf monitoring.

### From a pilot study to essential conservation and management tool: genetic monitoring of brown bears in Slovenia after 20 years

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**Keywords:** Genetic monitoring, genotyping by sequencing, high-throughput sequencing, capture mark recapture, wildlife management

Wildlife monitoring using molecular genetics often presents a considerable challenge to anyone tackling it. However, it is frequently the only method allowing robust, precise estimates of wildlife abundance, providing powerful tools for ecologists and wildlife managers. In Slovenia, we have developed these tools for the last two decades to establish a robust national-level monitoring of brown bears. Starting with a pilot study in 2004 and followed by the first national-level sampling in 2007, the value of the obtained data quickly became obvious, and genetic monitoring implemented at 8-year intervals became an essential part of Slovenian brown bear management. In Autumn 2023 we implemented sampling for the third monitoring session within this scheme through a citizen-science approach. The response from participants (mainly hunters and foresters) was excellent; the goal of 2,500 samples within the 3-month sampling period was exceeded with 2,864 samples collected, of which 2,500 were analysed with 70% genotyping success. Samples were genotyped using high-throughput sequencing, which allowed a rapid and cost-effective analysis. The laboratory analysis and genotyping were completed within 8 months after the end of the sampling, and the full study with capture-mark-recapture modelling was completed in 10 months. We managed to obtain a good population size estimate and documented a further expansion of the population towards the Alps. The sex ratio remained similar to that in previous monitoring sessions, with 61.7 % of females. As Slovenian brown bear monitoring progressed from a purely scientific pilot study towards a well-established, cost-effective routine monitoring essential for the management and conservation of this species, many lessons were learned. We believe that this knowledge can be transferred to other populations and species to establish similar well-functioning genetic monitoring systems

### Translocation of subterranean blind mole rats as a conservation tool to save endangered species and recover dry grassland ecosystems

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**Keywords:** Spalacidae, ecosystem engineer, biodiversity conservation

Grasslands have been transformed for croplands worldwide and consequently have lost many of the species playing a role as ecosystem engineers. All European blind mole rat (Rodentia: Spalacidae) species are endemic to the continent and fundamental to grassland ecosystems. Their digging creates mounds of bare soil surfaces available for plant colonisation, maintains soil structure, and provides burrows for other animals. Blind mole rats have long been persecuted, and their habitats have been lost, fragmented or degraded. Many species are threatened by extinction as they only exist in a few small and isolated populations. The translocation of individuals for reintroduction or establishment of new populations is a promising tool in conservation. Translocation of blind mole rats or other strictly subterranean mammals had not been attempted elsewhere in Europe before. Here we discuss the methods and evaluate the results of seven translocation projects carried out in Hungary between 2013 and 2024. We found that these projects varied greatly in their efficacy. Habitat quality, the number and sex ratio of translocated animals, as well as survival during the first winter were the decisive factors for success. Translocations require the strict application of a detailed protocol, which covers the thorough assessment of the soil and vegetation quality of the target habitats, careful selection of source populations and individuals, timing of the capture and release, and the regular monitoring of translocation success. We developed recommendations for future translocation projects of subterranean mammals, which could be applied to the threatened species of this guild in open grassland ecosystems all over the world

### Possible inbreeding effects on survival and reproduction in two reintroduced Eurasian lynx populations in Switzerland

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**Keywords:** Lynx, inbreeding, survival, reproduction, reintroduction

Several reintroduction projects starting from the 1970s resulted in the successful establishment of Eurasian lynx populations in Switzerland, France, Slovenia, the Czech Republic and Germany. But even 50 years after the first reintroductions, a low genetic diversity, slow population growth and isolation of the reintroduced populations remain a serious challenge for lynx conservation in Western Europe. This study analysed the potential effects of inbreeding on lynx survival and reproduction in two Swiss lynx populations. A novel modelling approach allowed us to combine picture data from camera-trapping and chance observations, telemetry data and dead individuals, over a monitoring period of 25 years (1997–2023). Our results show that high inbreeding levels (homozygosity by locus, HL) were associated with reduced survival in both populations, especially in juvenile lynx. Males were more strongly impacted than females. The body weight of lynx kittens at four weeks old was negatively related to inbreeding levels of the mother, suggesting that inbreeding might be a possible factor influencing reproduction. Our findings show that inbreeding has a negative effect on lynx fitness parameters in two reintroduced populations and highlight the importance of genetic management and connectivity for the long-term viability of reintroduced mammal populations.

# Subterranean Mammals in a Changing World

*(R. Šumbera & A. Németh)*

## SUBTERRANEAN MAMMALS IN A CHANGING WORLD

### Museomics reveal the relictualisation of Afrotropical golden moles (Chrysochloridae, *Kilimatalpa*)

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**Keywords:** Chrysochloridae, Afrotropical mountains, museomics

Golden moles (Chrysochloridae) are subterranean African mammals with strong phenotypic convergence to true moles (Talpidae). Due to their cryptic lifestyle and low abundance, golden moles are one of the least-studied placental mammal families. They have their diversification centre in southern Africa's (semi)arid regions, where almost all species can be found. However, two species are also roaming tropical central Africa. One of them, Stuhlmann's golden mole (*Kilimatalpa stuhlmanni*), is most particular, given its disjunct distribution. Although its distribution covers most of central and eastern Africa from Cameroon to Tanzania, it is actually limited to a few geographically very distant, isolated Afrotropical mountain forests and nearby forest-savannah mosaics. So far, undisputed specimens have been discovered from four mountain ranges: I) Albertine Rift mountains; II) Central Eastern Arc Mountains; III) Tanzanian Southern Highlands; and IV) Mount Elgon and Cherangani mountains in western Kenya/eastern Uganda. In addition, two disputed ranges have been described: V) from Kisangani region in northern central DR Congo, where it possibly occurs sympatrically with the other tropical species; and VI) from Mount Oku in Cameroon, where only a single specimen has been found so far (the holotype of a separate subspecies). Genetic connectivity and relationships among these isolated patches are entirely unclear. Here I use museomics to extract archival DNA from historical museum skins that cover the whole geographic distribution (including the holotype from Mount Oku) to clarify the phylogeny and phylogeography within the monotypic genus *Kilimatalpa*. The results suggest the presence of multiple, deeply divergent lineages within Stuhlmann's golden mole. Their diversification dates back to the fragmentation of the former pan-African forest since the late Miocene aridification. Thus, the deep lineages within *Kilimatalpa* likely represent relicts of a previously more widely distributed clade of Afrotropical golden moles that persisted in isolated mountain refugia.

### Ecophysiological and morphological insights into the Upper Galili Mountain blind mole rat (*Nannospalax galili*): thermal biology, bite force, and their role in ecological speciation

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**Keywords:** Subterranean rodent, ecophysiology, bite force

The traditional view of speciation as a process requiring only geographical isolation and time has been increasingly challenged by evidence of ecological speciation, where gene flow between incipient species is restricted due to ecologically driven divergent selection. Recent genetic, ecological, and behavioural studies suggest that this process may be occurring between two populations of the blind mole rat (*Nannospalax galili*), a subterranean rodent inhabiting adjacent but ecologically distinct basaltic and rendzina soil types in Israel. In this study, we investigated whether mole rats from these two soil types differ in selected morphological and physiological traits, specifically resting metabolic rate (RMR), digging metabolic rate (DMR), surface body temperature, and bite force. Our findings revealed no significant differences in RMR between mole rats from basaltic and rendzina soils. However, mole rats from basaltic soils exhibited a lower core body temperature, reduced by 1.6°C compared to those from rendzina soil. Digging metabolic rate did not vary based on soil origin when burrowing in either substrate, though DMR was significantly higher when burrowing in basaltic soil compared to rendzina soil. Similarly, surface body temperature patterns showed no differences between the two populations, and bite force did not vary significantly. Overall, these results suggest that mole rats inhabiting the two ecologically distinct soil types do not exhibit substantial differences in the selected morphological and physiological traits, except for core body temperature. While most of these traits are unlikely to contribute to the proposed speciation process between the two populations, the potential role of thermal biology in this process warrants further investigation. The research was supported by GAČR 22-30366S.

## SUBTERRANEAN MAMMALS IN A CHANGING WORLD

### Taxonomic review of Western Anatolian mole rat cytotypes (Genus *Nannospalax*) with descriptions of new species

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**Keywords:** Cytotype variation, taxonomy, subterranean rodents, speciation, Geometric Morphometrics

Chromosomal rearrangements can lead to the emergence of new cytotypes, often representing the initial steps of speciation—particularly in mole rats. Recent karyological surveys have nearly completed the distribution map of mole rat cytotypes in western Anatolia, uncovering several newly identified cytotypes and their respective ranges. In this study, we analysed eight cytotypes ( $2n = 36, 38, 40, 50N, 52W, 54N, 58N, 60K, 60$ ) in *Nannospalax xanthodon* using 137 individuals, complemented by two additional *Nannospalax* species (*N. leucodon*, *N. ehrenbergi*) in Turkey. Geometric morphometric analyses reveal that seven out of the eight cytotypes exhibit distinctive morphological divergence consistent with separate species status. Accordingly, we propose the following new species:  $2n = 36$  named *Nannospalax anatolicus* sp. nov.,  $2n = 40$  named *Nannospalax gazi* sp. nov.,  $2n = 50N$  named *Nannospalax tenebrosus* sp. nov.,  $2n = 52$  named *Nannospalax mursaloglu* sp. nov.,  $2n = 54N$  named *Nannospalax serifebaci*,  $2n = 58N$  named *Nannospalax victorius* sp. nov. and  $2n = 60K$  named *Nannospalax boreanatolicus* sp. nov. Also, for the  $2n = 38$  cytotype we propose that the previously assigned name “*xanthodon*” for samples from Bornova, İzmir remains valid. We also retain the name already given the  $2n = 60$  cytotype as *Nannospalax cilicicus*. These findings highlight the significance of chromosomal and morphological variation in driving speciation in subterranean rodents and emphasise the need to reassess taxonomic boundaries in *Nannospalax*.

## SUBTERRANEAN MAMMALS IN A CHANGING WORLD

How fast do mammals speciate under the ground?

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**Keywords:** Subterranean, species, diversity

In taxonomic compendia, subterranean mammal genera are often species-rich. The question arises, whether the subterranean lifestyle makes mammals especially prone to speciation. There is a reason to think so: burrowing specialisation inevitably limits dispersal, which promotes population fragmentation and local fixation of different, possibly incompatible, mutations and karyotypes. On the other hand, the exceptional species richness of subterranean mammals can be a taxonomic artefact due to the overestimation of tiny morphological differences in the past and tiny genetic differences in the present. In the past years, we subjected species diversity in African root-rats and mole-rats to close scrutiny, which allowed us to compare it with diversity of co-distributed above-ground rodents. Species delimitation based on genome-scale sequence data both lumped and split species listed in taxonomic compendia and some entirely new species were discovered. Generally, however, the estimated prevalence of cryptic taxa was lower than proposed by earlier research. In some genera, this endeavor also changed our idea about the area of highest species and phylogenetic diversity. In any case, however, the rate of speciation seems to be comparable above and under the ground.

## SUBTERRANEAN MAMMALS IN A CHANGING WORLD

### Evolution, Taxonomy and Conservation - Phylogenetic investigations of European blind mole rats of the genus *Nannospalax*

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**Keywords:** Species delimitation, Taxonomic revision, Biodiversity

Species delimitation is a powerful approach to support taxonomic decisions in challenging taxa where species boundaries are difficult to establish. European taxa of blind mole rats (genus *Nannospalax*) show small morphological differences and complex chromosomal evolution at low levels of evolutionary divergence. Previous analyses have led to the recognition of 25 'forms' within their range. We provide a comprehensive framework to improve knowledge of the evolutionary history and revise the taxonomy of European blind mole rats based on samples from all but three of the identified European forms. Using concatenation and coalescence-based species tree estimation, we sequenced two nuclear-encoded genetic regions and the entire mitochondrial cytochrome b gene for phylogenetic reconstructions. We found that, contrary to the previously held single-species concept, European lesser blind mole rats can be divided into three distinct superspecies and 11 well-separated species, all endemic to Europe. The species delimitation models also allowed the recognition of a previously unnamed blind mole rat taxon from Albania, described as a new subspecies. The observed geographic pattern suggests a robust peripatric speciation process and rapid chromosomal evolution. The present treatment is, therefore, considered as a minimum taxonomic content of each lineage, which can be further refined based on other sources of information such as karyological characters, crossbreeding experiments, etc. Many newly recognised taxa are characterised by very restricted distributions and/or declining populations. They represent a significant new challenge for the conservation of European biodiversity.

### Breeding males, but not females have a stronger bite: comparison of bite force in five social African mole-rat species from the genus *Fukomys*

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**Keywords:** African mole-rats, subterranean mammal, bite force, competition for breeding

Bite force is a simple trait that is used as an excellent indicator of an animal's overall performance in various respects, as it is related to dietary niches, social dominance and the ability to defend itself, its territory or group. These aspects can be consequently mirrored in individual reproductive success. In this study, we analysed the effect of breeding status on bite force in five species of African mole-rats (Bathyergidae) within the genus *Fukomys*. All of these bathyergids are cooperative breeders where reproduction is limited to a few animals in each group, which typically consists of a breeding pair and their non-breeding descendants spanning several generations. We collected *in vivo* bite force data from a total of 404 individuals across 75 families and tested whether breeders exhibit stronger bite force. Our findings revealed that breeding males outperformed non-breeders of both sexes, whereas breeding females underperformed the other categories, with many showing reluctance to bite. We propose that reproductive males need stronger bite force because of repeated competition with non-related, intruding males. In contrast, there is much less competition for the breeding position among females, as females rarely intrude into established families.

# Threatened Mammalian Species

*(G.P. Mitsainas & D. Youlatos)*

## THREATENED MAMMALIAN SPECIES

### Rapid range decline of the garden dormouse (*Eliomys quercinus*): A call for urgent conservation action in Europe

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**Keywords:** Dormice, conservation, range contraction, extinction

The garden dormouse (*Eliomys quercinus*) is among the European species that have experienced significant range loss in recent years. The species has vanished from large areas of central and eastern Europe. This dramatic reduction, estimated to exceed 30% of its range in the last decade, has led to its recent classification as Vulnerable by the IUCN. We analysed national red lists and reviewed available data on the species' presence and distribution across all countries where it was historically recorded. The garden dormouse is deemed Regionally Extinct in Estonia, Finland, Latvia, Lithuania, Slovakia, Belarus, Poland, and Ukraine and is listed as Endangered or Critically Endangered in the Czech Republic, Flanders (Belgium), Germany, and the Netherlands. Even in Western Europe, it is classified as Near Threatened in Portugal and Italy, with reports of localised declines in Spain, France, and Switzerland. Current knowledge cannot fully explain the significant contraction of the garden dormouse's range. This decline is likely linked to a combination of factors, including the substantial reduction of insect biomass (a key food source for the species), exposure to rodenticides which are used in pest management, the accumulation of pesticides and other pollutants, and general habitat loss. Consequently, it is essential to develop an action plan for the species at the European level and to implement conservation measures without delay.

## THREATENED MAMMALIAN SPECIES

### Conservation of rare and threatened mammal species in Ghana, West Africa

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**Keywords:** Upper Guinea, mammal fauna, conservation, mining, deforestation

An ongoing review of the Mammals of Ghana and their IUCN Red List status has brought to light the precarious situation of the mammalian fauna of Ghana, if current developments with urban sprawl, illegal or uncontrolled mining, the deforestation of protected areas and the loss of sacred groves continue. The talk will highlight representatives of several mammalian orders in Ghana, including the shrew *Crocidura wimmeri*, (IUCN CR) the rodent *Hylomyscus baeri*, (IUCN EN), the primate *Procolobus (Piliocolobus) waldroni* (IUCN CR), the lion *Panthera leo* (IUCN VU) and the sirenian *Trichechus senegalensis* (IUCN VU). While the plight of Ghana's protected areas, river systems and sacred groves is worrying, there is also an increasing interest in conservation, nature education, and (eco)tourism among Ghana's students, teachers and the general public. We should encourage and support basic research and applied conservation collaborations at all levels between Ghanaian and European institutions and NGOs.

## THREATENED MAMMALIAN SPECIES

### Distribution of the Romanian Hamster (*Mesocricetus newtoni*) in the Natura 2000 sites of Romania: Implications for Conservation

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**Keywords:** *Mesocricetus newtoni*, protected areas, Natura 2000, Romania

The Romanian hamster (*Mesocricetus newtoni*), a vulnerable species endemic to southeastern Romania and northeastern Bulgaria, faces significant threats due to habitat loss and fragmentation, driven by agricultural intensification and urbanisation. Out of 30 Natural Protected Areas designated within the range of the Romanian hamster, it is officially declared as present in only 9. This study investigated the efficacy of the protected areas network for conserving this species' habitat in Romania. To achieve this, an ecological niche model (SDM) was developed using Corine Land Cover and WorldClim Bioclimatic variables based on 62 points of occurrence data, obtained from a comprehensive literature review and field surveys. Of these points, 47 were used to build the model, and 15 were used to test it. Furthermore, an overlay analysis was conducted between the Natural Protected Areas and a total of 72 occurrence points, with a 3 km buffer, to account for the species' limited mobility. Our results indicate that the hamster should be added to the species list for another 6 Natural Protected Areas. Moreover, both the occurrence points and the SDM highlight the necessity for establishing new protected areas to adequately conserve *M. newtoni* in Romania. Additionally, the establishment of buffer zones, ecological corridors, and the promotion of sustainable agricultural practices are crucial for the long-term survival of this vulnerable species.

## THREATENED MAMMALIAN SPECIES

### Unlocking Iberian lynx recovery: Enhancing habitat models with European rabbit availability for long-term successful lynx restoration

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**Keywords:** Iberian-lynx, European-rabbit, reintroduction, environmental-favourability-models,

The remarkable recovery of the Iberian lynx (*Lynx pardinus*) in the past two decades is primarily attributed to targeted reintroduction efforts in predefined areas, guided by large-scale environmental suitability models, which focus mainly on land use and human activity. Being a super-specialist predator, lynx long-term survival is linked to its key prey: the European rabbit (*Oryctolagus cuniculus*). Therefore, considering rabbit's occurrence in the modelling approach is essential. This study aimed to identify potential areas for Iberian lynx restoration in Spain, with a special focus on its key trophic resource. First, we modelled environmental favourability for the lynx using stepwise logistic regression on various factors such as climate, topography, land use, landscape, human activity, and nature conservation. Second, using fuzzy logic, we intersected the resultant map with a spatial model of potential rabbit availability, which was built using fine-scale hunting yield data. Our results suggested that approximately a quarter of peninsular Spain would be environmentally favourable for lynx restoration. Most of the environmentally favourable areas for the lynx were located in southwestern Spain close to the current existing lynx populations. These areas were characterised by continental climate, flat regions, partial cultivate and being distant from large cities. When we intersected those environmentally favourable areas with the map of rabbit availability, the areas for potential restoration of the lynx were considerably reduced, approximately to half of the areas formerly considered as favourable, confirming that the scarcity of this prey is a limiting factor for the conservation of the felid. Estimating rabbit abundance at large-scale may be challenging due to the species' susceptibility to local environmental factors and diseases. Nonetheless, our approach, integrating fine-scale data to map rabbit availability, represents a significant step towards a more realistic assessment of the Iberian lynx's potential distribution.

## THREATENED MAMMALIAN SPECIES

### Macaronesian bats: a review of research effort and directions

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**Keywords:** Macaronesia, Chiroptera, island, bat, endemic

Around 60% of all bat species inhabit islands, and nearly one in four is an island endemic. Bats are often the only native terrestrial mammals on oceanic islands. Despite increasing human pressures, the distribution, natural history, and population status of most insular bat populations remain poorly understood. Macaronesia, a biogeographical region in the Atlantic Ocean, consists of four archipelagos—the Azores and Madeira (Portugal), the Canary Islands (Spain), and Cape Verde. The region has ca. 16 bat species, including three IUCN-listed threatened endemics, but significant knowledge gaps persist regarding these species. Between September 2022 and January 2023, we conducted a literature review on Macaronesian bats, emphasising studies on individual species and identifying prevailing research trends. Using Google Scholar and keywords such as “Bat”, “Macaronesia”, “Azores”, “Canaries”, “Madeira”, and “Cape Verde”, we identified 94 publications in English, Portuguese, and Spanish. After screening titles and abstracts, we included 81 papers (1966–2022) relevant to bat populations in the region. Our findings show that the Azores have the highest number of studies on native bats, followed by the Canary Islands, Madeira, and Cape Verde. The most studied species are *Pipistrellus maderensis* and *Nyctalus azoreum*. Despite this, significant gaps remain, especially regarding endemic and native species. Addressing these gaps is critical for understanding Macaronesian bat biodiversity and implementing effective conservation measures, as recommended by the IUCN.

## THREATENED MAMMALIAN SPECIES

### Can we save Roach's mouse-tailed dormouse for the European fauna?

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**Keywords:** Dormouse, wildfire, threats, habitat loss, conservation

Roach's mouse-tailed dormouse (*Myomimus roachi*) has a restricted distribution range, comprising southeastern Bulgaria and a few locations in European Turkey. In 2017, after 40 years without sightings, an animal was caught near Svilengrad, Bulgaria. In 2019, we started a thorough survey in its former range, but until now, the population near Svilengrad remains the only one known in Bulgaria. Recently, an animal was photographed in Greece, the first sighting ever in the country. Regular monitoring of the Bulgarian population during the last six years has enabled us to gain unprecedented insight into the biology and behaviour of this rare dormouse. The species is sedentary and nocturnal, active only four months per year. This means acquiring food at the right moment is crucial for a species with such a long hibernation period and only one litter per breeding season. Using environmental DNA, we also analysed the dormouse diet, revealing the prevalence of arthropods. This species lives in semi-open habitats with old-growth oak stands and extensive agriculture, an ecosystem currently threatened in southeastern Bulgaria. Land abandonment and expansion of intensive agriculture are leading to the disappearance of this small-scale mosaic landscape, representing the main threat to the dormouse's survival. An ongoing analysis of habitat preferences, combined with the results from the diet, will provide information for developing habitat management measures. Meanwhile, an additional serious threat has emerged: wildfires. In two successive years, wildfires occurred near Svilengrad. Besides possible direct deaths, the fires destroyed food resources at a critical time, i.e. when the dormice were fattening up for the hibernation period. After the first fires in 2013, only five adults were seen in a 3-ha plot, compared to more than 16 the year before. With the exacerbating effects of climate warming, the future of this unique mammal remains uncertain. We will discuss possible conservation measures.

## THREATENED MAMMALIAN SPECIES

### Conservation status of the blind mole rat species endemic to the Pannonian region (Rodentia: Spalacinae: *Nannospalax*)

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**Keywords:** conservation status, Spalacinae, Pannonian region

Regular reviews of long-term research and conservation programs are useful sources of information for future directions in science and the assessment of the current conservation status of species. However, the unclear taxonomy of the European blind mole rats has significantly hindered the determination of the conservation status of blind mole rats in the Pannonian region until recently. The results of recent studies have helped us gain a much clearer picture of the phylogeny and, thus, the taxonomy of the blind mole rats of this region. All these results indicate that there are three distinct endemic species of *Nannospalax* blind mole rats in the Pannonian region. In our investigation, we compiled all available data from the last 20 years related to blind mole rat populations in the studied region and assessed this information according to the following main themes: systematics, distribution, threats, and conservation actions. Based on the most recent information, national and global risk assessments are provided for the three species of *Nannospalax* that are currently accepted as part of the mammal fauna of the Pannonian region. Hungarian (*N. hungaricus*), Vojvodina (*N. montanosyrmiensis*), and Srem blind mole rats (*N. syrmiensis*) are all highly endangered and immediate actions are needed for their conservation. We do hope that, with the help of the new results, new funding sources and opportunities will arise for the preservation of the blind mole rat species in the Pannonian region.

## THREATENED MAMMALIAN SPECIES

### Conservation of the European Ground Squirrel in Greece: A management approach for an endangered small mammal

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**Keywords:** *Spermophilus citellus*, conservation, peripheral distribution range, Action Plan

The European ground squirrel (*Spermophilus citellus*) is a fossorial rodent endemic to Central and Southeastern Europe, listed as Endangered on both the IUCN Red List and Greece's Red Data Book of Threatened Species (2024). This species is emblematic of Greece, representing the southernmost extent of its range, where populations have adapted to Mediterranean climatic conditions. However, these populations face unique challenges, with tiny, isolated groups persisting, two-thirds of which occur outside Natura 2000 protected areas. Historically, limited conservation knowledge on the species in Greece has hindered effective management. Recent efforts have aimed to address this gap through comprehensive ecological studies and monitoring initiatives. These have yielded critical insights into the species' habitat preferences, threats, and population dynamics, forming the foundation for developing targeted management practices. Key findings have informed proposals for mitigating anthropogenic pressures, such as habitat degradation and fragmentation while also promoting recovery efforts. Management measures include habitat enhancement and the establishment of conservation zones. Additionally, efforts have been directed towards raising public awareness about the species' ecological significance and the need for its protection. Engaging local communities and fostering positive public attitudes are crucial for ensuring long-term conservation success. These proposals have been formally submitted to relevant authorities for incorporation into Action Plans for the species' protection, ensuring its long-term viability within its Mediterranean range. This case highlights the importance of evidence-based approaches to species conservation, particularly for peripheral populations facing climatic and human-induced pressures. It underscores the necessity of integrating scientific knowledge into national conservation policies and strategies for the protection of biodiversity.

## THREATENED MAMMALIAN SPECIES

### Understanding Human-Elephant conflict dynamics in a protected area of eastern India: Implications for threatened species conservation

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**Keywords:** Asian Elephant, Endangered species, Conflict

Human-elephant conflict (HEC) remains a pressing challenge for the conservation of the endangered Asian elephant (*Elephas maximus*), particularly in India, which supports 60% of the species' global population. This study investigates HEC patterns and community perceptions in the Palamau Tiger Reserve, a protected area in Eastern India where human settlements border critical elephant habitats. Through semi-structured questionnaire surveys (n=108) and participatory risk mapping sessions (n=30), we examined conflict patterns, community responses, and perceived risks across 21 villages. Results revealed that elephants were unanimously identified as the primary crop raiders, with raids occurring predominantly at night (100% of respondents) and during the monsoon seasons (96.3%). While traditional deterrent methods like shouting (91%) and using explosives were common, their effectiveness varied significantly. Risk mapping identified animal raids, particularly by elephants, as the community's highest perceived risk, followed by inadequate compensation systems. Despite universal awareness of compensation policies, 65.7% of respondents reported receiving no compensation, highlighting a critical gap in conflict management. Our findings reveal that bureaucratic barriers to compensation (affecting 65.7% of victims) and the reliance on largely ineffective traditional deterrents have increased community resentment towards forest authorities and wildlife, potentially threatening long-term conservation goals in this protected area. This study contributes to the broader understanding of Asian human-elephant dynamics and offers valuable insights for developing effective conflict management policies that could benefit elephant conservation across their range.

# Urban Ecology

*(L. Wauters & C. Tranquillo)*

### Who stays and who is gone: trait-driven bat extinctions in Italian cities

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**Keywords:** Chiroptera, bats, extinction, synurbisation

Urban expansion poses significant threats to wildlife by depleting habitats and fragmenting landscapes, in turn affecting species' persistence and population viability. Despite these challenges, cities often host diverse wildlife assemblages, particularly among urban-tolerant taxa, sometimes also featuring conservation-relevant populations. However, the long-term impacts of urbanisation on wildlife remain poorly understood. We investigate the temporal dimension of urban ecology using bats as a model, given their behavioural plasticity and longevity, both factors that make them responsive to environmental changes at different spatio-temporal scales. We hypothesised that urban bat assemblages change in time, with local extinctions in urban areas being trait-biased, and assessed species persistence over a long time window in four Italian cities through historical records, museum collections, field surveys, and citizen science. Final datasets span over two centuries, documenting the occurrence of 25 species, with 22 local extinctions involving 14 species. Extinction events varied geographically, with only two species disappearing consistently, namely *Myotis capaccinii* and *Plecotus austriacus*. Generalised linear mixed models revealed that extinction probability and last observation date were significantly influenced by species' traits, including diet, hunting strategy, and home range size. Larger home ranges, and diets focused on Diptera, were key in securing species' persistence in cities. Conversely, species hunting by gleaning moths from the substrate were more prone to local extinction. Our results underscore the importance of trait-based analyses in understanding biodiversity responses to urbanisation, emphasising the need for long-term monitoring to inform urban conservation strategies, especially for long-lived and wide-ranging mammals like bats. Our findings highlight urban areas as dynamic ecosystems where conservation planning should focus on taxa characterised by specific sets of traits, in order to secure their future in biodiversity-friendly cities.

### Bat habitat use in urban environment based on citizen science data

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**Keywords:** Bats, citizen science, urban ecology

Urbanisation presents significant challenges for wildlife, particularly bats, as their habitats are increasingly modified by human development. Understanding how bats use urban spaces is crucial for effective conservation of this sentinel species. This study utilised a citizen science approach to map bat species, habitats, and activity patterns in an Estonian city, Tartu. Twenty volunteers were trained and surveyed 189 locations, recording bat activity for five minutes per site, with species identifications confirmed by a professional. Across these locations, eight bat species were detected, including *Eptesicus nilssonii*, the Northern bat, which was the most abundant. This adaptable species was found in various habitats, from riverside areas to highly developed urban zones, and was analysed separately due to its ability to thrive in urban environments. High vegetation emerged as a primary predictor of suitable habitats across species, while proximity to water was particularly significant for species other than the Northern bat. This study enhances our understanding of bat adaptation to urban environments and provides valuable insights for conservation strategies aimed at mitigating urbanisation's impacts on bats. By identifying essential habitat features, such as vegetation cover and water availability, we can promote urban designs that are more conducive to bat populations. Furthermore, the study underscores the value of citizen science for ecological research, as it not only generates extensive data and empowers communities to participate in wildlife conservation but also enables researchers to conduct large-scale studies with limited resources, gathering data over broad geographic areas and fostering public interest in conservation efforts.

### Spatial and habitat drivers of small-mammal diversity in urban green areas: Lessons for urban green planning

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**Keywords:** Mice, shrews, biodiversity, city, Italy

In a rapidly changing world, urban green areas are critical for biodiversity conservation. Identifying good biodiversity indicators to investigate whether the environmental characteristics of urban green areas can effectively maintain high biodiversity levels has therefore become increasingly pressing. In our study, we focused on small mammals as urban biodiversity indicators due to their renowned prompt responsiveness to environmental changes. We collected small mammal data in three major Italian cities using about 400 hair-tubes located along a green area size-fragmentation gradient. We adopted a multi-scale approach, and we separately focused on synanthropic and non-synanthropic species. Linear regression mixed models assessed the influence of spatial and habitat characteristics of green areas on richness at the landscape scale. At this scale, synanthropic species richness was positively associated with manicured urban parks, while non-synanthropic species increased in woodland green areas with high shrub cover. Through linear modelling and nestedness analyses, we found that competitive exclusion and selective extinction/ colonisation processes did not significantly influence community composition, proving the key role of habitat composition in supporting urban biodiversity. To further investigate this effect, we applied generalised linear mixed models to non-synanthropic species richness after aggregating local-scale habitat variables using a multivariate approach. The analyses showed that diversified communities of non-synanthropic species can be found in ecotonal areas with a developed shrub layer mainly composed of brambles and hazel, a tall grass layer, water sources, dead trees, and fallen branches. Conversely, communities poor in species were found in green areas with large isolated trees, alien species dominating the shrub layer, and a low grass layer. Some of these results have been published in urban ecology journals and in reports aimed at the development of national restoration plans, showing that small mammals could become key players in studies focused on urban green planning for biodiversity conservation.

## URBAN ECOLOGY

### Urban mammal species, communities and our attitudes towards them

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**Keywords:** Urban biodiversity, Vulnerable, Endangered, mammals

Urbanisation and habitat fragmentation pose significant threats to vulnerable and endangered mammal species. We focused on Dorset, a UK biodiversity hotspot characterised by extensive urbanisation and intensive agriculture. Specifically, we examine the Bournemouth, Christchurch, and Poole conurbation and its surrounding area to assess the role of urban areas in supporting vulnerable and endangered mammals relative to four other land cover types: arable & horticulture, grassland, woodland, and heathland. Utilising 10,872 georeferenced mammal records from 2000–2018, we found that urban areas, despite hosting distinct mammal communities, supported four of the five vulnerable or endangered species recorded: European rabbit, hazel dormouse, West European hedgehog, and European water vole. Complementing this, we studied private gardens and highlight their potential to enhance urban biodiversity through wildlife-friendly practices. Using an online survey, we analysed socio-demographic factors, garden characteristics, and biodiversity indicators to identify opportunities for improving garden biodiversity. This emphasises the critical role of urban landscapes and private gardens in conserving vulnerable species.

### Small mammals along a gradient of human presence and disturbance: behavioural and cognitive perspectives from the wild

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**Keywords:** Innovation, novelty, rodents, human disturbance

Human activities expose wildlife to multiple novel situations in which the ability to produce innovative behaviour could be beneficial. Innovation is generally considered crucial for survival, particularly in novel, complex, and dynamic environments. However, the relationship between animal innovation and anthropogenic alterations is usually examined within highly urbanised areas, leaving the effects of human disturbance in natural areas – where less innovation-prone animals are presumed to find refuge – relatively uninvestigated. Here we exploit a gradient of human presence and disturbance that includes areas with different levels of protection within a National Park, as well as green areas in small human settlements outside the Park, to investigate: 1) how small mammals respond to novel stimuli; and 2) individuals' propensity to express novel behaviour (i.e. innovation). We adapted standard tests commonly used to assess cognition in captive animals to examine neophobia and innovation propensity of free-living small mammals in dietary innovation assessment and a battery of problem-solving tasks. Results suggest that even low levels of human disturbance are linked to differences in responses to novelty and innovation propensity. The study of animal innovation and the factors underpinning among-individual variation in the responses to novelty could thus further increase our understanding of how animals cope with human-induced rapid environmental change.

### Urban disturbance at the wildland-urban interface: Mammalian responses on Bogd Khan Mountain, Mongolia

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**Keywords:** Urban-encroachment, occupancy, activity, human, community

The expansion of urban areas poses significant challenges for biodiversity conservation at the wildland-urban interface. Bogd Khan Mountain, one of the world's oldest protected areas and a UNESCO Biosphere Reserve, is increasingly impacted by the growth of Ulaanbaatar to the north and Zuunmond to the south. This sky-island forest ecosystem faces pressures from road construction, outdoor recreation, and resource exploitation, intensifying human and livestock disturbances. We investigated how urban encroachment affects the mammalian community of Bogd Khan Mountain using 72 camera traps deployed across habitat types, accumulating over 11,500 camera trap nights in 2022–2023. Metacommunity occupancy modelling with a Bayesian formulation and Markov chain Monte Carlo sampling revealed that only the sable exhibited a strong negative response to urban proximity, while species such as Pallas's cats, Siberian chipmunks, and Eurasian red squirrels were more influenced by anthropogenic factors, including the relative abundance of humans, cattle, and horses. To further assess behavioural impacts, we analysed 24-hour activity patterns in the presence and absence of disturbing factors (humans, dogs, cattle, horses). Most species significantly altered their daily activity in response to disturbance. However, wolves co-occurring with dogs, red foxes with cattle, and Siberian chipmunks in the presence of horses and people showed no changes in activity. These findings highlight the diverse responses of mammalian species to urban related disturbances, indicating that species at lower levels of the trophic chain, such as rodents and specialised mesocarnivores, are more significantly affected. As anthropogenic disturbances in the protected area increase, larger herbivores and predators may also experience a bottom-up effect over time. To conserve biodiversity in this rapidly urbanising landscape, stricter regulations on development, enhanced habitat connectivity, and community-led management are essential. Balancing recreation, sustainable resource use, and biodiversity protection is key to ensuring the coexistence of wildlife and people.

### Exploring the urban large and medium-sized mammal assemblage in a small city of South-Central Italy. Implications for human-wildlife conflicts and coexistence

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**Keywords:** Urban, mammals, camera trapping

As urban areas grow, they disrupt natural habitats and have broad consequences on climate and species diversity, impacting ecosystems well beyond urban limits. We explored the large and medium-sized mammal assemblage across an urbanisation gradient within the Functional Urban Area of Campobasso, the largest city and administrative capital of the Molise region (South-Central Italy), which has 47,557 inhabitants. Nine camera traps were deployed in nine grid cells, each classified according to green area surface and fragmentation. A transect survey was also run monthly and compared to results from camera traps. From January to December 2024, we collected 2,400 videos and pictures and presence signs from transects surveys for a total of 13 species of mammals, including the endangered grey wolf *Canis lupus*. Results revealed a significant species diversity variation across grid cells, with species richness ranging from 3 to 12, whereas species abundance varied from 675 individuals to 9, with *Vulpes vulpes* and *Sus scrofa* prevailing across the study area. Specifically, the latter is the most concerning species, as this wide-ranging species is raising human-wildlife conflicts, such as crop damage, vehicle accidents and zoonotic disease transmission, at global scale. However, Shannon diversity index (ranging from 0.315 to 1.79) and evenness (0.846) suggested a balanced species distribution. The estimated species richness (Chao1) aligned closely with the observed richness, indicating that few species went undetected. Our findings emphasised the need for proactive management strategies, such as waste management, fencing, and public education. Further research into wildlife corridors could promote coexistence and guide urban planning that balances biodiversity conservation with human requirements.

### A new dawn for the Eurasian beaver in Italy? Ecological and social implications

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**Keywords:** *Castor fiber*, unauthorised releases, rewilding

After centuries of absence, the Eurasian beaver, *Castor fiber*, once a prominent species in Italy, has re-emerged in recent years, following both natural re-expansion, rewilding and unauthorised releases. This return presents a unique opportunity to study the ecological and social implications of beaver recolonisation. Our research focuses on several key aspects. First, molecular analyses confirmed a central-European origin of beavers both in northern and central Italy, with shared mitochondrial haplotypes with all neighbouring countries. As to beaver ecology, we employed camera traps and field surveys of beaver presence to map the distribution and population density across central and southern Italy. Currently, at least 50 individuals are thought to occur in Italy. Camera trap data from 40 locations and over 3.000 videos confirmed the nocturnal behaviour of this species and 19 reproductive events in 2022-2023, mostly in central regions. To understand public attitudes towards beaver recolonisation, we conducted a comprehensive standard survey of over 1.100 residents. Beavers were confirmed to be widely appreciated, and most respondents showed positive feelings towards the return of this species. We investigated the ecological effects of beaver activity on riparian ecosystems, and we detected positive effects on riparian forest regeneration, as well as on bat and small mammal communities. Neutral effects were detected on macroinvertebrate and meiofauna assemblages. Similarly, beavers have not yet been included in the diet of local large-sized carnivores. Some Eurasian beaver parasites were detected for the first time in Italy, potentially posing a risk to native fauna. Our findings provide worthwhile information for developing effective conservation strategies for the Eurasian beaver in Italy. Northern Italian populations should at least be monitored according to the Habitats Directive 92/43/EEC, whereas management of central and southern populations is still debated given their doubtful origin.

### How mobile generalist bats survive in a resource-depleted urban environment

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**Keywords:** Urban filter, metabarcoding, urbanisation, city

Urbanisation generally leads to a decline in both taxonomic and functional diversity in almost all animal taxa, but the mechanisms underlying this urban filter are largely unknown. Urban bats have been characterised as mobile generalists in a recent meta-analysis (Hahs et al. 2023 NatComm). Here, we evaluated this categorisation by investigating the movement range, hunting success and diet of common noctule bats (*Nyctalus noctula*) in an urban environment. Using GPS tracking, we showed that urban common noctules have large home ranges that even encompass suburban and rural areas. Further, by tagging noctules with sensor loggers we found that urban and rural common noctules feed on insects of similar size, but urban individuals had a lower hunting success than rural conspecifics. Finally, we applied DNA metabarcoding to faecal pellets of common noctules to show that urban individuals consume a greater diversity of insect species than their rural conspecifics, despite the fact that arthropod diversity and availability were decreasing with increasing urbanisation. We speculate that the reduced foraging efficiency of urban common noctules may be offset by the thermal advantage of living in the warmer environment of a city, which is likely to support bat reproduction. Our results highlight that the survival of noctule bats in cities is facilitated by their high mobility and dietary flexibility, both of which are key traits associated with the mobile generalist syndrome. We conclude that the protection of a diversity of green spaces is key to the conservation of common noctule bats in cities, and even more so for bat species with lower mobility and specialised roosting and diet habits.

### Phenotypic variation of an arboreal mammal along a rural-urban gradient

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**Keywords:** Personality, phenotype, urbanisation, *Sciurus vulgaris*

The global expansion of urbanised areas presents significant challenges for wildlife, yet urban green spaces can support diverse mammal communities. Species compositions and diversity in these areas often differ from nearby natural habitats. Mammals can respond to urban pressure through phenotypic changes. We investigated these adaptations in Eurasian red squirrels (*Sciurus vulgaris*) using a pseudo-experimental study design along a rural – urban gradient. Our study examined personality traits, physiological stress response, body size and mass. Using Capture-Mark-Recapture methods, squirrels were measured for hind foot length (a proxy for body size) and body mass, and sex was determined. Fresh faecal samples were analysed to determine concentrations of FGMs (faecal glucocorticoid metabolites), an integrated measure of physiological stress. Personality traits, including activity, exploration, and sociability, were assessed using Open Field and Mirror Image Stimulation tests. We found no significant differences in personality trait expression across rural, suburban and urban sites. However, these traits correlated in a behavioural syndrome in urban and rural sites, but not in suburban ones, suggesting reduced plasticity in suburban areas where mixed challenges from both urban and rural pressures converge. FGM concentrations correlated with squirrel density in rural and suburban sites, with urban sites showing an intermediate response. Body size did not differ along the gradient, but urban squirrels were heavier than rural ones, with sex-specific variations in suburban environments. Whether higher body mass, in association with subtle differences in personality, improves squirrels' fitness in urban areas will need further investigation. This work provides a multi-faceted view of the strategies used to persist in cities, laying the foundation for the development of suitable urban planning.

# POSTER PRESENTATIONS

*(Listed in alphabetical order per session, according to presenter's last name)*

## 1. Enhancing trappability by bait pre-feeding in capturing European ground squirrels

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**Keywords:** *Spermophilus citellus*, trappability, trap-shy, bait, carrot

Trappability is a crucial factor in most field works on mammals. In ground squirrels, we have found site-specific differences in responding to our trapping activities; the animals were especially trap-shy where previous human activity was sparse. These day-active animals were seen to avoid approaching the traps in such places. Here, we report our attempts to reduce fear and increase the trappability of animals by dispersing small carrot slices over the site one day before the actual capture session starts. Carrot slices are unknown to ground squirrels and using them as baits did not enhance trappability. Still it was assumed that such pre-feeding might reduce their initial avoidance by increasing their propensity to enter the traps baited with the already known food. To test this assumption, well-separated parts of the study site were pre-fed with carrot slices, while other parts remained empty. Trapping started next day with all traps baited with carrots. Similar response patterns were recorded from all treated areas, and we found that the trapping success was twice as high in pre-fed areas and remained higher for another two days even though the density of animals, estimated from hole densities, was the same. Such significant difference in trapping success could be attributed to animals being attracted to the valuable bait as we have seen animals fighting for carrot slices mainly because it was a drought period and carrots are rich in fluids hard to obtain from dry grasses. We plan to test the effect of pre-feeding with other baits and in less dry periods to see how robust the results are.

## 2. Factors affecting movement and rest patterns in European pine marten

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**Keywords:** *Martes martes*, movement ecology, radio-tracking

Literature reports several studies on the space use of European pine marten *Martes martes*, but only a few were conducted on fine-scale movement ecology and behaviour. Yet such knowledge is of interest, given the behavioural and physiological characteristics of this mustelid. We investigated the influence of both extrinsic and intrinsic factors on the movement pattern of seven radio-tagged pine martens. Data were collected during 66 sessions of 24-hour radio-tracking with locations taken at a mean of 24 min intervals. By generalised linear mixed models we related movement metrics, rest frequency and rest duration to weather- and light-related variables, habitat composition and weight of individuals. Pine martens covered a mean total distance of  $11.43 \pm 4.08$  km in the tracking sessions, with a length between the starting and the ending points of  $0.75 \pm 0.47$  Km. The distance between consecutive locations averaged  $0.28 \pm 0.31$  km and the speed  $0.67 \pm 0.75$  km/h. Resting activity occurred  $4 \pm 2$  times, with a duration of  $62 \pm 39$  min. Effects of external and internal factors were found on all movement metrics and on rest frequency and duration, with only a few of these variables significantly influencing the movement metrics and none on the resting activity. The distance between consecutive locations and the speed were strongly influenced by cloud cover, whereas the total and the net distance by the percentage of forests included in the 24-hour home range. Animals moved faster and for a longer distance as the cloudiness percentage decreased and the forested habitat increased. Our results point out that pine marten flexibility in movement behaviour is driven by multi-factorial processes, highlighting that movement metrics are mainly influenced by light-related variables and habitat composition. In contrast resting activity is only mildly affected by internal or external factors.

### 3. Wild boar rooting: influence of environmental variables and effect on wood mice abundance in a Mediterranean oak forest

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**Keywords:** *Sus scrofa*, *Apodemus*, vegetation, acorn

Wild boar *Sus scrofa* has been claimed to directly or indirectly impact a wide array of taxa, habitats and ecological processes through its rooting behaviour. Although foraging is the main factor determining the occurrence of rooting, this activity can also be influenced by several environmental variables, such as characteristics of soil layer, habitat type and vegetation composition and structure. Among habitat types, forests are known to be characterised by high population densities of wild boar and intense rooting activity. European forests are amongst the most intensively managed forests in the world, affecting forest compositional and structural features that can influence rooting activity. As part of the biotic community in forest ecosystems, ground-dwelling rodents may suffer from this wild boar foraging activity, due to food competition and direct disturbance. This study assessed whether acorn availability, vegetation composition and structural components of forest habitats (at ground, shrub, and tree levels) influence rooting activity, and whether the latter affects the abundance of *Apodemus* species. The research was carried out in a Mediterranean deciduous oak forest of central Italy across 12 forest sites coppiced in different years, thus belonging to a gradient of regeneration stages. We quantified rooting activity for five years and related it to the composition and structural components of forest sites, *Apodemus spp* abundances and acorn production by generalised linear mixed models. Our results indicate that environmental variables and acorn production did not directly affect rooting extent and suggest that other local factors might have influenced the rooting pattern we recorded. Rodent abundance was not significantly affected by rooting activity, possibly due to a negligible direct disturbance and/or a low degree of food competition with wild boar. Our study contributes to understanding the factors driving this foraging behaviour, which has relevant ecological and socio-economic implications.

#### 4. Should I stay or should I go? Space use of European bison around feeding sites in Białowieża Primeval Forest

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**Keywords:** Feeding, winter, climate, herbivore

Supplementary feeding is a common wildlife management practice, but while it may bring benefits and fulfil management goals, it can also result in unintended negative consequences. In the temperate zone, winter supplementary feeding can reduce movement of some ungulate species, leading to increased utilisation of feeding sites by individuals and, consequently, animal aggregation. However, the intensity of feeding site utilisation varies based on various extrinsic factors, e.g. habitat type, population density, or weather. We examined how winter severity affects European bison (*Bison bonasus*) proximity to feeding sites in Białowieża Primeval Forest, Poland. Using data from 43 GPS- and VHF-collared bison (24 males, 19 females) from 2005–2012, we found that females remained closer to feeding sites than males throughout winter, and regardless of sex, bison were closest to feeding sites in mid-winter (January–February), and on colder days independently of the time of the season. Additionally, the distances of bison to feeding sites were significantly related to snow cover and depth, i.e. bison were closer to the feeding sites on days with present snow cover and deeper snow. Hence, the winter area occupied by bison differed with changing weather severity — being 4 and 28 times larger in the warmest days compared to the coldest days with snow cover (for females and males, respectively). This may have direct and indirect ecological consequences for the ecosystem due to potential impact on nutrient cycling, seed dispersal, interspecific competition, vegetation growth, forest succession and carrion distribution. Given these ecological impacts of bison and weather-dependent utilisation of supplementary fodder, we recognise the possible need in the future to revise and adapt winter supplementary feeding to annual and seasonal variation in winter severity to meet management goals while optimising the costs.

## 5. Diet composition of golden jackals (*Canis aureus*) in Central Europe: Preliminary insights from Austria, Croatia, and Hungary

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**Keywords:** Stomach content, body morphometrics, *Echinococcus*

Golden jackals (*Canis aureus*) have expanded their range across Central Europe in recent decades, raising questions about their ecological role and interactions with local wildlife and human activities. This study investigated the diet of golden jackals from Austria, Croatia, and Hungary to assess their reliance on different prey categories and to investigate potential zoonotic risks. A total of 12 golden jackal specimens were collected between 2021 and 2024 through cooperation with hunters and as roadkill. The mean adult weight was 10.90 kg and morphometric analyses resulted in the mean values of: total length 100 cm, tail length 23.5 cm, head-torso-length 77.1 cm, hind foot length 15.9 cm, ear length 7.9 cm, paw length 5.4 cm and paw breadth 4.2 cm. Stomach content analysis identified nine food categories with the most diverse stomach content containing five food categories. The heaviest stomach content weighed 366 g. Dietary analysis revealed that cervids and wild boar were the most important food categories in terms of biomass – (46.4 % and 27.1 % respectively), some of those samples contained maggots, indicating feeding on carcasses. These findings provide valuable insights into the feeding ecology of golden jackals in Central Europe, highlighting the significance of wild prey in the jackals' diet. This contrasts with findings from many studies Balkans studies, where jackals have adapted to human-dominated environments, with livestock often dominating their diet. One stomach from Austria contained a big plastic bag, indicating potential anthropogenic resource availability, and nature conservation issues because of improper waste management. Additionally, fecal samples were tested for *Echinococcus* spp., with all results proving negative. These findings enhance our understanding of the public health implications, zoonotic risks and potential ecological impacts associated with this expanding species.

## 6. Large carnivores of the Białowieża Forest – anthropogenic effects on intraguild interactions and temporal activity patterns

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**Keywords:** Large carnivores, Białowieża Forest, temporal activity patterns, human disturbance

Sympatric predators partition their ecological niche according to resources, space and time. Therefore, niche partitioning is crucial for facilitating coexistence between sympatric species, and a better understanding of that process is of importance for adjusting conservation efforts and advancing ecological research. Currently, camera trap data has been increasingly used to investigate spatio-temporal interactions within the carnivore guild and how they are affected by different factors. Using camera trapping, this study aims at understanding how human disturbance and associated landscape features impact temporal activity overlap or partitioning, and intraguild interactions between Eurasian lynx (*Lynx lynx*) and grey wolf (*Canis lupus*) in a temperate forest ecosystem (Białowieża Forest, Poland). Higher human presence was associated with increased temporal overlap between lynx and wolves, indicating synchronised activity. Lynx displayed more distinct temporal partitioning from humans compared to wolves across varying disturbance levels. Trapping rates of both species were influenced by proximity to buildings and the presence of other large carnivores. The study also found no correlation between distance from border barriers and predator registration, which may reflect the complexity of border phenomena and the short monitoring periods. These results also highlight the high behavioural flexibility of wolves. Roads and trails acted as crucial movement corridors, therefore telemetry studies are recommended for further insights into temporal overlap in high human activity areas.

## 7. Cultural tapestry: Den-Site selection of Indian Gray Wolves in tribal landscapes

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**Keywords:** Human-Wolf co-existence, cultural beliefs

Species that rely on dens are integral to sustaining ecosystem balance, and gaining insight into their den selection patterns is essential for successful conservation efforts. The Indian Gray Wolf (*Canis lupus pallipes*) faces significant challenges in finding safe denning sites amidst India's human-dominated landscapes. The survival of this species depends heavily on its ability to coexist with humans. As one of the oldest wolf lineages, it has evolved separately and adapted to the semi-arid landscapes of India. This study investigates den-site selection within a 64 km<sup>2</sup> area of the Mahuandanr Wolf Sanctuary, Jharkhand, India. Between 2022 and 2024, 18 active dens were identified and analysed comparing them to 40 random locations to assess the importance of habitat and anthropogenic variables in den-site selection. The results revealed that dens are typically found in areas with abundant Sal (*Shorea robusta*) trees, steep slopes, and increased shrub cover. This highlights the significance of the Sal tree, whose cultural association helps minimise disturbances, indirectly supporting wolf breeding habitats. This study emphasizes the need to understand the ecological requirements of the Indian Gray Wolf and incorporate traditional cultural practices into wildlife management strategies. By shedding light on den site selection in tribal landscapes, the study offers crucial insights for wildlife managers, enabling them to develop effective conservation plans that promote the survival of Indian wolves and foster coexistence with humans amid evolving environmental conditions.

## 8. Consumption of prey contaminated with natural and anthropogenic toxic substances by protected species of shrews (*Sorex araneus* and *Crocidura suaveolens*)

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**Keywords:** Foraging, contamination, lead, toxins, Soricidae

Shrews are a group of mammals particularly vulnerable to the adverse effects of heavy metals in the soil due to their diet, which primarily consists of soil-dwelling invertebrates. This study experimentally tested whether selected shrew species (the common shrew *Sorex araneus* and the lesser white-toothed shrew *Crocidura suaveolens*) can detect and actively avoid contaminated food (hypothesis H1). The animals were subjected to a cafeteria test, allowing them to forage freely for two hours in an experimental terrarium where they could choose among five types of live prey: lead-free earthworms and mealworm larvae, lead-contaminated earthworms and larvae, and millipedes containing natural toxins. All trials were recorded using a digital camera. The study also compared: (a) responses to different toxic food types, specifically natural millipede toxins with anthropogenic lead contamination in earthworms and mealworms, assuming that shrews would be more effective at avoiding prey with natural toxins than with anthropogenic ones (H2); and (b) food preferences between *S. araneus* and *C. suaveolens*, hypothesising that *S. araneus*, with a faster metabolism and higher food requirements, would be less selective in prey type (H3). The results led to rejecting hypothesis H1, as the test animals did not avoid lead-contaminated food. Analyses showed no significant differences in shrews' responses to contaminated versus uncontaminated prey. However, the remaining hypotheses were supported. The shrews demonstrated a clear trend of avoiding millipedes, aligning with hypothesis H2. In line with hypothesis H3, common shrews consumed four out of five prey types, exhibiting more opportunistic behaviour compared to lesser, white-toothed shrews, which restricted their intake to only two of the five available prey types. This study suggests that shrews avoid naturally toxic millipedes but not lead-laden prey, likely due to a longer evolutionary period to adapt to avoiding natural toxins than anthropogenic ones, such as heavy metals.

## 9. Size matters: hibernation site effects on bat abundance and species composition

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**Keywords:** Bat, hibernation, site selection

Bats (Mammalia, Chiroptera), being the only flying mammals, have a worldwide distribution and wide ecological range. In temperate latitudes, bats are small and insectivorous. Hence, they face various challenges associated with seasonality. Long and cold snowy winters bring dangers such as starvation because of the lack of food or death due to extreme weather conditions. To survive until spring, bats can either migrate to areas with milder conditions or hibernate *in situ*. The latter relies on finding appropriate hibernation sites with suitable environmental conditions. Natural and artificial underground sites act as such places and can shelter between a handful up to thousands of animals. Very little is known about how bats select overwintering sites that facilitate their survival over the critical hibernation period at northerly latitudes. Through our research, we investigate how the size of the hibernacula could affect the selection of overwintering shelter by bats. The data for this research was collected in South-Eastern Finland and North-Western Russia. Our results show that it is the length of the hibernation site, measured as the distance from the entrance to the most remote part of the site, that has the greatest influence on bat presence. Both the number of bat species and the total number of bats increase with distance, but only up to a certain point. We also found species-specific preferences in hibernacula choice. For instance, *Eptesicus nilssonii* tends to utilise small-sized hibernacula, whereas the probability of meeting *Myotis* species increases when the size of the hibernation site is over 15 m. These results will be useful in underground sites management and for the purposes of bat conservation.

## 10. The ongoing search for one of the smallest of predators: the least weasel *Mustela nivalis vulgaris*

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**Keywords:** *Mustela*, *Mostela*, detection, camera-trap

Small mustelids play an important role in ecosystems as specialist predators of rodents. However, due to their small size and elusive behaviour, observing small mustelids is challenging, and our knowledge about their population dynamics is still limited to inferences based on tracks and signs. The development of enclosed camera-trap systems to study small mustelids in a non-invasive way has changed these conditions and long-term study of the animals is now a possibility. Since August 2022, we have been conducting a study of the spatial activity of the least weasel *Mustela nivalis vulgaris* at the Middachten Estate, a 50 ha floodplain area in the Central East part of the Netherlands. This study had two specific aims: 1) to study how the spatial occurrence of weasels in the area changed across the seasons and 2) to test if we could identify individual weasels to allow density estimation using capture-mark-recapture methods. We placed 16 Mostelas — enclosed camera-trap systems — in linear landscape features on average 275 m apart and checked and baited them with salmon oil every two weeks. Up to Winter 2024/2025, over a period of a little over two years, we obtained more than 900 weasel observations. Our initial results confirm earlier studies showing that daily detection probabilities of weasels in Mostelas are highest at the end of summer/beginning of autumn. We also found the first evidence of seasonal fluctuations in the relative abundance of the weasel. Furthermore, with identification of at least eight individual animals, we confirmed the idea that least weasels can be identified from their spot patterns. We are planning to conduct capture-mark-recapture analyses on these data as well as dynamic occupancy models to study how the spatial occurrence and density of weasels changed over time.

## 11. Diet selection of the Barbary Deer in Beni Salah Natural Reserve, Algeria

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**Keywords:** Cervidae, Barbary deer, diet selection, micro-histology, selectivity index

The Barbary deer (*Cervus elaphus barbarous*) is the only cervid species in Africa. It can be found in a limited patchy distribution in the country's Northeastern area and has been considered a protected species by the Algerian government since 1982. However, hunting pressure, habitat degradation, and fragmentation have resulted in a decline in the quality and availability of suitable habitats for the species, leading to a severe decrease in the population and an increased risk of extinction. A preliminary diet selection study was conducted in Beni Salah Forest, a 2,200-ha natural reserve in northeast Algeria, to determine if the area may support adequate population growth. Ten 25-m south-to-north line transects were used to assess vegetation availability. The density of the vegetation cover along the line was measured 40 cm above ground. Eleven faecal samples were collected during the year. Plant material was collected for the epidermis reference collection, and the Micro-histology method was applied to obtain slides with epidermic fractions from the faecal samples. Manly's selectivity index ( $w_i$ ) was calculated for each plant species and resource category. Our results show that *Quercus suber* and unidentified herbs formed the bulk of the diet: ( $21.3 \pm 7.8\%$ ,  $19.2 \pm 8.3\%$ ), respectively. Overall, trees and shrubs were the most positively selected class ( $w_i = 1.111$ ,  $p < 0.045$ ), with seven tree and shrub species positively selected and *Erica arborea* (4.45%) being the most positively selected species ( $w_i = 3.402$ ,  $p < 0.001$ ). However, herbs and grasses were classified as a negatively selected class ( $w_i = 0.732$ ,  $p < 0.001$ ). Our results were in accordance with other studies in the Mediterranean region, with slight differences in diet and preferences compared to other populations in the North African region, which may be explained by the difference in the vegetation cover, landscape heterogeneity, and seasonal changes in availability.

12. Getting to the point: Antler growth cycle in the Visayan spotted deer  
*Rusa alfredi*

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**Keywords:** Wildlife, monitoring, Philippines, cervids, pedicle

Deers undergo impressive physiological changes throughout the year. One of the most evident changes is antler development. The study was conducted at Negros Forest Park, Bayawan Nature Reserve, the Phillipines managed by the Talarak Foundation Inc. Data, including pictures and videos, were collected using camera traps and mobile phones. Antler growth and identification of cyclical or non-linear growth patterns of adult and sub-adult male deer were measured. Individual antler growth was measured according to its development stage when the collected camera trap footage and mobile photos were reviewed. The initial first growth is button bucks, i.e.the first time a deer grows antlers in individuals born within the reserve. The data was collected by observing various stages of antler development. These stages included the Young stage, where no antler is present, followed by the Pedicle Growing stage, during which the antler pedicle protrudes significantly from the skull and velvet begins to form. In older animals, Antler Growth resumes after the casting of previous antlers. During the Velvet stage, antlers are actively growing, characterised by a lighter colour compared to the pedicle. The Cleaning stage occurs as the velvet sloughs off, revealing the Hard Antler stage, where the hard, sharp, calcified antlers are fully exposed with all tines visible. Finally, during the Casting stage, the antlers are shed, completing the cycle. The combination of data from these individuals has been collated to identify if there is a seasonality to the growth period, a consistency in the duration for the growing period and wear prior to dropping or if these specific growth patterns are individualistic and influence more by genetics than environmental factors. For this analysis, we will use a combination of rank correlation tests and ANOVA test of variance to identify similarities or differences among the individuals.

### 13. Effects of different snow cover conditions on the breeding of Japanese field voles

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**Keywords:** Winter breeding, snow, population dynamics, *Alexandromys*, vole

The Japanese field vole (*Alexandromys montebelli*) causes damage to fruit tree barks in orchards during winter, but the extent of agricultural damage varies greatly from year to year. Empirical observations suggest that damage tends to increase in years with heavy snowfall, but the mechanism underlying this pattern remains unclear. Our previous studies of population dynamics have shown that Japanese field voles in this region breed under snow cover in winter. An ongoing study that started in 2022 aims at determining how variations in the onset and the amount of snow cover affect vole breeding. Japanese field voles were captured by live-trapping every 10 days from December to March, corresponding to the period of snow cover in the region, and their breeding status was recorded based on sex, weight and appearance. Snow conditions differed markedly in 2022 and 2023. In 2022, snowfall was average, whereas 2023 experienced record low snowfall, with a maximum snow depth reaching only about 25% of the previous year's depth and a snow cover duration reduced to 1/3 of the 2022 level. Despite these differences, the onset of breeding did not vary significantly between the years. However, in the low-snow year, voles had significantly lower body weights. In addition, while the majority of adult females captured in 2022 were reproductive (in late gestation or lactation), in 2023 fewer than 20% of adult females exhibited signs of reproduction. These results suggest that deep and consistent snow cover plays a role in increasing vole weight and improving reproductive success. In years of heavy snowfall, the increased reproductive success is likely to lead to a population spike during the snow cover, resulting in increased damage to fruit trees.

## 14. All you can eat: artificial feeding sites affect space use of large herbivores and their predator in a human-dominated landscape

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**Keywords:** Artificial feeding, predation, wildlife management

The re-expansion of large mammals in European human-dominated landscapes poses new challenges for wildlife conservation and management. Supplementary feeding of ungulates is a widespread practice with several motivations, including hunting, yet the known effects on target and non-target species have yet to be disentangled. According to optimal foraging theory, such concentrated food sources may attract herbivores and carnivores in turn. As such, feeding sites may skew the spatial distribution of wildlife and alter intra and interspecific interactions, including predator-prey dynamics. Here, we investigated the use of ungulate-specific feeding sites by target and non-target species in a human-dominated and touristic area of the Alps, using systematic camera-trapping. We assessed potential temporal segregation between roe deer and red deer at feeding sites, and whether these concentrated artificial food sources influenced occurrence and site-use intensity of ungulates and wolves at the broader scale. We found that feeding sites frequentation by roe deer was influenced by the presence of red deer, with a higher crepuscular and diurnal activity at feeding stations strongly used by red deer, indicating potential temporal niche partitioning between the two ungulates. We also found that ungulates occurred with a higher probability at shorter distances from feeding sites and used sites with high human activity less intensively than undisturbed ones. Wolf site-use intensity was higher closer to feeding sites, indicating a potential effect of supplemental feeding sites on both prey and predator space use. Our results unveil undesired side effects of artificial feeding sites, thus contributing to a more informed and evidence-based management, with high relevance especially in light of the considerable recovery of large mammals across anthropised regions of Europe, and the popularity of artificial feeding of ungulates for hunting or recreational purposes. We thus advice limiting this practice in areas where large herbivores, predators and humans closely coexist.

## 15. The foraging ecology of *Plecotus kolombatovici* on Lokrum Island, Croatia

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**Keywords:** Bats, *Plecotus kolombatovici*, foraging

*Plecotus kolombatovici* is the smallest of the European long-eared bats; it is largely confined to the islands and coastal areas of the eastern Mediterranean, from Istria in the north-west to Cyprus in the south-east. Its recognition as a full species is relatively recent, and consequently it is one of the least studied European bats. In this study we investigated spatial use, habitat selection and resource partitioning of a population of c100 *P. kolombatovici* on a small Croatian island. The study site, Lokrum Island, is located some 600m off the port of Dubrovnik. It is 1600m long and between 300 – 600m wide, with an area of 70 ha. The underlying geology is limestone and dolomite, resulting in the island's fertile soils. Lokrum is heavily vegetated with a mosaic of habitats from dense woodland to more open scrub; the predominant tree species are Aleppo pine (*Pinus halepensis*) and Holm oak (*Quercus ilex*). During June 2017 and 2019, 17 adult female *P. kolombatovici* were fitted with 0.3g radio-tags and tracked overnight with fixes taken every 5 minutes. Spatial analysis was undertaken in Ranges 7 and habitat selection was determined using Compositional Analysis. The mean foraging range (Minimum Convex Polygon) was 48.15 ha (SD 13.69), the mean core foraging area (50% Kernel) was 5.37 ha (SD 3.08) and the mean distance from the roost to the centroid of the foraging area was 125 m (SD 79.67). There was considerable crossover in the foraging ranges and core foraging areas of the tagged bats. Dense, evergreen forest with holly and myrtle scrub, along with areas of open water, were highly selected habitats. On Lokrum Island this species avoided olive groves and coastline.

## 16. Rodents vs endophytic fungi: Do mice and voles recognise infected food in cafeteria tests?

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**Keywords:** Toxicosis, behaviour, alkaloids, food preferences

This study examines the potential influence of toxic alkaloids produced by endophytic fungi on rodents from different trophic groups: the granivorous striped field mouse *Apodemus agrarius*, the herbivorous common vole *Microtus arvalis* and the omnivorous house mouse *Mus musculus*. The rationale is that fungal mycelium of endophytes can infest the plant's seeds and vegetative parts, though to varying extents. As a result, the alkaloids may be contained in both, causing toxicosis of differing intensity among herbivores from different trophic groups. The following hypothesis was verified: rodents avoid feeding on grasses infected with fungus. The specific predictions were: (1) the striped field mouse will prefer eating seeds over green parts of plants, while common voles will prefer eating green parts over seeds; (2) the striped field mouse will avoid infected seeds more than infected green parts; (3) the common vole will avoid infected green parts more than infected seeds; and (4) the house mouse will show less differentiated responses. A total of 69 individuals from the three species were tested in cafeteria (food selection) tests. During the two-hour trials, the animals could choose between infected with the endophytic fungus and uninfected seeds and green parts of grass *Puccinellia distans*. Initial analyses revealed significant food preferences and avoidance differences among the tested rodents, consistent with the above-mentioned predictions. Studying these interactions in the model of wild rodents offers valuable insights for both basic research (understanding mechanisms and dependences) and practical applications (using this information to modify agricultural practices). These studies will also enhance our understanding of how different concentrations of fungal alkaloids affect small wild mammals at the individual level (changes in food preferences) and the population level (changes in survival or reproduction).

## 17. Does predation shape stress physiology in Białowieża forest ungulates?

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**Keywords:** Predation risk, stress, glucocorticoids, gluconeogenesis

Non-consumptive effects of predation can elicit physiological responses in prey. However, the mechanisms driving these effects remain poorly understood, and factors influencing prey stress responses are as yet unclear. We aim to investigate the physiological stress responses of wild deer populations in Białowieża Forest (BF), Poland, under varying long-term predation risk (high, medium, low) from wolves and lynx. We hypothesise that deer in high-risk areas will exhibit higher levels of faecal glucocorticoid metabolites (FGMs) than in lower-risk areas. Following the general stress paradigm hypothesis, we also aim to determine whether the predation-induced stress may result in protein gluconeogenesis that promotes nitrogen (N) excretion in faeces and urine, anticipating higher N levels in high-risk areas. We obtained FGMs concentration (by enzyme immunoassay) and N content (by elemental analysis) in 858 faecal samples (red deer: 612; roe deer: 246) and 213 urine samples (red deer: 163; roe deer: 50) collected across distinct areas with different predation risk levels in BF (2023, 2024). Predation-risk data were obtained by modelling camera-trap data from long-term carnivore monitoring. Preliminary results indicate consistently higher FGM levels in red deer in low-risk areas in both years. This may explain possible temporal fluctuations in the predation risk gradient, suggesting that red deer in low-risk areas may currently experience a higher predation risk. In contrast, faecal N concentrations revealed a generally higher level in roe deer and low-risk area, whereas red deer faeces were N-richer in medium-risk area. This may be related to the different winter diets of the two deer species, depending on the location. Our faecal N results will soon be complemented by urine N analyses to better understand how predation risk and dietary constraints affect deer physiological stress.

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18. Arboreal locomotor and postural behaviour in captive *Apodemus* sp.  
(Rodentia: Muridae)

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**Keywords:** Forest, grassland, Greece, positional, woodmouse

The arboreal habitat is characterised by a complex structure of intertwined available substrates that vary in dimensions, inclinations and structure, imposing significant behavioural constraints. To better understand how small mammals perform in such complex, multidimensional, and unstable habitats, we compared the positional behaviour of wild woodmice (*Apodemus* sp.) from forested and grassland habitats. Four and three wild-trapped individuals from the respective habitats were video-recorded at night in a specially designed enclosure with branches of varying sizes and inclinations. Video recordings were subsequently analysed to collect data on postural and locomotor modes as well as substrate type, size and used inclination. Both forest and grassland individuals showed a remarkable diversity in positional modes and the use of the available arboreal substrates, underlining the arboreal abilities of woodmice. Nevertheless, forest-dwelling individuals were more arboreal, used more arboreal substrates of fine size and horizontal inclination, and engaged in more climbing and bridging locomotion and standing and suspensory postures. Between the sexes, males were significantly more arboreal than females. Forest dwelling males were more arboreal than grassland males, using more fine and horizontal substrates and adopting more climbing and suspensory postures. Females from forest habitats were more arboreal than grassland females, using a higher proportion of smaller substrates and more standing and bridging postures. Our findings indicate that woodmice that live in forested habitats employ a more proficient use of arboreal substrates through more flexible positional modes that contribute to more effective navigation and more efficient exploitation of challenging habitats. More research in this direction will highlight the behavioural adaptations of small rodents that contribute to their success in exploiting a variety of different habitats.

## 19. Wind and Wings: Exploring the potential for bat migration in Ireland in the context of offshore wind energy

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**Keywords:** Migration, offshore wind-energy, genomics, SIA

Offshore wind energy production is an important component of the Irish renewable energy sector. However, through turbine impacts and barotrauma, studies worldwide have demonstrated that windfarms can cause high instances of bat mortality, particularly for migratory species. Despite this, there remains a paucity of information not just on the potential impacts of offshore windfarm development on Irish bats, but also on the extent to which bats migrate over open marine waters to and from Ireland in the first place. Focusing on two native Irish species that are known to be migratory elsewhere in Europe, the Nathusius' pipistrelle (*Pipistrellus nathusii*) and Leisler's bat (*Nyctalus leisleri*), we aim to identify migratory patterns in Irish populations, which could expose these species to the impacts of future Irish offshore wind turbine developments. Using tissue and fur samples from bats in Ireland, Britain and continental Europe, we aim to compare two different methods to infer if migration is occurring between these regions. For the first method, we will screen thousands of single nucleotide polymorphisms (SNPs) using ddRAD sequencing in individual bats to determine the extent of gene flow/migration between sampled populations. Secondly, fur keratin samples will be subjected to stable isotope analysis for five stable isotopes (hydrogen, oxygen, nitrogen, carbon and sulphur) for a comparison of the isoscape origins of bats between sampled regions. The application of these complementary methods will allow us to determine the extent of migration in these Irish bat species and identify the potential impacts of offshore wind development on these species in an Irish context.

## 20. Discovering how young minds see wolves: Can we learn to coexist?

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**Keywords:** Youth opinions, science communication, education

Despite substantial evidence highlighting the crucial role of top predators in maintaining ecological balance, public perception of wolves remains predominantly negative and intolerant. This negativity often arises from a combination of lack of knowledge, misunderstanding, and cultural traditions shaped by the absence of predators. The objective of our project is to bridge the gap between science and the public, particularly among children, by utilising a board game as a tool for science communication. In doing so, we explore an innovative approach to teaching, and we report the opinions and attitudes of children towards large carnivores. The project is in progress, and preliminary findings are already yielding intriguing insights.

## 21. Assessing wildlife mortality on Uzbek highways: A study of roadkill patterns and influencing factors

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**Keywords:** Roadkill, mammals, Uzbekistan

Uzbekistan ranks fourth among the CIS countries in terms of the length of public roads, totalling 42,900 kilometers. It is widely recognised that highways are a direct factor in animal mortality. During three years, we investigated wildlife mortality on Uzbek roads, focusing on sections of the A380 Tashkent-Samarkand-Bukhara-Nukus-Karakalpakstan, A379 Navoi-Zarafshan-Uchkuduk, and 4R36 Jizzakh-Nurata-Zervshan-Uchkuduk-Nukus highways. For analysis, the roads were divided into 50-kilometre sections, resulting in a total of 54 segments. Each section was characterised by traffic intensity, average vehicle speed, road width, and landscape type (natural and anthropogenic). The total length of the surveyed routes was 6081 kilometres. A total of 140 individuals from 21 species were recorded, including three reptiles, four birds, and 14 mammals. Wild animals accounted for 97.1 % of the recorded roadkill. Mammals comprised 51.9 % (11 species) of the total, including Insectivores (6.7 %), Rodents (21.5 %), Lagomorphs (12.6 %), and Carnivores (10.8%). *Spermophilus fulvus* (8.2 %), *Rhombomys opimus*, and *Allactaga elater* (5.2 % per each) were the most frequently observed species among the roadkill. *Vulpes vulpes* (7.4 %), one of the most abundant carnivores in Uzbekistan, was also frequently found as roadkill. Cases of roadkill involving *Canis aureus* and the endangered *Vulpes corsac* were also recorded. The highest probability of animal mortality was observed on road sections with a medium width (three-lane), vehicle speeds of at least 40 km/h, and traffic volumes of at least 10 vehicles per hour. Additionally, the landscape influenced the likelihood of wildlife being struck by vehicles, with natural biocenoses exhibiting higher species diversity than urban and agricultural areas. Seasonal variations also played a role, with spring witnessing increased roadkill due to the dispersal of young animals and the emergence of species that hibernate during the summer-winter season, such as yellow ground squirrels.

## 22. Protection, restoration and management of important roosting sites for bats in Greece

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**Keywords:** Chiroptera, conservation, cave gating

Bats (Chiroptera) are one of the most vulnerable orders of mammals in Europe, with all species being listed in Annex IV and 14 of them included in Annex II of the Habitats Directive. Eleven species establish large colonies in caves, mines and other underground roosts and occasionally buildings, facing diverse pressures including improper gating, nuisance, vandalism and demolition. In the framework of the project "Greek Caves and Bats: Management Actions and Change of Attitude" - LIFE GRECABAT (LIFE17 NAT/GR/000522), eleven caves, and other bat roost types inside N2000 sites were chosen for restoration. These sites provide shelter to important colonies of twelve bat species and are subjected to substantial pressures and threats. Here, we present the designed works which include the restoration of a collapsed mine entrance, the installation and replacement of gates, grilles and fences, the management of vegetation and the reconstruction of a building. We also address the impact on the protected sites and wildlife species as evidenced by the subsequent surveys and lessons learned so far.

## 23. After 50 years Eurasian otters are (slowly) returning to central and northern Italy

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**Keywords:** Eurasian otter, recovery, Italy, range, *Lutra lutra*

Once widespread throughout the Italian peninsula, Eurasian otters dramatically declined during the 1970s, and their range remained restricted to few rivers in Southern Italy till the onset of 2000. Thereafter, legal protection and banning of harmful pollutants by the European Union promoted a gradual re-expansion of the species into its former range. However, otter recovery has mainly occurred in southern Italy, with a few records in the northern Italian regions. To assess the current status of otters in the northern and central parts of its historical range, WWF Italy launched in 2023 a systematic monitoring in 2023. We identified 651 10x10 km grid cells (ETRS89 LAEA projection) across 38 river basins which were chosen as neighbouring the current otter range, including the last otter strongholds before extinction, or because of recent otter sightings or road-killings. To optimise sampling efforts, we selected one survey site per grid cell based on a habitat suitability model produced for a 150 m buffer around the hydrographic network up to the fourth river order. Each site was surveyed for otter signs following the IUCN/SSC Otter Specialist Group standard method. A total of 65 cells yielded signs of otter presence (10%) and the species occurrence was recorded in four regions where it had been considered extinct. The new records confirmed the ongoing expansion in Central Italy (i.e., Latium, Marche and Tuscany), and north-eastern Italy (i.e., Veneto and Friuli) and the colonisation of north-western Italy from neighbouring countries (i.e., Liguria, from France). Small populations were also detected at the border with Switzerland (i.e., Lombardy) and Austria (i.e., Alto Adige). Despite these promising findings, otters remain extremely rare, and their current distribution is still highly fragmented in central and north-western Italy, stressing the need to enforce strict protection measures and maintain a surveillance monitoring of the newly colonised river basins.

## 24. Satellite monitoring of the endangered pampas deer (*Ozotoceros bezoarticus* L.1758) in an agroecosystem

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**Keywords:** Home range, habitat, daily activities

The Pampas deer (*Ozotoceros bezoarticus* L.1758) is one of the threatened deer of South America. In Uruguay there are two endangered and isolated populations belonging to two different subspecies *O. b. arerunguaensis* and *O. b. uruguayensis*. The subspecies *O. b. arerunguaensis* inhabits the North of Uruguay in livestock ranches (31° 56' S; 56° 90 'W). Through the rut season last March 2022 and April 2024 five males were captured on each occasion in two livestock ranches. The livestock density of these two ranches are 0.6-0.7 cattle per hectare, and they did not share the area with sheep. During the chemical immobilisation process, Telonics™ GPS-Globalstar telemetry collars with a programmed drop-off mechanism were placed on the captured males. The aim of this study was to examine the home range, and daily and seasonal activity patterns. For this, GPS fixes collected every seven hours over 13 months were analysed for five males. The data were analysed using two methodologies: Minimum Convex Polygon (MCP) and Kernel Density (KD) as estimators of home range. Movement patterns were analysed considering seasonality, as well as diurnal and nocturnal activity. The average home range obtained in hectares by MCP was 272 (100%), 102 (95%), and by KD was 128 (95%). The minimum home range was obtained for individual number 1: 91 MCP (95%) and 98 KD (95%). The maximum home range was obtained for individual number 3: 124 MCP (95%) and 171.85 KD (95%). The results show significant overlapping between males of the same establishment and pasture. This overlap is expected in a gregarious species. There are differences in the patterns of diurnal and nocturnal home ranges. These findings suggest that Pampas deer can coexist within agroecosystems if their habitat is protected, and agricultural management practices incorporate biodiversity conservation.

## 25. Cultural bridges to coexistence: Local perceptions of wolf conservation in tribal landscapes

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**Keywords:** Human-wildlife Conflict, perception, attitude

Human culture plays a vital role in fostering sustainable coexistence between people and wildlife. While protected areas serve as critical havens for wildlife conservation, they are often intertwined with the livelihood activities of local communities. This overlap can sometimes result in conflicts, reducing local tolerance for wildlife, especially carnivores that occasionally prey on livestock. Integrating cultural dimensions into conservation efforts has the potential to bridge these challenges and promote harmonious human-wildlife interactions. Understanding the factors that drive conflicts and the perspectives of communities living alongside carnivores is crucial for improving conservation outcomes and increasing the social tolerance towards these species. We conducted a questionnaire survey between 2022 and 2024, using a Likert scale, to assess villagers' attitudes and explore the socio-economic and cultural factors influencing their views on wolf conservation in India's only wolf sanctuary, the Mahuadanr Wolf Sanctuary. The results revealed that most villagers hold a positive attitude towards wolf conservation and are willing to take responsibility and collaborate with the forest department on conservation activities. Furthermore, the study found that higher education levels, female respondents, and followers of the Sarna religion exhibited the highest attitude scores among the villagers. These findings underscore the significance of socio-cultural factors in tribal landscapes and contribute to a broader understanding of human-wolf coexistence.

26. It's been here all along! Initiatives to disseminate knowledge and raise awareness on the endemic Cretan shrew, *Crocidura zimmermanni*, at Psiloritis UNESCO Global Geopark (Crete), Greece

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**Keywords:** Science communication, education

UNESCO Global Geoparks (UGGp) are areas where sites and landscapes of international geological significance are managed with a holistic concept of protection, education and sustainable development, that concerns geological, biological and cultural diversity. Within this context, the present contribution presents initiatives that Psiloritis UGGp has undertaken to introduce to the residents and visitors of our area one of the most interesting, but still largely unknown, endemic species of Crete: the Cretan shrew, *Crocidura zimmermanni*. The Cretan shrew is one of the few remaining representatives of the Pleistocene insular fauna of the Mediterranean and the only recognised endemic mammal of Greece. Psiloritis UGGp actively supported recent research on the species and with the resulting up-to-date scientific knowledge, new signage referring to the Cretan shrew was installed in the Geopark's Information Center and at Nida Plateau, the type locality for the species and one of the most visited geosites of the geopark. The new signage, along with the outreach events and printed and digital informative material where the Cretan shrew had already been mentioned, significantly increases visibility for the species within and outside the territory. Furthermore, the Cretan shrew has been incorporated into the Geopark's educational tools and presented as a case study in the educational program on biodiversity, focusing on endemism and threats. Finally, a new activity is being developed for teenagers and young adults in the form of a "detective game", where the Cretan shrew is the protagonist that is searching for its "lost friends", the rest of the Quaternary endemics of Crete (e.g., dwarf deer, giant mice) that have now gone extinct! Through this activity, the visitor discovers the history of the Geopark's Quaternary species and the Cretan shrew's own journey from its first appearance until today, where it is itself Endangered.

## 27. Who's that cat? Paving the way to characterise the Sardinian wildcat and assess its conservation status

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**Keywords:** *Felis silvestris lybica*, Sardinia, wildcat

Sardinian wildcats (*Felis silvestris lybica*) were introduced from North Africa into the island of Sardinia during Late Neolithic or Iron Age. Despite a long history of isolation and possible divergence from other wildcat populations, knowledge on this taxon is scarce. The Sardinian wildcat population is threatened by various factors such as habitat fragmentation, illegal or incidental killings and potential hybridisation with free-ranging domestic cats. A lack of knowledge about its distribution, morphological variation and genetic make-up is hampering a correct definition of this population's taxonomic and conservation status. In order to fill this gap, an integrated approach was adopted for the first time, including the collection and standardised morphological evaluation of 23 road-killed individuals, combined with their genetic characterisation using 29 polymorphic autosomal microsatellite loci. To complement this approach, a questionnaire was distributed among local communities to collect baseline information on the perception of wildcat presence and morphology by people inhabiting rural areas of Sardinia. Molecular investigation allowed us to identify pure wildcats on the island, as well as a small number of hybrids, and *F. s. lybica* individuals showed recurrent specific morphological traits. Further ongoing research, including camera-trapping and non-invasive genetics, will shed light on this island taxon and enhance its conservation.

## POSTER PRESENTATION-Conservation Biology

### 28. A multi-faceted approach to conserving the lesser horseshoe bat on the north-western edge of its range

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**Keywords:** Roosts, landscape modelling, stakeholders, agriculture

Ireland holds a small, isolated population of the lesser horseshoe bat (*Rhinolophus hipposideros*), comprising approximately 14,000 individuals. Although monitoring indicates that its numbers are increasing, it is confined to six regions that are separated by large areas with few or no colonies. The population now consists of four distinct sub-populations due to habitat fragmentation, urbanisation and the presence of two large water bodies that may pose additional barriers to movement. In contrast to other species whose numbers are declining and for which little is known about their ecology, the lesser horseshoe bat in Ireland has been the subject of surveys, long-term monitoring, research and conservation since the late 1970s. By 2019, however, its conservation status within Ireland was unfavourable and inadequate. During 2021, Vincent Wildlife Trust partnered with the National Parks and Wildlife Service, Ireland's Statutory Nature Conservation Organisation, to write the first Species Action Plan for the lesser horseshoe bat in Ireland, the aim of which is to guide, inform and provide structure for the conservation management of this important bat species over a five-year period (2022-2026). The plan contains 29 actions, with significant progress made on many of these by a range of stakeholders, including the provision of new roosts through an agri-environment scheme, repairs and enhancement of existing roosts, improvements to data recording, and habitat modelling studies to identify key locations for retaining or creating landscape connectivity. Here, we present the progress in implementing these actions and the subsequent impact on lesser horseshoe bat populations in Ireland.

## 29. Discovery of new maternity colonies (2023 – 2024): Lesser Horseshoe bats thrive despite conservation challenges in Bosnia and Herzegovina

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**Keywords:** Lesser horseshoe bat, *Rhinolophus hipposideros*, maternity colonies, biodiversity conservation

The lesser horseshoe bat (*Rhinolophus hipposideros*), a vital species for biodiversity conservation, is highly sensitive to habitat alterations. Field surveys conducted in Bosnia and Herzegovina from June 2023 to September 2024 documented significant reproductive activity and identified several new maternity colonies, providing critical insights into the species' reproductive ecology. Research conducted during the summer months relied on direct visual observation and photographic analysis to assess colony size and reproductive status. Noteworthy findings include a colony in an unfinished house in Maglaj, which grew from eight individuals in July 2023 to nine adults by June 2024, including six females with juveniles in both years. Similarly, a previously unoccupied house in Dištica (Zavidovići) hosted 11 individuals, in June 2024. A cave in Turovi supported six bats in 2023, increasing to eight in 2024, indicating consistent use and reproduction. Sutjeska National Park emerged as a conservation hotspot, hosting 183 individuals in 2023 and 162 in 2024. However, technical difficulties prevented a complete survey of all sites in 2024. In 2024, additional colonies were discovered: 17 bats in an abandoned tavern in Orlja (Olovo), 18 in a watermill in Nevesinjsko Polje (with two more in another mill), 26 adults (15 with juveniles) in a neglected building in Stojčevac, and six in a derelict motel on Mount Šator. These findings underscore the critical role of abandoned structures and karst habitats for *R. hipposideros*, serving as essential roosting and breeding sites. Habitat preservation efforts should focus on maintaining these environments and mitigating threats. Continuous and standardised monitoring is crucial to track population dynamics and assess the effectiveness of conservation measures. This approach ensures the protection of *R. hipposideros* and supports broader biodiversity conservation goals.

30. Investigating the role of ecological and anthropogenic factors in shaping the site use patterns of Gaur (*Bos gaurus*) in Palamau Tiger Reserve, Jharkhand, India

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**Keywords:** Threatened species, ecological modelling

The Gaur (*Bos gaurus*), a crucial herbivore in tropical forest ecosystems, contributes significantly to ecological balance and is listed as vulnerable by the IUCN. However, its survival faces threats from habitat degradation and increasing anthropogenic pressures. Understanding the relationship between Gaur and their habitats is essential for effective conservation strategies. This study explored the impact of ecological and anthropogenic factors on Gaur site use in Palamau Tiger Reserve (PTR), Jharkhand, India, using a 'use versus availability' resource selection function. A 1 km × 1 km grid over Betla and Chhipadohar East forest ranges created 146 sampling units. Random 5 km walks within these units identified Gaur signs, with 15-meter circular plots (used plots) established at sign locations and two random plots (availability plots) within the same unit. Data collection occurred between April and June 2024, with generalised linear models analysing factors affecting site use. Gaur signs were detected in 29 of 146 units, comprising 56 used plots out of 87 habitat plots. The best-performing model included distance to road, distance to the watchtower, grass cover, and livestock presence, with the lowest AICc value (68.52) and highest model weight (0.44). Site use increased in areas with higher grass cover and proximity to watchtowers, while it decreased with increased livestock presence and greater road proximity. These findings highlight the need for targeted conservation actions such as habitat restoration, watchtower construction, and regulation of livestock grazing in PTR. This study provides a foundation for evidence-based management strategies to support Gaur conservation in the region.

### 31. Reproductive success and offspring viability in captive European Mink *Mustela lutreola*: Insights for conservation strategies

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**Keywords:** Captive breeding, inbreeding, offspring survival, parental experience, pedigree

The European mink *Mustela lutreola*, classified as Critically Endangered (CR) by the IUCN Red List, has faced severe population declines due to habitat loss, invasive species and overhunting. Conservation efforts, particularly the European Association of Zoos and Aquaria (EAZA) Ex-situ Programme (EEP), aim to mitigate these threats through captive breeding and reintroduction initiatives. This study evaluates the EEP's effectiveness by analysing studbook data from 1972–2013 (utilising a publicly available dataset developed by Farquharson et al., 2021) to identify factors influencing reproductive success, litter size, and offspring survival. By applying statistical and machine learning analyses, key predictors of reproductive outcomes were identified, including inbreeding coefficients, parental characteristics, and generations in captivity. Findings highlight significant challenges, including high inbreeding coefficients resulting from successive captive generations, reduced survival in larger litters, and lower reproductive success among first-time breeders. Inbreeding adversely affects both offspring survival and litter size, emphasising the need for genetic management. Parental age and experience emerged as critical factors, with experienced breeders producing larger litters and achieving higher offspring survival rates. While the EEP retains 93.2% of the founder's genetic diversity, challenges remain in maintaining genetic health and minimising inbreeding depression. The study recommends targeted conservation strategies, including minimising inbreeding, enhancing founder representation, integrating wild genetic diversity, prioritising experienced breeders, and supporting maternal resource allocation in large litters. Advanced genetic and demographic data analysis should be leveraged to optimise breeding protocols, improve genetic health and support reintroduction efforts. By drafting actionable recommendations on optimising breeding strategies and incorporating genomic data, this research contributes to refining ex-situ conservation efforts and improving the long-term sustainability of the European mink captive population. These findings have broader implications for conservation breeding programs aimed at maintaining genetic diversity and mitigating inbreeding risks in critically endangered species.

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## 32. Rehabilitation of northern white-breasted hedgehogs (*Erinaceus roumanicus*) in Romania: A retrospective study

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**Keywords:** *Erinaceus roumanicus*, wildlife, rehabilitation, Romania

This study investigated the health status and rehabilitation outcomes of 524 northern, white-breasted hedgehogs (*Erinaceus roumanicus*) admitted to the “Visul Luanei” Rehabilitation Center in southeastern Romania, between 2020 and 2024. Trauma was the main cause of admission and comprised 142 individuals (27.1% of all admissions), including 59 cases of domestic animal attacks (41.5% of trauma cases), 17 cases of road traffic accidents (12.0% of trauma cases), and 66 cases of undetermined origin. Orphaning (n=106, 20.2%), parasitic infections (n=102, 19.5%), and inappropriate human intervention (n=101, 19.3%) were also frequent admission reasons. Bucharest, the main originating location of the hedgehogs, exhibited significantly higher rates of parasitic infections (22.7%) compared to surrounding rural areas (Ilfov county; 12.0%;  $p < 0.05$ ). In contrast, rural areas experienced higher rates of domestic animal attacks (16.0%) than Bucharest (8.3%;  $p < 0.05$ ). Parasitic infections were significantly associated with poor body condition scores (67% of infected hedgehogs were classified as thin or emaciated;  $p < 0.01$ ) and reduced survival rates (59.8%). Survival rates varied significantly by admission reason, with orphaning cases showing the highest release rate (78.3%) and trauma cases, including those resulting from domestic animal attacks and road traffic accidents, exhibiting the lowest (37.9%). These findings highlight the importance of addressing urban-specific threats, such as parasitic status and managing rural-specific risks, such as domestic animal attacks and vehicle collisions. Furthermore, the study emphasizes the crucial role of rehabilitation centres in collecting valuable data on wild populations, informing conservation strategies, and facilitating public education campaigns to promote responsible coexistence with wildlife.

### 33. Does bison brain size correlate with increased inbreeding?

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**Keywords:** Brain size, inbreed, European bison

Inbreeding depression is estimated to occur in many natural populations contributing to decreased survival and reproductive success. However, research to date on the evolutionary consequences of inbreeding has focused on humans and domestic animals. The European bison experienced a drastic population decline in the 1920s, reducing its genetic pool to just a few founding individuals. Today, over 80% of its gene pool traces back to only two ancestors, resulting in exceptionally low genetic diversity and a high inbreeding rate of 75%. The reported potential symptoms of inbreeding depression in bison are related to skeletal conformation, including different regions of the skull. Inbreeding may also indirectly affect cognition by inducing changes in the brain and its neuronal systems leading to underdeveloped brains or specific brain structures, and poor neuronal systems or sensory organs. Reduced cognitive abilities in highly inbreed populations have been observed mainly in human populations, and indirectly through weaker defences against predators in birds or reduced ability to compete for resources in common shrews. To investigate the problem of probable inbreed-related brain shrinkage, we are initiating a project of scanning bison skulls using CT scans and analysing 3D models of the brain endocasts, comparing the dynamics of changes in brain size of individuals from a highly inbreed population from the Białowieża Forest over the last 70 years with individuals from the last 600 years from Europe.

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### 34. Neglected bats and wind energy development in Southwestern Norway

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**Keywords:** Bats, wind turbines, acoustics, green-on-green

Norway constitutes the northern limit of distribution for many European bat species, but due to its climatic conditions, it has mostly been considered unsuitable as habitat for bats, but ideal for wind energy production, which was therefore rapidly developed all around the country. However, during the last few years, bat carcasses have regularly been found during raptor carcass searches around wind facilities. Wind turbines are one of the main characters of the green-on-green dilemma, a silent, modern conflict between the need for sustainable energy production and wildlife conservation, where bat species can be particularly affected through direct collision, avoidance or habitat loss. In Norway, no pre- or post-construction assessments of wind energy impact on bats has been carried out until recently. Because little information is available on bat populations in the country, the risk that local population declines go unnoticed is high, with cascading repercussions to the ecosystem. Our research aims to describe bat communities in onshore wind parks in Southwestern Norway. In this region, wind parks differ from those in other European countries in bat community composition, topography and climate. We are investigating spatial movements, habitat use, daily and seasonal activity patterns of bats, as well as the influence of environmental variables, to inform evidence-based decisions about placement and mitigation. We deployed 36 acoustic detectors in 6 wind parks and one adjacent control site, collecting acoustic recordings from June to the beginning of October 2024. In one of the wind parks, we also installed 9 camera traps to monitor insect abundance throughout July and part of August. We will present preliminary results on bat activity and community composition in Norwegian wind parks - and relationships between spatio-temporal activity patterns and environmental covariates - from a previously overlooked northern corner of several European bat species' geographical range.

### 35. How protected is the marbled polecat in Bulgaria?

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**Keywords:** *Vormela peregusna*, conservation, threats, monitoring

The marbled polecat (*Vormela peregusna* Guldenstaedt, 1770) is a vulnerable and rare mustelid species and one of the least studied mammals in Europe. In the present study, we assess its current status in Bulgaria, identify the main threats and provide forecasts for the future state of its populations. MaxEnt analyses of current occurrence data reveal that land cover and temperature are important factors shaping the species' distribution. The Natura 2000 network has limited significance for its conservation in the country as the species prefers areas influenced by human activity. Climate change is expected to reduce its suitable habitats. Under future climate scenarios, some protected areas in eastern Bulgaria will be particularly valuable for the conservation of *V. peregusna* at both national and regional levels. The main threats to the species in Bulgaria are outlined and recommendations for conservation measures are made. We also present our experience in monitoring the species in Bulgaria and discuss the methodological approach. Our research shows that collecting presence and population data for this difficult-to-record species is extremely challenging. We argue that the monitoring of *V. peregusna* should rely primarily on opportunistic and questionnaire-based data of species presence, as well as on assessments of its habitat characteristics.

36. Morphometric analysis of 3D scans of historical and contemporary skulls of the European bison *Bison bonasus* in the context of increasing inbreeding of this species

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**Keywords:** European bison, morphometry, 3D scanning

The European bison *Bison bonasus* has a unique demographic history. In the 1920s, it was on the brink of extinction. The beginning of the current world European bison population arose from only 12 individuals, and in the case of the so-called Białowieża (lowland) line - only 7 individuals. The genes of two of them dominate and as a result, the genetic diversity of the population is very low. Previous, preliminary studies have shown developmental instability in the morphology of bison skulls and have identified this instability as essential for characterising population fitness. It is not clear yet if high inbreeding results in higher levels of developmental instability in the European bison. The development of 3D scanning techniques and tools for the analysis of morphometric measurements makes it possible to compare the features of the skulls of historical bison (up to about 1915) and modern bison. The research material can be found in Polish and foreign collections of scientific institutes, universities and museums, particularly natural history museums. The research aims to answer the following questions: (1) Do morphometric traits of bison skulls change over time? (2) Does increasing inbreeding affect skull morphometry? (3) If so, which traits are subject to change? (4) Are there sex differences? (5) What are the ontogenetic patterns? (6) What are, if any, discrepancies in skull morphometry and fluctuating asymmetry between both genetic lines of the European bison: Lowland and Lowland-Caucasian?

### 37. Unseen hitchhikers: Screening for pathogens in ectoparasites of wintering Eastern European bats

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**Keywords:** Bats ectoparasites, pathogens, *Borrelia*, *Bartonella*

Deforestation and urbanisation compel bats to adapt to life in cities and human buildings. As bats relocate, their ectoparasites accompany them, potentially increasing the risk of zoonotic pathogen transmission. Arthropods, as ectoparasites, are critical vectors, often playing a key role in facilitating the spread of pathogens to new hosts. Our study focused on ectoparasites collected from *Nyctalus noctula* winter groups that were disturbed during hibernation in human dwellings (in Ukraine) and later rehabilitated at the Ukrainian Bat Rehabilitation Centre. We analysed 200 individual DNA samples, representing three major ectoparasite families: Ischnopsyllidae, Spinturnicidae and Gamasoidea. The aim of the study was to assess the presence of zoonotic pathogens among arthropods inhabiting bats in human-occupied areas. The results showed that *Bartonella* spp. was found in 24.1% of the samples, *Borrelia* spp. in 6.78% and *Rickettsia* spp. in 2%. Both *Borrelia* spp. and *Rickettsia* spp. were detected in representatives of all three taxa. The presence of *Bartonella* spp. was detected only in the families Ischnopsyllidae and Spinturnicidae, and requires additional confirmation. The results obtained reflect the moderate prevalence of pathogenic microorganisms in local populations of bats. Our data underscore the need for ongoing surveillance and screening of pathogens in bat populations and associated ectoparasites for an objective and timely assessment of pathogen transmission risks within One Health.

### 38. Diversity of trypanosomes in rodents and marsupials from New Guinea

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**Keywords:** Blood parasites, trypanosoma, biodiversity, mammals, Melanesia

The tropical island of New Guinea is recognised as a biodiversity hotspot, boasting a rich and unique biota shaped by its geographical history. This island is home to marsupials that migrated in multiple waves from Australia and to Rattini and Hydromyini rodents that colonised the island independently, arriving from Indonesia via Wallacea. The distinct evolutionary histories of these two groups may influence their blood parasite communities. Understanding the diversity and prevalence of blood parasites in New Guinea's marsupials and rodents is crucial for addressing potential pathogen threats to these endemic species. We analysed samples from 1,267 individuals across more than 40 genera of marsupials and rodents along elevational gradients of Mount Wilhelm and the Finisterre Range, with the highest trapping elevation reaching 3,700 meters. We detected blood parasites using nested polymerase chain reaction targeting the 18S rDNA subunit. Our findings revealed *Trypanosoma* infections with an overall prevalence of 13.9% among all species. Prevalence was 21.7% in Rattini, 7.9% in Hydromyini, and 5.7% in marsupials. Infections were identified from two primary *Trypanosoma* clades: *T. lewisi* (50.6%) and *T. theileri/cyclops* (49.4%). The *T. lewisi* clade was found in invasive species (*Rattus exulans*, *R. rattus*) and native *Rattus* species, but absent in marsupials. An elevation gradient showed separation of infections into two clades at elevations of 1,200-2,700 meters and 2,200-3,700 meters. The *T. theileri/cyclops* clade was present in native marsupials and rodents, but absent in invasive species, exhibiting no elevation pattern. The overall prevalence was slightly higher at Mount Wilhelm (14.6%) than Finisterre Range (11.6%). Two marsupials were infected with two unique *Trypanosoma* species not found in rodents. Further research is needed to determine the potential health impacts of *T. theileri/cyclops* and *T. lewisi* infections on New Guinea's endemic marsupials and rodents and to understand their role in these unique ecosystems.

### 39. Local maintenance and genomic diversity of lymphocytic choriomeningitis virus in natural populations of house mice, Czech Republic, over a 24-year period

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**Keywords:** LCMV, Arenaviridae, Mammarenavirus, house mouse

Lymphocytic choriomeningitis virus (LCMV, *Mammarenavirus choriomeningitidis*) is a bisegmented RNA virus primarily associated with house mice. While it can cause severe disease in humans, especially in immunocompromised individuals or during congenital infections, it persists asymptotically in mice infected during the intrauterine period or early in life. These chronically infected mice transmit the virus vertically to their offspring, enabling local long-term persistence within stable, isolated populations (demes). Our earlier study in the Bavarian-Bohemian region revealed LCMV in a restricted 12 km<sup>2</sup> area within the *Mus musculus musculus* territory, with repeated detection in Buškovice in 2008 and 2014. This study aimed to investigate the long-term stability of the virus in Buškovice and assess its genetic diversity using archived samples from the early 2000s and new collections from 2022–2023. Screening of 60 archived tissue samples (2000–2014) identified viral RNA in five samples, while ELISA and genetic screening of 216 serum samples and 98 lung samples collected in 2022 confirmed the virus presence in three Buškovice individuals. Two additional mice were sampled in Buškovice in 2023 and included in the screening, one of which was also positive. Full genome characterisation of five samples from Buškovice from the years 2000 (1), 2003 (2), 2014 (1) and 2022 (1) showed that the strains from Buškovice do not form a single clade but are clustering with LCMV virus found in the two adjacent localities, 5 and 8 km away. These findings suggest that while vertical transmission plays a major role in maintaining LCMV, occasional mouse dispersal between villages contributes to its persistence over two decades, highlighting the importance of local dynamics in viral maintenance.

## 40. The management of wild boar in Italy between the pandemic of COVID-19 and the emergence of African Swine Fever

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**Keywords:** Wild boar, ASF, covid-19 pandemic, hunting bags, population dynamics

Wild boar (*Sus scrofa*) populations in Italy have significantly increased in recent decades, challenging agriculture, human-wildlife interactions, and wildlife health. The restrictions on movement and gathering imposed by the COVID-19 pandemic limited hunting seasons. This reduced hunting pressure, which is likely to have contributed to the increase in wild boar numbers and range expansion. The arrival of African Swine Fever in 2022 worsened the situation, with wild boar acting as a primary reservoir host, facilitating the disease's spread. The environmental resistance of the ASF virus and the challenges of effectively reducing wild boar numbers make the disease very difficult to control, posing a significant threat to both wild and domestic pig populations. We assessed the potential impact of the Covid-19 pandemic and the spread of the ASF on wild boar harvests, considering both the impact on wild boar and hunter populations. Between 2015 and 2019 annual wild boar harvests ranged from 250,000 to 300,000 animals. The harvest decreased slightly in 2020 (286,000), peaked in 2021 (373,000) and steadily returned to pre-covid levels by 2022. In 2020, the total harvest did not show the decrease that would have been expected with the hunting restrictions associated with the lockdown periods. The presence of a reproductive peak may likely have mitigated the effects of reduced hunting pressure during the pandemic, keeping the harvest broadly similar to previous years. In 2022 and 2023, despite post-ASF efforts to increase hunting pressure to reduce boar numbers and facilitate disease management, total removals did not increase as expected. In this case, the lack of consistent and co-ordinated management strategies between infected and neighbouring regions, hunters' disagreement with the depopulation objective, and the steady decline and ageing of hunters, likely all played a role in limiting their effectiveness.

## 41. First record of coronaviruses in microchiropteran bats dwelling in Armenia

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**Keywords:** Zoonotic virus reservoirs, Coronavirus prevalence, Western Asia

Armenia's unique geographic location and diverse landscapes provide a vital opportunity to study bat populations and their role as reservoirs for zoonotic viruses. This study represents the first extensive investigation into the diversity of bat species and their associated viruses in the country. Field surveys were conducted at six distinct locations, identifying 14 bat species across three families. Non-lethal sampling protocols were employed to ensure ethical and biosafe practices during data collection. A total of 540 fecal samples were collected from individual bats and screened for coronaviruses (CoVs) using molecular assays in collaboration with regional laboratories. Preliminary results revealed an overall CoV prevalence of 13.1%, with site-specific variation ranging from 0.0% to 42.2%. Positive detections included species such as *Hypsugo savii*, *Miniopterus pallidus*, *Myotis blythii*, and *Rhinolophus ferrumequinum*. Remarkably, this study also documented CoVs for the first time in *Barbastella caspica* and *Plecotus macrobullaris*, providing valuable insights into viral diversity within lesser-studied bat taxa. This research not only enhances the understanding of bat-associated viruses in Armenia but also contributes to broader efforts in global zoonotic surveillance. The findings underscore the importance of continuous monitoring in Western Asia to assess potential zoonotic risks and update public health strategies.

## 42. Preliminary results of an ectoparasite survey on wild rodents (Muridae and Arvicolidae) in Greece

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**Keywords:** Ectoparasites, arthropoda, wild rodents, vector-borne diseases

Small mammals, particularly rodents, serve as hosts to a diverse array of ectoparasites that act as vectors for pathogens responsible for serious vector-borne diseases (VBD) in mammals, including humans. Given the limited understanding of the parasitic fauna of rodents in Greece, this survey aims to document the ectoparasites of wild rodents and identify pathogens associated with zoonotic potential. The survey focused on rodent species from the families Muridae and Arvicolidae, which often inhabit areas close to domestic animals and humans. Ectoparasites were collected from 110 live-trapped rodents, representing species of the genera *Apodemus* (n=73), *Microtus* (n=33), and *Clethrionomys* (n=4) across 10 different prefectures of Greece. All the rodents were released after the ectoparasite collection. A total of 2,371 ectoparasites, i.e. ticks, fleas, lice, and mites, belonging to 21 different taxa, were collected and identified based on published morphological identification keys. Most of the examined rodents (90.91%) were infested with ectoparasites, while only ten individuals (9.09%) were not infested. From the ectoparasites identified (with percentages indicating their presence among the sample of infected rodents), the ticks belonged to the genera *Ixodes* (6%), *Haemaphysalis* (2%), *Dermacentor* (1%), and *Rhipicephalus* (1%), the fleas to the genera *Leptopsylla* (10%), *Ctenophthalmus* (31%), *Nothopsyllus* (2%), and *Typhloceras* (1%), the lice to the genus *Polyplax* (11%), and the mites to the genera *Laelaps* (53%), *Eulaelaps* (1%), *Echinonyssus* (8%), *Listrophorus* (24%), *Dermacarus* (9%), *Radfordia* (5%), *Liponyssoides* (1%), *Brunehaldia* (6%), *Schoutedenichia* (17%), *Neotrombicula* (5%), *Kepkatrombicula* (6%), and *Leptotrombidium* (2%). Molecular confirmation of the morphological identification of the ectoparasites and molecular detection of carried pathogens associated with significant zoonotic VBD are currently underway. The preliminary findings of this survey highlight the high diversity of ectoparasite species present in Greece, some of which may act as carriers of pathogens, underscoring the need for further research in this field.

### 43. Study of the impact of environmental changes on wild boar microbiome involving health risks

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**Keywords:** Zoonotic disease, wild boars, microbiome, urban colonisation, genomics

European wild boar (*Sus scrofa*) populations have risen sharply due to climate change or inappropriate hunting management. As a result of this population explosion, the species has been forced to colonise new highly anthropised areas, leading to more frequent contact with domestic species and humans. However, ungulates (including wild boar) are the animals that host the most pathogens transmissible to humans. Wild boars can host or be affected by numerous zoonotic diseases (brucellosis, tuberculosis, salmonellosis, yersiniosis, etc.). Better knowledge of the circulation of these pathogens among wild boar populations is therefore essential to prevent future threats to public health and that of domestic animals. Little is also known about the risk of an increase in the prevalence of these pathogens as a result of the changes to which wild boar is exposed: change of habitat (and hence diet), increase in densities, increase in contact with humans and domestic animals, etc. Nothing is also known about the relationship between these factors and the diversity of the bacterial microbiota of wild boar, which is so important for the health of individuals. Our study aims to gain a better understanding of the circulation of bacterial communities (commensal and pathogenic) in ten selected areas of Belgium, with contrasting characteristics (wild boar population densities, proximity to livestock, different habitats, etc.) by: 1) developing a non-invasive detection method for pathogenic bacteria and 2) studying the impact of environmental changes on the bacterial diversity of wild boar.

#### 44. Recording the presence and modelling the distribution of dormouse species in protected areas of the Peloponnese, Greece

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**Keywords:** Gliridae, *Glis glis*, *Dryomys nitedula*, *Muscardinus avellanarius*, SDMs

The distribution and ecology of the three dormouse (*Gliridae*) species — the forest dormouse (*Dryomys nitedula*), the edible dormouse (*Glis glis*) and the hazel dormouse (*Muscardinus avellanarius*) — in the protected areas of southern Greece remains outdated and incomplete, due to a lack of systematic field surveys. This study aimed to address this gap by presenting findings from track tunnel surveys conducted across 15 Natura 2000 sites in the Peloponnese during the summer 2023. At each site, 15 track tunnels were deployed, resulting in the identification of Gliridae footprints in 50.2% of the tunnels. *Dryomys nitedula* was the most commonly recorded species accounting for 45.7% of the identified tracks. Notably, the regionally rare *Muscardinus avellanarius* was detected at only one site, supporting its reputation for more cryptic behaviour in comparison to the other two dormouse species. Survey data on the presence of the forest and edible dormouse were combined with georeferenced ecological and topographical variables to generate potential species distribution models (SDMs) within the Natura 2000 sites using Maximum Entropy models (MaxEnt). Results showed that *Dryomys nitedula* appeared to prefer shrublands, while the larger *Glis glis* seemed to favour deciduous forests. Both species were commonly encountered in sites with maquis vegetation. Moreover, the results of the distribution models suggest that higher altitudes and the isolation of forest patches from larger forested ecosystems are limiting factors for the distribution of the Edible and Forest dormouses in the Peloponnese. The above findings contribute to the development of local monitoring and conservation strategies for dormice and enhance our understanding of the ecological plasticity of these wide-ranging European species. This is particularly important for southern Greece, which is expected to be among the first impacted by the climate crisis.

## 45 The European Observatory of Wildlife: Continental-scale wildlife density estimation in Europe

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**Keywords:** Camera trapping, density estimation, harmonised protocol, random encounter model, network

## POSTER PRESENTATION-Ecological Modelling

The European Observatory of Wildlife (EOW), within the ENETWILD project ([www.enetwild.com](http://www.enetwild.com), funded by the European Food Safety Authority), focuses on improving European wildlife monitoring by developing international data collection standards, supporting density estimation guidance, and fostering open, collaborative data networks. To achieve these objectives, EOW implemented a protocol using the random encounter model (REM) based on camera trap (CT) data for estimating mammalian density. This protocol integrates photogrammetry, allowing the three-dimensional reconstruction of camera scenes for calculating parameters essential to the REM, including day range and detection rates. The workflow, optimised on the Agouti platform, streamlines image processing and parameter estimation. Since 2021, ENETWILD stakeholders have employed the EOW protocol to assess densities of species like wild boar, roe deer, and red fox across Europe. By 2023, 30 institutions surveyed 44 sites in 22 countries, accumulating 79,092 CT activity days from 1,722 CT deployments. Density estimates show interannual stability with refined precision across several monitored populations. In 2024, network expansion included 40 institutions across 64 sites, prioritising areas affected by African Swine Fever (ASF). Thirty-three sites now fall within ASF-affected countries, and 28 lie near the ASF frontline. Twenty sites (31%) contain an interface between wild boar and domestic pigs (i.e. high ASF risk), while 25 sites (39%) include wetland habitats, which are of possible epidemiological interest for Avian Influenza both within bird populations themselves and in relation to possible spill-over events to wild and domestic mammals. Ongoing networking links the EOW with other wildlife monitoring and disease-prevention initiatives, enhancing transnational collaboration. The refined protocol, with augmented photogrammetry and Agouti functions, has promoted data standardisation and minimised user-related error. EOW data supports continental-scale risk assessment, providing harmonised density estimates essential for disease modelling and can contribute to future schemes of biodiversity monitoring in Europe.

## 46. Genetic characteristics of non-native ungulates between Alps and Dinaric islands

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**Keywords:** Alpine ibex, mouflon, chital, genetics

Populations of non-native and/or reintroduced species, such as Alpine ibex (*Capra ibex*) (until recently it used to be classified as a non-native species in Slovenia), European mouflon (*Ovis gmelini musimon*), and chital (*Axis axis*) in Croatia, typically exhibit low genetic variability due to the founder effect. Alpine ibex populations in Slovenia originate from reintroductions into the Kamnik-Savinja and Julian Alps. For these reintroductions and subsequent augmentations, individuals were sourced either from the only surviving population in Gran Paradiso, Italy or reintroduced populations in Switzerland. Mouflons were brought to mainland Europe from Sardinia and Corsica in the 18th century and were introduced to Slovenia in the 1950s and 1960s. Chital was introduced to various parts of the world during the 19th and 20th centuries. In Croatia, chitals were initially introduced to the northernmost Adriatic archipelago. In the studied populations of all three species, we observed reduced genetic variability compared to their source populations. This suggests that population isolation and the founder effect significantly influence genetic diversity and likely impact long-term viability. Specifically, the genetic variability of mouflons in Slovenia was found to be significantly lower than that of their source populations. Similarly, the genetic and genomic variability of Alpine ibex was found to be extremely low. Analysed samples displayed long homozygous stretches within their genomes, indicating a loss of genetic variability and evidence of inbreeding. All ibex across the Alpine arc are descendants of the genetically impoverished population from Gran Paradiso. In chital samples from two Adriatic islands, Rab and Dugi Otok, two mitochondrial haplotypes were identified, suggesting that chitals in Croatia were introduced from at least two distinct maternal lineages. The observed low genetic variability within the populations highlights the need for systematic monitoring and active management, including measures to increase genetic diversity.

## 47. UCE phylogenomics resolves complex relationships within the *Crocidura muricauda* species complex (Eulipotyphla: Soricidae)

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**Keywords:** Shrews, *Crocidura*, phylogeny, UCE, Africa

The genus *Crocidura*, the most speciose among mammals, comprises 109 described sub-Saharan species, making it a cornerstone for understanding Afrotropical biodiversity. However, species-level identification is often hindered by significant morphological similarity, necessitating the use of genetic tools. Despite a growing body of molecular data, phylogenetic relationships within *Crocidura* remain incompletely resolved, particularly when relying on traditional mitochondrial markers such as cytochrome b (cytB). In this contribution, we present a robust phylogeny based on Ultra Conserved Elements (UCEs) sequenced across the genomes of 183 crocidurine shrew specimens. This approach yielded a highly supported topology, particularly clarifying relationships within the *C. muricauda* species complex. This group, containing two valid species (*C. muricauda* and *C. douceti*), is distributed across West African forests. Prior analyses of about 400 cytB sequences suggested additional cryptic lineages but failed to resolve interspecific relationships due to limited phylogenetic signal. To address these challenges, we sequenced UCEs from 23 specimens representing the majority of cytB lineages. Our analyses revealed a well-supported phylogeny, with *C. douceti* in a basal position to all *C. muricauda* lineages. Furthermore, multiple distinct lineages within *C. muricauda* exhibited sympatric distributions. These findings suggest substantial cryptic diversification within *C. muricauda*, underscoring the potential for the recognition of additional species pending integrative taxonomic revision incorporating morphological data. Our study highlights the power of UCE-based approaches in resolving phylogenetic uncertainties and contributes to a deeper understanding of the evolutionary history, biodiversity, and conservation needs of these understudied African shrews.

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#### 48. Structural variation in the Iberian lynx (*Lynx pardinus*)

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**Keywords:** Conservation, inbreeding, genomics

Little doubt remains that population decline can result in genetic erosion, causing a reduction in fitness and adaptive potential and increased extinction risk. In recent years, novel methodological and analytical developments in the field of genomics have facilitated genomic studies in non-model organisms and broadened the scope of the types of variation that can be monitored. The Iberian lynx (*Lynx pardinus*) was recognised as the most endangered felid in the world and one of the most endangered vertebrate species in Europe. By 2002, the species was at the verge of extinction, with only two small and isolated subpopulations: the protected area of Doñana, and the Sierra de Andújar, with population sizes estimated to 42 and 60 individuals respectively. Active conservation measures have largely reverted the situation with the latest census estimating more than 1.100 individuals distributed in both remnant and newly introduced subpopulations. However, the genetic variation of the species is alarmingly low and the Doñana subpopulation remains highly isolated. In an ongoing study, we have identified structural variants (mutations spanning from 50 base pairs up to several mega base pairs in size) from long read sequencing data in ten individuals from both the Doñana and Andújar population. We found a total 20,600 structural variants of which 8305 overlapped coding regions of the genome. Individuals from Doñana had significantly more mutations in homozygote state, likely due to isolation and inbreeding. This pattern is concerning, especially as structural variants are expected to have a greater impact on gene expression and to be more deleterious than single nucleotide polymorphisms. Establishing regular gene flow between subpopulations will be key to maintain population viability.

## 49. Hybridisation between endemic Martino's (*Talpa martinorum*) and European moles (*T. europaea*)

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**Keywords:** Moles, *Talpa*, hybridisation

Moles from the genus *Talpa* are endemic to the Palearctic, occurring from the Atlantic coast in Europe to the Lena river in Asia. Currently 16 species of moles are recognised, allopatrically and parapatrically distributed. Moles are solitary and strictly territorial animals, with females and males encountering each other only briefly during the breeding season. Their ecology is poorly studied due to their subterranean lifestyle, and it is not very well understood how individuals within and among species separate their territories, and whether species potentially hybridise. Here we studied potential hybridisation between the recently described endemic Martino's mole (*Talpa martinorum*) and the widely distributed European mole *T. europaea* using one mitochondrial (Cytb) and two nuclear markers (HDAC2 and RAG1). We analysed a total of 38 samples of putative, morphologically identified *T. martinorum* and 17 samples of putative *T. europaea*, mostly from within and around a contact zone between both species in SE Bulgaria. Despite the small distribution area of *T. martinorum* we identified 16 haplotypes, with one predominating (55 %). We also identified a case of potential introgression. In one sample, morphologically identified as *T. europaea*, we found a mitochondrial haplotype otherwise found in *T. martinorum*, but the nuclear genome of *T. europaea*. The hybrid shows clear *T. europaea* morphological features: the eyes are not covered by skin, the pelvis is "europaea" type, and there is a small but visible parastyle on the first upper molar.

## 50. Evolutionary history of the brown bear in the Balkans

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**Keywords:** Brown bear, Balkans, ancient DNA, modern DNA, stable isotopes

The brown bear (*Ursus arctos* L.) is an iconic megafauna species that survived the Late Pleistocene extinction. Historically, this large carnivore has been widespread throughout Europe, but human activities, such as hunting and habitat alteration, have caused its extirpation disappearance in many regions. Although brown bear populations are stable in some countries, others are on the brink of extinction. Brown bears in Europe are divided into ten isolated populations, three of which are present in the Balkans, with possible contact zones in Serbia. The main aim of this project is to reconstruct the evolutionary history of this species in the Balkans over the last 50,000 years using advanced biomolecular methods. Preliminary results for Holocene brown bears from Serbia have shown high mitochondrial DNA (mtDNA) diversity. We detected not only all known European mtDNA lineages but also a new lineage that has not yet been described. This suggests that the genetic diversity was much higher in the past. In this project, we plan to analyse the osteological remains of brown bears excavated from various palaeontological and archaeological sites in Serbia, Bulgaria, Romania, and Italy, dating from the Late Pleistocene to the Middle Ages. Modern samples from the Dinaric-Pindos population collected in recent years by non-invasive sampling will also be included. This project incorporates the newest methods of genomics, paleogenomics, and isotope biochemistry (stable isotopes and radiocarbon dating). Genome-wide data will enable temporal and spatial analyses to provide information on demography, ancestry, past admixture events and migrations, relationships between individuals and populations, and changes in effective population size. Stable isotope analysis of bone collagen carbon and nitrogen will be used to reconstruct the diet. The chronology of the bone samples will be confirmed by direct AMS radiocarbon dating of bone collagen.

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## 51. What can flies tell us about bears? The use of invertebrate-derived DNA in bear monitoring

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**Keywords:** eDNA, invertebrate-derived DNA, brown bear

Successful conservation management planning is dependent on effective monitoring. The challenges of carrying out surveys for rare or elusive species are compounded by limited human and financial resources. This calls for the exploration of alternative monitoring techniques that are more cost- and time-efficient than the current standard methods. Invertebrate-derived DNA (iDNA) is a technique previously used with metabarcoding to elucidate species richness within a habitat. In this paper we describe the development and field testing of an iDNA quantitative PCR assay for detecting and monitoring brown bear, *Ursus arctos*. In laboratory experiments we demonstrated the routine amplification of bear mtDNA from flies up to 20 hours after the ingestion of bear faeces. We could also detect bear mtDNA from flies when the proportion of faeces-fed flies was less than 5% of the homogenised fly sample. We went on to demonstrate in field trials that the method is effective at detecting bears in the wild. We posit that our iDNA assay can form the basis of a low-cost, non-invasive method of assessing brown bear distribution. These methods are a readily translatable tool for monitoring terrestrial mammals, representing a valuable complement to other survey techniques.

## 52. We all live in the tanuki latrine: diversity of dung beetles associated with invasive raccoon dog latrines

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**Keywords:** Invasive, carnivore, facilitation, conservation, diversity

Raccoon dogs (*Nyctereutes procyonoides*), or tanuki, are native to mainland Japan, but were introduced to two islands in the country in the last century: Chiburijima and Yakushima. Both islands have significant biological and cultural value and are protected by UNESCO, yet the effects of the invasive raccoon dogs remain poorly understood. Facilitation, whereby the presence of an invasive benefits other species, is an often-overlooked consequence of species introductions, despite the effects on community dynamics being demonstrably biologically significant. Facilitation can include direct (i.e. habitat modification, trophic subsidy) and indirect (i.e. increased parasite prevalence) interactions. Raccoon dogs are unique among canids as latrine formers, utilising communal defecation sites. These latrines are a form of habitat modification and trophic subsidy, allowing for the facilitation of insects. Dung beetles (Family: Scarabaeidae) have been observed utilising raccoon dog latrines on both island habitats for food and as egg laying sites. These beetles are also intermediate hosts for nematode parasites (i.e. *Streptopharagus* and *Gongylonema*) which can infect other mammals (i.e. endemic Yakushima macaques (*Macaca fuscata*), and livestock. An increase in the dung beetle population may increase the prevalence of these parasites. The aim of this study is to identify and compare the diversity of dung beetle species that utilise raccoon dog latrines on both islands, as well as compare the beetle diversity between Yakushima latrines and native macaque faeces. In a study conducted between 2021 and 2024, we collected 551 dung beetle specimens from latrines on Yakushima and Chiburijima, and from endemic macaque faeces on Yakushima. We conducted genetic analysis using CO1 barcode primers LepF1 and LepR1 to determine the species diversity. The results from this study will determine if raccoon dog latrines are affecting species composition of dung beetles, with knock-on effects for associated parasite prevalence.

### 53. Monitoring invasive species by combining eDNA and citizen science approach: the case of the American mink in Sardinia

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**Keywords:** *Neogale vison*, qPCR, IAS, Italy

The American mink (*Neogale vison*), a semiaquatic mustelid native to North America, is one of the most invasive species in Europe following its introduction for fur farming in the early 20th century. With a generalist diet, the American mink may impact native species through increased predatory pressure and competition for resources. In Italy, the species has been reported in Lazio, Sardinia and northeastern regions. The knowledge about its presence in Sardinia remains scarce, requiring further investigation to understand its impact on the native, often endemic, Sardinian fauna and effective management strategies. In this work, we investigate American mink presence in Sardinia using various approaches, including camera trapping, citizen science and environmental DNA (eDNA) surveys. Through a citizen science approach, we collected information on species presence by interviewing local communities across the island, and verified potential occurrence records through targeted monitoring with camera trapping and visual detection of faeces. To complement reports and field surveys, we are developing a qPCR-based eDNA assay to detect the species in areas where its presence is uncertain. We designed two new sets of primers and probes targeting two fragments of approximately 150 bp of the Cytochrome b mitochondrial marker, successfully tested *in vitro* on tissue samples of the American mink and other mustelids. *In situ* tests of water samples collected from verified sites of species presence (Nuoro, Benetutti) are underway. Integrating eDNA data with occurrence records will enable us to produce the first comprehensive Sardinia species distribution map.

## 54. The stealthy arrival of the golden jackal in central Italy

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**Keywords:** *Canis aureus*, distribution, jackal howling

The golden jackal *Canis aureus*, a medium-sized canid native to Asia and Eastern Europe, has experienced a significant range expansion since the 20th century. This species was first recorded in Italy in the early 1980s. Still, its presence has been primarily confined to north-eastern regions, in spatial continuity with Balkan populations, until recent years. In 2021, the first record of a golden jackal was documented in Tuscany, marking a substantial southward expansion. To assess the current distribution of the golden jackal in Tuscany, we conducted a comprehensive review of published records. We performed acoustic surveys in areas with presumed occurrence based on the available data. Additionally, mitochondrial analysis was conducted on a road-killed individual to determine its potential origin. Our findings suggest that the golden jackal presence in Tuscany is still relatively scarce, with two individuals detected via opportunistic camera trapping between the provinces of Prato and Florence, a single roadkill near Empoli (i.e., in the central part of the region) and one individual camera-trapped in the Maremma Regional Park (southern part of the region). Acoustic surveys yielded positive results only in the northern outskirts of Florence (municipality of Calenzano), indicating a territorial settlement. However, the reproduction of this group has not been confirmed yet. Molecular analysis revealed a strong genetic affinity between the Tuscan individual and populations from the Balkan Peninsula, confirming the southward expansion of the Italian golden jackal population amidst environmental and anthropogenic pressure. Further research is needed to fully understand the ecological implications of this range expansion, which might be hindered by the presence of a large grey wolf *Canis lupus* population in central Italy.

## 55. Trophic ecology and abundance of free-ranging cats on an endemic-rich subtropical oceanic island

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**Keywords:** *Felis catus*, islands, diet, camera-traps

Free-ranging cats (*Felis catus*) pose a significant threat to biodiversity. However, little is known about their trophic ecology, population status, and ecological drivers in insular ecosystems, where they often represent the top predator. This study used DNA metabarcoding to assess the diet of free-ranging cats and camera traps to investigate their abundance and activity in a peri-urban protected area on the subtropical Madeira Island in Portugal. Cats were found to consume a wide range of native and non-native vertebrates, including multiple endemic taxa. Based on 582 trapping-nights we estimated a density of 1.4 cats per km<sup>2</sup> and landscape-scale analysis showed that cat activity was positively influenced by the proportion of rocky areas in the landscape and the distance to human resource subsidies. However, no significant driver was found for cat abundance. Our results suggest that cats are highly abundant throughout the protected area and that their core home ranges are associated with rocky terrain away from the most humanised sections of the park. Furthermore, our diet data indicates that free-ranging cats do not rely heavily on anthropogenic food sources and may rely mostly on wild prey to fulfil their dietary needs. Cat abundance and activity were particularly high in the vicinity of the only known breeding colony of Manx shearwater on the island. Taken together, these findings indicate that free-ranging cats pose a significant threat to the native vertebrate fauna of Madeira Island and that their management, especially during the breeding season of nesting seabirds, should be considered.

## 56. Identifying spatial distribution patterns and emerging hotspots of the European rabbit on a Mediterranean island

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**Keywords:** *Oryctolagus cuniculus*, spatial analysis

Islands are globally recognised as biodiversity hotspots. Yet their ecological integrity is highly vulnerable to the introduction of non-native species due to their often-limited biotic resilience and isolation. The European rabbit (*Oryctolagus cuniculus*) is a paradigmatic example of an introduced species whose ecological impact is particularly pronounced in insular ecosystems, where its presence can disrupt local habitats and threaten native fauna. On the island of Lemnos, Greece, the absence of terrestrial predators, coupled with the abandonment of agricultural land, has led to an overpopulation of this species, resulting in extensive degradation of both local ecosystems and agricultural areas. Despite the considerable ecological impacts on the island, however, there remains a substantial knowledge gap regarding the specific hotspots of this introduced species—information that is essential for implementing effective management and conservation strategies. To address this, we conducted field surveys and collected 1534 presence localities of *O. cuniculus* across the island, while we employed spatial statistical techniques, including kernel density estimation, hotspot analysis, and cluster and outlier analysis, to assess its distribution spatial patterns. Our findings reveal that the distribution of *O. cuniculus* is not uniform across the island but instead displays distinct clusters, with certain areas showing significantly higher densities than others. The hotspot analysis identified regions where the concentration of the species was significantly higher than expected, providing insights into the habitats most suitable for the European rabbit. In parallel, the cluster and outlier analysis highlight areas where the presence of the species significantly deviated from the surrounding pattern. Ultimately, our study highlights the urgent need for targeted management strategies based on the identified hotspots to mitigate the ecological impacts of *O. cuniculus* on Lemnos Island.

57. Temporal patterns and environmental drivers of crop yield loss compensation due to European rabbit (*Oryctolagus cuniculus*) activity on Lemnos Island, Greece

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**Keywords:** Wild rabbits, time-series analysis, compensation payments, precipitation abnormalities

The European rabbit (*Oryctolagus cuniculus*) is a highly adaptable species that exerts significant pressure on agricultural systems, often resulting in significant crop productivity losses and persistent economic challenges for farmers. On Lemnos Island, NE Greece, the activity of *O. cuniculus* has become a persistent problem, with frequent claims for compensation payments underscoring the need to understand the environmental drivers and temporal patterns influencing these claims. To address this, we analysed a 12-year dataset (2011-2022) of annual compensation payments for crop yield losses and investigated the influence of key environmental predictors in shaping these patterns. Auto-Regressive Integrated Moving Average (ARIMA) and Vector AutoRegression (VAR) models were applied to capture temporal patterns, evaluate predictor contributions, and examine dynamic relationships among variables. Additionally, Impulse Response Function (IRF) and Forecast Error Variance Decomposition (FEVD) analyses were conducted to assess long-term impacts and quantify the relative importance of predictors in compensation variability. Our results revealed that annual precipitation abnormalities were the primary environmental driver influencing compensation payments. This was evidenced by their sustained effects in the IRF analysis and their substantial contribution to long-term variability observed in the FEVD results. These abnormalities likely alter the availability of natural forage resources, particularly during periods of reduced rainfall. Such environmental shifts probably force *O. cuniculus* to modify its foraging behaviour, increasing its reliance on cultivated crops, particularly during periods of reduced rainfall, amplifying interactions with agricultural fields. Therefore, understanding these dynamics is essential for developing integrated management strategies that incorporate ecological processes into long-term agricultural and wildlife policies. Such strategies would enable more effective mitigation of *O. cuniculus* impacts on crop productivity.

## 58. How otters can surmount vertical and steep arch dams

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**Keywords:** Otter, *Lutra lutra*, movements, dam, barrier

Eurasian otters are semi-aquatic mammals often wandering out of the water body to accomplish activities like denning or dispersing toward new rivers. It has been broadly documented that dams generally do not represent real obstacles to otter movement. Embankment dams are constructed with excavated natural materials and can be directly crossed by otters, whereas gravity dams are usually made of concrete and built on large valleys, offering otters a bypass on land. Arch dams, instead, are often designed on steep and rocky gorges and act as substantial obstacles that interrupt otter movement, reducing gene flow and dispersal rates. We report a case study in central Italy, where an arch dam was located at the boundaries of the otter range in southern Italy. This specific dam interrupted the range recovery of the endangered population of Italian otters, known to be the most genetically differentiated in Europe, for at least 10-15 years. We deployed camera-traps at the top and at the base of the dam to keep track of single passages and individual otters. We discovered otters using a very narrow path for their movements carved into the rocky walls of the gorge, half natural and half artificial, with many sections constituted by bridges and ladders. These findings provide insights into possible adjustments to dams to make artificial barriers sustainable for otter movements.

## 59. Boreal temporal wetlands as mammal habitats

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**Keywords:** Ephemeral, community, vernal

Boreal temporal wetlands are little known habitats. Their occurrence, temporal dynamics and role for wildlife are largely unknown. Likely, however, they are especially suitable habitats for many aquatic invertebrates because seasonal dry periods prevent fish from persisting, leading to low competition and predation pressure. Furthermore, their vegetation differs from the plant species composition in their surroundings making them as potential hotspots of biodiversity within otherwise low productive boreal forest landscapes. In this study, we investigated the occurrence of mammals around boreal temporal wetlands by using camera traps, faeces tracking, trapping and passive audio recorders. Permanent wetlands were used as reference. More mammals and mammal species were detected with camera traps by temporal wetlands than by permanent ones. Moose, roe deer and hares were more common by temporal than by permanent wetlands. The same was shown with faeces tracking for the moose. The small mammal trappings revealed no constant differences in species composition or abundance, although abundance was higher by temporal wetland in spring, while the trend was reversed in summer. Audio recorders detected more *Myotis* bats in permanent wetlands than temporal ones. Northern bats were similarly abundant in both habitats. Our results suggest that the temporal wetlands are important habitats for medium- and large-sized herbivores, not just because of abundant food sources in shallow waters but also because they appear as more sheltered and cooler habitats than permanent wetlands.

## 60. Influence of centennial olive tree traits on Persian Squirrels' den selection

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**Keywords:** *Sciurus anomalus*, traditional olive groves

Centennial traditional olive groves are increasingly acknowledged as critical habitats within agricultural landscapes, playing a significant role in biodiversity conservation and supporting various wildlife species. In the Mediterranean region, these groves provide not only agricultural resources but also essential habitat features, such as shelter, food availability, and favourable microhabitat that enhance the survival of local fauna. Among the species utilising these groves is the Persian squirrel (*Sciurus anomalus*), which is classified as Vulnerable in the Greek Red List of Threatened Species and relies on these environments for nesting. Despite the ecological significance of traditional olive groves, there is limited knowledge regarding the den-site selection of Persian squirrels, particularly concerning the specific characteristics of the olive trees that are favoured for nesting. For this, we assessed the den-site selection by Persian squirrels, identifying 35 active dens within the traditional olive groves of Lesbos Island, Greece. A 50-meter radius buffer was created around each den to measure various tree phenotypic traits, including height, diameter, crown area, age, leaf area index (LAI), as well as features specific to the dens. Logistic regression analysis was employed to determine the tree traits that significantly influence den selection by Persian squirrels. Our analysis revealed that tree height, age, and LAI are significant predictors of den selection, indicating a preference for taller, older trees with larger canopy cover. These characteristics likely provide enhanced shelter and stable conditions favourable for nesting, underscoring the ecological importance of centennial olive groves as key habitats for wildlife. This suggests that the structural attributes of mature olive trees are particularly advantageous for Persian squirrels within these traditional agroecosystems.

61. Rediscovering one of the most elusive small mammals of Greece, the Balkan Pine Vole, *Microtus felteni* (Rodentia: Arvicolinae)

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**Keywords:** Felten's vole, burrow architecture, fossorial, ecology, threat assessment

Greece possesses one of the richest mammalian faunas in Europe. However, data on certain mammal species still remain scarce. Some small mammals, such as the Balkan endemic vole species *Microtus felteni* (Felten's vole), the target species of this study, are particularly understudied. Contributing factors include their inaccessible habitats, cryptic behaviour and the need for specialised trapping techniques and equipment. These challenges require extensive fieldwork, making data collection particularly difficult. Although globally assessed as Least Concern (LC), *M. felteni* is recognised as rare, with limited ecological and behavioural data available, and is listed as Endangered (EN) in the updated Red List of Greece. Despite a significant portion of its range in Greece, the species remains understudied, preventing the identification of potential threats and accurate conservation status assessments. This project aimed to update distribution data by verifying species presence in previously recorded sites of Northern Greece and identifying new ones. We also collected data on the species' biology and potential pressures or threats. Extensive fieldwork was conducted across Macedonia, Thessaly and Epirus. *M. felteni's* presence was confirmed through live trapping at two sites in Florina prefecture, where soil mound patterns and burrow systems architecture were meticulously studied for the first time. These burrow systems were simple and more linear, with few and sparsely placed soil mounds, when compared to other co-occurring, mound-building mammals in the study areas, such as *Microtus thomasi* and *Talpa stankovici*, allowing for distinction from them. Using this new information, *M. felteni* presence was indirectly confirmed at four additional sites in Western and Central Macedonia (Florina, Kozani, and Pella prefectures), one of which is newly registered for the species. This work contributes to the knowledge of *M. felteni's* distribution and ecology and provides critical data that can inform future conservation efforts to safeguard species' survival in Greece.

## 62. Mammals of Morocco. Community, distribution, ecology

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**Keywords:** Atlas, paleontology, archeozoologie, taxonomy, conservation

Until the end of the 19<sup>th</sup> Century, mammals remained poorly known in Morocco, and it was only at the beginning of the 20<sup>th</sup> Century that Angel Cabrera published the first synthesis of the current knowledge. Then, Jean-Bertrand Panouse published the first distribution maps in a new synthesis restricted to large mammals. In 1986, the first atlas of all wild mammals of Morocco with maps covering the whole territory was published. Thirty years later, the present atlas provides updated knowledge and cartography using grid maps of 0.25° longitude by 0.25° latitude. In addition to the distribution of current wild mammals, this collective work places the recent mammal fauna from a historical perspective. It includes several chapters dedicated to fossil species, which are now better known, and to mammals in rock art (rock paintings and mainly rock engravings). It then deals with all present mammals in monographs starting with scientific and vernacular names, a list of synonyms found in the literature and sometimes comments on the specific status and phylogeny of the species. Description and measurements precede a paragraph describing the species distribution's striking elements. Biological and ecological data, restricted to Morocco or even to the Maghreb, can lead to conservation features of species whose IUCN Red List category is indicated. An identification key of Rodent cranial remains from owl pellets completes this work. In comparison with the previous atlas, the number of terrestrial mammal species remains stable, despite some taxonomic adjustments and the extinction of two species in the wild. However, the level of knowledge has dramatically increased. The bibliography now exceeds 3000 references. Several museum collections are now available online. Recent surveys have been enhanced by new techniques (ultrasound recording, camera trapping), and the opportunity to travel in the Saharan regions.

### 63. Do Irish bats migrate?

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**Keywords:** Migration, *Nyctalus leisleri*, *Pipistrellus nathusii*

My research over the years has examined questions of ecology and genetics for two Irish species known to be long distant migrants in continental Europe, the Leisler's bat (*Nyctalus leisleri*) and Nathusius' pipistrelle (*Pipistrellus nathusii*). From these combined works, a pattern seemed to emerge of species which had dropped their migratory habit to remain resident in our island. While the insights from these studies are interesting, they are not definitive, and the question remains do any Irish bats populations migrate seasonally? This is a question which has now taken on new impetus, given the push for offshore wind energy in the North and Irish Seas. In this poster I summarise some of the previous findings on the question of migration in Irish bats and outline some of the new studies underway in Ireland.

## 64. Citizen involvement in research: Monitoring the expanding Greater White-toothed Shrew in the Czech Republic

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**Keywords:** Citizen science, *Crocidura russula*, expanding

Engaging the public in research activities can be highly beneficial, providing valuable insights for scientists while offering individuals a deeper understanding of how science operates through engaging projects. Certain research initiatives are particularly suited to public involvement—one such example is the monitoring of the greater white-toothed shrew (*Crocidura russula*). This non-native species has only recently expanded into the Czech Republic. As a synanthropic species often caught in rodent traps, we launched a public appeal in the autumn of 2023 to map its current distribution in the Karlovy Vary region, where it was first recorded by our team in 2022. Within just a few months, we collected over 200 photographic and video records of shrew sightings from across the Czech Republic. In some cases, we also requested tissue samples for genetic identification based on the Cyt b gene. Our analysis of these photographic and genetic data revealed: (i) *C. russula* is currently present in the Cheb area, Aš panhandle and Kraslice, (ii) the genetic diversity of *C. russula* populations across Europe is remarkably low, reflecting historical events like the founder effect and rapid expansion, (iii) the extremely rare occurrence of Lesser white-toothed shrew (*C. suaveolens*) in the Cheb area, and (iv) the coexistence of the White-toothed bicoloured shrew (*C. leucodon*) with *C. russula* in Cheb's urban habitats. Additionally, we obtained new photographic evidence confirming the presence of *C. leucodon* in northeastern Bohemia, where it had not been documented before. This study underscores the efficiency of citizen science as a tool for rapid and cost-effective data collection. By harnessing public enthusiasm and participation, we gathered extensive data that would have otherwise required considerable time and resources. This approach accelerates research efforts and fosters public interest and involvement in scientific endeavours, offering a sustainable model for future biodiversity monitoring initiatives.

## 65. Synanthropic and migrant bats in Yerevan City

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**Keywords:** Vespertilionidae, acoustic monitoring, Chiroptera, Yerevan city, urban ecology

Armenia, located in the Caucasus biodiversity hotspot, is home to an incredible diversity of bats, comprising 30 species from four families. However, there is a significant lack of information regarding bat populations in urban areas. To address this gap, research was conducted in Yerevan city to evaluate bat species diversity and activity levels in this urban environment. The study was carried out from August to November over the years 2019 to 2021 using an automatic recording device known as the BatLogger C across 12 districts of Yerevan. A total of 17,794 bat calls were recorded, with 6,489 calls analysed and classified. The findings indicate the presence of seven genera within the Vespertilionidae family in Yerevan. Species distribution varied among districts, and bat activity peaked during nighttime hours from 22:00 to 01:00. Maps were created to illustrate species distribution across Yerevan's districts, emphasising their connections to green zones and buildings. Species richness and evenness were calculated for each district, and these metrics were compared to evaluate the influence of urban landscapes on individual species. This information provides valuable insights into the role of green zones in shaping bat ecology within urban areas.

**66. Distribution of *Microtus levis* and *Microtus arvalis* species in Armenia**

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**Keywords:** Vole, pest, sympatry

The species *Microtus levis* and *Microtus arvalis* belong to the Cricetidae family of rodents and play an essential role in Armenia's ecosystems. These species are widely distributed across both humid and arid regions, demonstrating a high level of adaptability. In Armenia, *Microtus levis* is primarily found in lowland areas, particularly in the Ararat Valley, where grass-covered landscapes, water availability, and agricultural fields are present. On the other hand, *Microtus arvalis* has a broader distribution, inhabiting both lowland and mountainous regions. This species is particularly well-adapted to dry and rocky habitats, contributing to its survival across various landscapes in Armenia. Both species are crucial to ecosystems, serving as key components of the food chain. However, in agricultural areas, they are often considered pests due to the damage they cause to crops. The distribution ranges of these species have been mapped, considering both climatic factors and certain behavioural characteristics.

67. Some bat species are spreading to the north, but one also to the south?  
New findings of *Myotis dasycneme* (Boie, 1825) from Bosnia and Herzegovina - southernmost records of Pond bat in Europe

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**Keywords:** Bats, Bosnia and Herzegovina, Pond bat, *Myotis dasycneme*

The pond bat (*Myotis dasycneme*) is predominantly distributed across northern and central Europe. However, recent studies indicate that some populations are expanding southward, challenging established notions about the species' ecological and geographical preferences. This contribution reports novel findings from Bosnia and Herzegovina, marking the southernmost confirmed records of *M. dasycneme* in Europe. In August 2024, a mist-netting survey captured an adult male in the upper Bosna River (E18.28604° N43.83146°). Additionally, in October 2024, two adult males were observed in Djevojačka Pećina cave (E18.64580° N44.21405°). These records complement earlier findings in Srednja Bijambarska Pećina (E18.50312° N44.09445°), where the species was first documented in May 2016, followed by winter monitoring during 2016/2017 and 2018/2019. Notably, during the winter of 2024, a reproductively active adult female was also recorded in this cave, further substantiating the hypothesis that it functions as a regular habitat for the species. The southern range of pond bats remains poorly understood, with previous records from Bulgaria considered the southernmost in Europe. A comparison with Bulgarian data, including the discovery of well-preserved skulls in Varteshka Cave, suggests that pond bats may primarily use caves in their southern range for transitional or non-breeding purposes. The Bosnian findings highlight the need for comprehensive studies on the species' migratory patterns, seasonal behaviours, and social dynamics. The consistent presence of *M. dasycneme* in central Bosnia suggests the possibility of year-round habitation in this region. The identification of local colonies is imperative for understanding the species' reproductive strategies and seasonal cycles in its southernmost habitats. These findings enhance our understanding of the species' range dynamics and provide valuable insights for long-term conservation and management.

68. Habitat associations of the island-restricted bats *Pipistrellus maderensis* and *Nyctalus azoreum* in the Azorean Island of Graciosa

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**Keywords:** Graciosa, Chiroptera, bioacoustics, island, land-use

Approximately 60% of all bat species are found on islands, with around 25% being island endemics. Insular bats face significant threats from various disturbances, including human activities and habitat changes, with nearly 50% of island bat species classified as threatened. The archipelago of Azores is home to two of the most threatened and poorly known bats in Europe: *Pipistrellus maderensis* and *Nyctalus azoreum*. In April 2023, we conducted an island-wide bioacoustic survey using AudioMoths in 59 sites on Graciosa Island. We detected 768 bat passes of *Nyctalus azoreum* and 93 of *Pipistrellus maderensis*. Both species were recorded in multiple habitats throughout the island with somewhat contrasting responses to land-use. This is the first island-wide bioacoustic survey to evaluate the influence of habitat type on the activity of Azorean bats and provides essential insight on their ecology and conservation.

## 69. Non-volant mammal communities along elevational gradient in Papua New Guinea

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**Keywords:** Non-volant, mammal, communities, elevation, sampling

Tropical rainforests are among the most biodiverse ecosystems on Earth. Papua New Guinea (PNG), within the Australo-Oceanian region, is unique in hosting all three subclasses of mammals—Marsupials, Monotremes, and Placentals. Despite this exceptional biodiversity, detailed studies of mammal communities and mammal taxonomy in PNG remain limited. This study provides a comprehensive assessment of non-volant mammal communities across an elevational gradient in PNG. Standardised sampling techniques were applied at eight sites along a transect in the Saruwaged Mts. (Huon Peninsula), regularly spaced by 500 m elevation increments from 200 m to 3700 m a.s.l. An additional site at 200 m elevation from a lowland adjacent to the transect, 150 km away, was included. At each site, trapping was conducted over 10 days using a combination of Elliott, Sherman, snap, pitfall, and Tomahawk traps, alongside spotlighting, hunter interviews, and bone collection. A total of 383 individuals representing 40 species were captured, with an additional 15 species identified through hunter interviews, bringing the total to 55 species from nine families. The mid-elevation 1200 m and 1700 m asl. exhibited the highest mammal diversity while 1700 had the highest abundance. The Species detection was determined to be an underestimation, as indicated by Chao 1 estimation for all sites. Canonical Correspondence Analysis identified three distinct clusters of mammal communities along the gradient: Low elevations (200 m and 700 m), Mid elevations (1200 m, 1700 m, 2200m and 2700m), High elevations (3200 m and 3700 m). These are some of the first data on non-volant mammals from complete rainforest elevation gradients, highlighting the importance of elevational studies in understanding biodiversity patterns and providing valuable insights for conservation efforts in PNG.

## 70. New data on the family Soricidae in Armenia

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**Keywords:** Soricidae distribution, habitat mapping, Armenian fauna

The fauna of Armenia is unique for many reasons; one of them is that it has been formed over a long period in a motley and diverse landscape structure with a complex three-dimensional distribution of habitats. Determining the species composition of any taxonomic group in such conditions is already challenging in itself. Identifying potential habitats of representatives of the Soricidae family (shrews) was carried out for the first time in the last 30 years. We studied all existing data on the distribution and ecology of these mammals collected from various sources, including scientific publications, museum collections and our field studies. Mapping was carried out using geographic information systems (GIS) and environmental parameters, which allowed us to identify potential habitats for various Soricidae species in the diverse landscapes of Armenia. The study also analyses factors influencing the distribution of shrews, such as climate change, vegetation types and anthropogenic impact on the environment. The results obtained can be helpful in planning measures for protecting and managing biodiversity in the region.

71. First density estimation of the brown hare (*Lepus europaeus* Pallas, 1778) in Mavrovo National Park, N. Macedonia

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**Keywords:** Brown hare, prey, REST, density

Effective conservation of predators requires a comprehensive understanding of their prey populations. Being a specialised hunter, the survival of the critically endangered Balkan lynx (*Lynx lynx balcanicus*) depends on an ample amount of the two main prey species, roe deer (*Capreolus capreolus*) and brown hare (*Lepus europaeus*). We used the REST model to calculate the density of brown hares in Mavrovo National Park (MNP), North Macedonia. To that aim, we selected four sites near villages within MNP, as the park harbours most of the Balkan lynx population. We randomly placed 10 camera-traps with at least 200 m distance in between, aiming at a survey period of 28 days. We focused on agroecosystems with a mix of active and inactive pastures and small agricultural fields. During the entire trapping period we collected 230 videos with hare observations, obtained over a total trapping effort of 867 active trapping nights. The site-specific diel activity pattern of the brown hare reveals distinct periods of inactivity from early morning to late afternoon, with activity levels peaking shortly after this interval. Results show that the density ranged from 3.38–16.45 (SE = 2.08–5.37) inds / km<sup>2</sup>. This study offers the first-ever density estimation of brown hare in the Balkan lynx range. If repeated and updated, this could potentially inform better management measures for the conservation of the Balkan's rare cat.

## 72. Mammals of North Macedonia

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**Keywords:** North Macedonia, mammals, diversity

We provide an overview of the available information on the presence and diversity of mammals in North Macedonia, a country located in the central Balkan Peninsula known for its high mammal diversity in Europe. Currently, 90 mammal species have been recorded, four of which were newly discovered in the past decade. The most diverse group is Chiroptera, with 31 species, followed by Rodentia (26 species), Carnivora (14 species), Eulipotyphla (11 species), Artiodactyla (6 species), and Lagomorpha (2 species). Four species are considered endemic to the Balkans, whereas eight species have been introduced in the country by humans either deliberately or accidentally. The total number of mammal species is still not final, and further research, particularly on bats found in neighbouring countries, is expected to reveal additional species.

### 73. Distribution of lynx (*Lynx lynx*) in Armenia

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**Keywords:** Wildlife monitoring, camera traps, Eurasian lynx

The Caucasian subspecies of the Eurasian lynx (*Lynx lynx dinniki*), also known as the eastern lynx, is widely distributed across the Caucasus region. According to the IUCN, this subspecies is currently in decline. Research on the lynx remains scarce, with a very limited number of conducted studies so far. Since 2010, the WWF Armenia office has been conducting research in the southern regions of Armenia to study the distribution of large mammals, including the lynx. The research employed transect surveys, camera traps, and structured interviews with local villagers. Data collection primarily occurred during the autumn season. Of the transect data collected, 67% were from the Syunik region and 33% from Vayots Dzor. Interviews were conducted in 92 villages in northern Armenia, with lynx sightings reported in 42 villages. Among 209 deployed camera traps, 48.3% captured images or other evidence of lynx presence.

## 74. The rise (and fall?) of European water shrews, *Neomys* spp.: combining phylogeography and Species Distribution Models to uncover the effects of future climate change

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**Keywords:** Evolution, environmental-modelling, climate-scenarios, distribution-changes, extinction-risk

Predicting the effects of climate change on species distributions, while considering their genetic differentiation and evolutionary history, is crucial for developing effective conservation measures. Here, we aim to: (1) assess the phylogenetic and phylogeographic relationships among European *Neomys* species and their respective lineages; (2) infer the demographic history of all genetic lineages; (3) estimate the potential impact of future climate change on their distribution and the persistence of these lineages. We reconstructed the phylogenetic relationships among the species in Europe and unveiled their demographic history based on cytochrome b gene sequences. Presence data were used to model potential changes in their distribution under distinct climate change scenarios. Our results confirm the existence of a distinct *N. milleri* lineage in the Italian Peninsula, whose population size has remained relatively constant over time. Except for this lineage, all species' populations had likely been increasing until at least 25,000 years ago. While our future projections are optimistic to *N. milleri* and relatively neutral for *N. fodiens*, they suggest the likely extinction of *N. anomalus*, endemic to the Iberian Peninsula, and of the Italian lineage of *N. milleri*. The Mediterranean Peninsulas, which served as refugia from the extreme cold conditions during the Last Glacial Period, have contributed to the genetic differentiation of *N. anomalus* and of the Italian lineage of *N. milleri*. However, as the climate warms, the Peninsulas may no longer sustain these species or lineages. Given the Peninsulas' status as biodiversity hotspots, the vulnerability of their ecosystems to climate change should mobilise conservation efforts guided by phylogeographic approaches, enabling the identification of potential lineages or endemisms before they face extinction.

## 75. Pride lands in peril: Forecasting lion habitats across changing African landscapes

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**Keywords:** Climate change, fragmentation, *Panthera leo*, species distribution models

The African lion (*Panthera leo*) has experienced significant range reduction due to habitat fragmentation, particularly in West and Central Africa. This study aims to model the potential distribution of lions in these regions under past, present, and future environmental conditions using Species Distribution Models (SDMs). We utilised occurrence data from 1900-1990 and environmental variables from the CHELSA database to calibrate our models. "Current" (1981-2010) and future (2041-2070) climate projections were used to assess potential shifts in habitat suitability. Two Earth System Models (IPSL-CM6A-LR and GFDL-ESM4) and two Shared Socioeconomic Pathways (SSP370 and SSP585) were considered to account for climate change uncertainties. Our preliminary results provide insights into the historical, current, and potential future distribution of suitable habitats for lions in West and Central Africa. The models highlight areas of high habitat suitability and potential range shifts under different climate change scenarios. These findings were overlaid with protected area and land use datasets to assess the implications for lion conservation. This study contributes to our understanding of how climate change and habitat fragmentation may impact lion distribution in West and Central Africa. The results can inform evidence-based conservation strategies and policy decisions aimed at protecting lions and other endangered species in increasingly fragmented landscapes.

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## 76. Tracking tubes and biomolecular tools: an experimental sampling for studying small mammals in Mediterranean scrublands

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**Keywords:** Micromammals, tracking tubes, community, France

Monitoring terrestrial small mammals requires sampling strategies fitted to their small body size, elusive behaviour and seasonal population dynamics. Thickness of some habitats increases the difficulty of finding signs of presence. Analysing the diet of predators can only assess the richness and composition of communities at a large scale. Ethics and time-consuming field work restrain live trapping. For the first time, we experimented with tracking tubes for sampling hair and droppings of terrestrial small mammals in Mediterranean scrublands. We used four types of baited tubes spaced three meters apart along a 100-m line transect in three scrublands of southern France, including thick vegetation of *Quercus coccifera* and *Q. ilex*. Species were identified by metabarcoding using the CO1 gene. Four two-week tracking sessions in each study site for a total of 30,251 sampling nights revealed the presence of six species, with 24.8 % of positive tubes of each type after the two-weeks sessions (15.8 % after one week). Wood mouse, *Apodemus sylvaticus*, and Algerian mouse, *Mus spretus*, were the most frequently detected species (64% and 25%, respectively). House mouse, *Mus musculus*, greater white-toothed shrew, *Crocidura russula*, and mole, *Talpa* sp., were more rarely detected. However, the detection of the smallest Eurasian mammal, the pygmy white-toothed shrew, *Suncus etruscus*, supports the sensitivity of the tracking tubes. The efficiency of this sampling method was better in autumn than in summer in 2021 (232 vs. 207 positive tracking tubes), and in summer than in autumn in 2022 (344 vs. 93 positive tracking tubes). This study highlights the efficiency of tracking tubes and metabarcoding as an alternative to live trapping for small mammal studies, particularly in weekly penetrable habitats. However, some adjustments are required (sites choice, sampling period, habitat conditions, bait type) for improving detection.

## 77. ChiroVox: the largest global bat call library, now enhanced with new features

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**Keywords:** ChiroVox, echolocation, global, biodiversity, identification

ChiroVox ([www.chirovox.org](http://www.chirovox.org)), launched in 2022, has become the largest open-access library for bat echolocation and social calls worldwide, supporting research in taxonomy, ecology, and conservation. The platform currently hosts over 5700 recordings from more than 250 species across 16 countries on four continents (Europe, America, Africa, and Asia), contributed by over 50 researchers. Each recording is paired with detailed metadata and a unique identifier, ensuring reproducibility in acoustic analyses and scientific publications. At the end of 2024, the second version of ChiroVox was launched in collaboration with the OpenBioMaps biodiversity data management platform, introducing significant improvements to serve the research community better. A new user management system enables registered users to track their contributions, efficiently upload large datasets, and customize access levels for their recordings. Advanced metadata capabilities now facilitate diverse analytical applications, including the development of automatic species identification tools. The platform also incorporates a mass-download function, reducing the time required to retrieve data, and a feedback system that allows users to comment on recordings, enhancing data reliability. The revamped ChiroVox provides significant support for interoperability, including using GIS tools or downloading data in customised formats, and can be integrated into reporting processes. The open-source architecture encourages community-driven development and facilitates seamless integration with international databases, such as GBIF. With these enhancements, ChiroVox continues to address critical challenges in species identification, particularly in biodiversity-rich regions and remains a cornerstone resource for the global bat research community.

**78. Monitoring wolves in the Netherlands using professionalised citizen science**

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**Keywords:** Citizen science, wolf

Wolves have made a spectacular comeback in Western Europe, including already 11 wolf packs in the Netherlands. The monitoring in the Netherlands is almost entirely based on systematic and professionalised use of citizen science. In this presentation, I will reflect on using the public when monitoring such a controversial animal out of my experiences as the national coordinator for wolf monitoring.

## 79. Using cameras to gain new insights on dormice nesting and improve nest box monitoring

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**Keywords:** Behaviour, disturbance, activity patterns, conservation

Dormice populations and their distribution ranges have declined due to habitat loss and fragmentation, as well as climate change. Their unique arboreal and nocturnal habits make them difficult to observe in the wild, contributing to the lack of research on the species. Nest boxes have become a widely used tool for studying dormice, and can provide insights into seasonal patterns, hibernation cycles, and behavioural observations. We set up 284 nest boxes in eight sites across Lower Saxony, Germany to target edible dormice (*Glis glis*). The boxes were checked monthly and in addition to the edible dormouse, we found the garden dormouse (*Eliomys quercinus*) and hazel dormouse (*Muscardinus avellanarius*) in our sites. We also added cameras above 60 of the most active nest boxes to provide enhanced insight into activity patterns, nest selection, and level of disturbance that nest checking may cause. Specifically, we aim to identify the best time for nest checks by determining when dormice are most active, and when they depart and return for hibernation. If dormice leave the boxes after nest checks and presence of predators, how long does it take for them to return? Finally, we aim to estimate the number of monthly visits to maximise detection rate while minimising disturbance. Understanding activity patterns and response to disturbance can help us assess how the dormice respond to environmental changes, resource competition, and determine if smaller-scale disturbances may be overlooked as potential stressors. Though knowledge gaps remain, these combined methods of nest boxes with camera traps can advance our understanding of dormice ecology and explore aspects of their behaviour seldom studied, enabling targeted, effective conservation strategies and enhancing our overall understanding of these elusive species.

## 80. Using iDNA and airDNA in biodiversity monitoring

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**Keywords:** Biodiversity, fragmented forests, iDNA, airDNA

Monitoring biodiversity is critical for effective conservation, yet traditional multi-species methods can be time-intensive, costly, and require significant field expertise. Novel eDNA approaches such as airDNA and iDNA offer promising alternatives, enabling efficient, broad-scale assessments of mammalian diversity. This study evaluates the temporal and spatial sensitivity of airDNA and iDNA as tools for biodiversity monitoring within a fragmented forest landscape. Laboratory tests assessed the temporal persistence of DNA in controlled conditions, revealing that airDNA is less temporally sensitive than iDNA, with detectable DNA decreasing significantly after 60 hours compared to 20 hours for iDNA. Field comparisons examined community evenness, species richness, and Shannon diversity indices to compare the suitability of each method. Community evenness measures whether specific species dominate the sample, reflecting potential biases in detection. iDNA is more temporally, and therefore spatially sensitive than airDNA, making it better suited for alpha diversity measurements. However, no significant differences were found between the two methods regarding diversity, richness, or evenness, indicating that either method is suitable for beta diversity metrics and provides broad species coverage. airDNA sampling proved more reliable, suggesting that a combination of techniques would be the most effective approach.

## 81. Innovative non-invasive genetic monitoring of UK beaver populations using eDNA

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**Keywords:** eDNA, population genetics, beavers, rewilding

Beavers (*Castor fiber*), once extinct in the UK due to overhunting, have begun to re-populate areas resulting from unauthorised releases, escapes from private collections and, more recently, licenced reintroductions. However, the UK's populations remain small, isolated, and derived from low-diversity founder groups, making genetic monitoring critical to ensure their long-term viability. This study presents the first use of environmental DNA (eDNA) to detect nuclear DNA and assess intraspecific genetic variation in UK beaver populations. Sampling saliva traces from gnawed wood, mitochondrial and nuclear eDNA were successfully amplified and sequenced using qPCR and Next Generation Sequencing. Initial results identified genetic differences between distinct populations and demonstrated the feasibility of non-invasive methods to capture genetic variation. Further sampling in January 2025 to obtain fresher samples to improve the detection of nuclear markers, will enable a more detailed understanding of genetic variation and population structure. This ongoing work aims to refine non-invasive genetic monitoring methods, providing vital insights for managing beaver populations and ensuring their genetic resilience in the UK and beyond.

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### 82. Establishment of a ground squirrel colony from laboratory bred animals

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**Keywords:** *Spermophilus citellus*, breeding

Laboratory-bred, RFID-chipped European ground squirrels were released in the Fertő-Hanság NP as part of the RAPTORS PREY LIFE+ Project (LIFE13 NAT/HU/000183) in August 2018 and 2019. The animals readily occupied the pre-drilled holes and established new entrances within a week, so their initial success was not impaired by the laboratory breeding. Long term success of the colony was judged by recapturing them in the following years and mapping their whole distribution each spring. Based on their RFID and body weight, from the capture data we could distinguish lab-originated animals from their descendants that were born only once each year. Most released animals were able to overwinter, and started to breed next spring, with a tendency that animals larger at release were better able to start breeding the following year. While the lab-produced animals remained within meters of their original release location, the area covered by the colony doubled each year due to the dispersal of new generations. This dispersal followed the suitable short grass vegetation grazed by grey cattle and was in part affected by the geography of the site as the animals preferred the elevated areas for establishing their own hole systems. Based on calculations from hole density data, the colony size is at least five times larger than the numbers originally released. Thus we have developed and tested the methodology for all necessary steps to breed, raise the ground squirrels in captivity and release them to suitable habitats. Therefore, we conclude that lab breeding and soft release of adults is a viable possibility for establishing new populations for this IUCN Red List species.

## POSTER PRESENTATION- Reintroductions and Wildlife Management in Changing Ecosystems

### 83. Successful breeding of the Romanian hamster (*Mesocricetus newtoni*) in captivity with conservation proposals

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**Keywords:** Dobrudja hamster, captive breeding, endangered, conservation, Balkans

The Romanian or Dobrudja hamster (*Mesocricetus newtoni*) is one of four species in the genus *Mesocricetus* and is endemic to Romania and Bulgaria. Its range is confined to the area between the Stara Planina Mountains and the Danube River, covering the Danube Plain and the Dobrudja region. The species is classified as Vulnerable (VU) in the IUCN Red List of 2024, reflecting its limited distribution and the lack of regular survey. Its Unfavourable conservation status (*U1 in Bulgaria, U2 in Romania*) underscores the need for conservation efforts, including captive breeding. Mid-20th-century publications mentioned hybridisation attempts with *Mesocricetus auratus* and *Mesocricetus brandti*, but breeding protocols, success rates, and litter sizes remain undocumented. In 2024, the LIFE 20 NAT/BG/001162 project in Bulgaria successfully bred Romanian hamsters in captivity. Four females produced 25 cubs, with an average litter size of six and a 1:1 sex ratio. Cubs stayed with their mothers for 40–45 days; after 60 days the incidence of conflicts between juveniles and between juveniles and their mothers increased. Hamsters were housed in 50 × 40 × 30 cm cages. Pregnant females were fed a mix of 67% starchy seeds and pulses, 24.8% oil-rich seeds, 4% animal protein, 2.2% vegetables and 2% flowers. Additional protein sources included dried mealworms, boiled eggs, live crickets, and fresh vegetables, with vitamin and mineral supplementation. This breeding program aims to reintroduce young Romanian hamsters into suitable habitats to support their declining population.

This work was supported by the LIFE 20 NAT/BG/001162 project and partially funded by the Bulgarian Ministry of Education and Science, under the National Research Program "Young Scientists and Postdoctoral Students – 2" (DCM No. 8/20.09.2024). Fieldwork was conducted under permits issued by the Bulgarian Ministry of Environment and Water (NSZP-440/01.08.2024, 02-BG-2009).

## 84. Overcoming the challenges in cryptic species recognition – the case of the strictly protected European lesser blind mole rat

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**Keywords:** ISSR-PCR, karyotyping, *Nannospalax*, non-lethal, sry

Wildlife monitoring can be a challenge when speciation is not always followed by morphological changes, i.e. cryptic species, the recognition of which is the first necessary step. Here, we present the case of the subterranean rodent European lesser blind mole rat (BMR) *Nannospalax leucodon supersp.* which comprises more than 20 chromosomal forms, five of which occur in Serbia and are strictly protected by law. Despite reproductive isolation and phylogenetic distance confirmed among these five chromosomal forms/cryptic species, they are not officially designated as species due to morphological convergence. From a conservation perspective, it is essential to monitor their populations and describe their distribution areas. Our approach combines karyotyping with molecular genetic species identification and sex determination. Since all known BMR's karyotyping protocols required animal sacrifices, we developed the only possible non-lethal sampling method using finger snips followed by the safe return of animals to their original underground systems. Additionally, standard procedures for mammalian fibroblast growth were not applicable due to the specific cell culture characteristics related to BMR's resistance to cancer. The composition of the complete medium followed the standard fibroblast protocol, with minor modifications. However, the karyotyping protocol (colchicine, ethidium bromide and the type of hypotonic solution) was significantly changed compared to other rodent species. For rapid and reliable species identification, we developed the Inter Simple Sequence Repeat - PCR profiling technique. Of 11 different ISSR primers tested for the presence of species-specific DNA fragments, three primers provided informative DNA profiles that ensured reliable and unambiguous recognition of analysed cryptic species. Sex of each individual was determined through PCR-based sry determination presented as sry marker presence/absence. Our results demonstrate the efficacy of these methods and provide a reproducible model for monitoring other cryptic species. This research underscores the importance of non-lethal genetic monitoring for biodiversity conservation.

## 85. Sexual dimorphism in ventral and dorsal cranium of the lesser blind mole rat from Serbia and North Macedonia

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**Keywords:** Allometry, geometric morphometrics, shape, size

The superspecies of the European lesser blind mole rat (BMR) *Nannospalax leucodon* (Spalacidae, Rodentia) comprises more than 20 chromosomal forms, some of which are recognised as morphologically uniform but genetically distinct, so-called cryptic species. As sexual dimorphism (SD) can be an important source of morphological variability, its assessment is the first step in the study of differences within and between (cryptic) species. Moreover, the evolution and maintenance of SD in BMR is poorly studied. We used two-dimensional geometric morphometric methods to investigate sexual size and shape dimorphism (SSD and SShD) in two cranial views of four cryptic species (*N. l. hungaricus*, *N. l. serbicus*, *N. l. montanoserbicus*, *N. l. syrmiensis*) from Serbia and one (*N. l. makedonicus*) from North Macedonia. For both cranial views, we found statistically significant SSD (males larger than females) and SShD in all cryptic species except *N. l. syrmiensis*. Males and females showed the same allometric trend, and a statistically significant effect of allometry on shape variation was observed. Furthermore, the overall shape variation between the sexes is identical in all cryptic species studied and resembles the allometric shape changes, emphasising allometry's role in the reported SShD. After allometric correction, SShD in the ventral cranium remained statistically significant in only one cryptic species (*N. l. montanoserbicus*), while in the dorsal cranium, none of the cryptic species showed statistically significant differences between the sexes in the non-allometric component of shape variation. The sexes of BMR do not differ in their ecological niches (habitats and diet), although males dig longer burrows (especially during mating), suggesting that underground adaptation may have evolved differently in males and females. Males do not invest in their offspring and are more aggressive. Thus, sexual rather than natural selection may be the predominant evolutionary mechanism responsible for the observed SD in BMR.

86. Estimating population abundance and monitoring population trends of endangered, elusive subterranean mammals using HRAMN methodology

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**Keywords:** High-resolution aerial monitoring, Spalacinae

Monitoring rare or endangered species is vital for biodiversity conservation but particularly challenging for hidden or elusive species. The subterranean Eurasian blind mole rats are such species. This group's newly identified endemic species, found in the Pannonian Basin (Central Europe), are highly endangered. Their hidden lifestyle makes population monitoring difficult, yet such data are crucial for their conservation. To address this problem, a new methodology called HRAMN was introduced, which uses complex aerial cartographic surveys. The method was tested in two protected sites in eastern Hungary, home to the endangered Hungarian blind mole rat (*Nannospalax hungaricus hungaricus*). HRAMN involves collecting data through aerial surveys and producing high-resolution orthophoto mosaics and digital surface models. These data allowed the identification of blind mole rat mounds and the monitoring of population trends. The HRAMN methodology proved to be a highly effective replacement for traditional full-field surveys of blind mole rat habitats. It is particularly useful for monitoring large areas, which was previously impossible. However, there were certain limiting factors in blind mole rat habitats that required field presence and control, even with the aerial HRAMN method. Recommendations were made to address these limiting factors. The HRAMN method not only improves survey accuracy but also allows for frequent monitoring, providing unprecedented detail on the population dynamics of these rodents. In addition, the investigation explored the relationship between the spatial patterns of blind mole rat mounds and their habitats, providing deeper insights into their ecology and potentially aiding in the development of more effective conservation strategies.

## 87. Predictors of fur insulative qualities in burrowing rodents around the globe

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**Keywords:** hairs, thermal insulation, social thermoregulation

Subterranean environment of damp sealed burrows with stable temperature presents great challenges to mammalian thermal biology, which many rodent clades all around the world have to face. In mammals, the most important trait to cope with such challenges is presented by fur. To identify the factors shaping the insulative characteristics of fur in burrowing mammals, we investigated the effects of environmental temperature, degree of fossoriality, body mass, and social system on hair length and density in 19 species of burrowing rodents representing five families of five continents and six zoogeographic regions. Our results highlight the environmental temperature, body mass, and social system as the most influential predictors of fur characteristics. Better insulation was found in dorsal fur compared to ventral, and its insulative properties decreased in species from warmer environments. We also confirmed the hypothesis on poorer thermal insulation in social species probably due to the opportunity of social thermoregulation. Surprisingly, strictly subterranean species evinced better fur than their less subterranean counterparts.

## 88. Going, Going, Gone? The dramatic silent decline of the Sardinian long-eared bat *Plecotus sardus*

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**Keywords:** Extinction, endemism, bats, Chiroptera

Human-induced pressures such as climate and land use changes in the Anthropocene disproportionately threaten island ecosystems and their host endemic species. Therefore, shedding light on the ecological needs of insular endemic species, and timely assessing their populations, is key to the conservation of these fragile ecosystems and their unique biodiversity. Here we report on the dramatic decline of the Italian endemic Sardinian long-eared bat *Plecotus sardus*, updating previous conservation assessments with quantitative data derived from recent roost counts and ecological studies unveiling its habitat needs. Moreover, we conducted a conservation gap analysis to assess anthropogenic pressures and identify urgent actions needed to secure the species' last colonies. We show that, besides showing a unique phenology and roost use, the species is intimately associated with mature standings of dry broadleaf forests of native *Quercus ilex* and *Q. suber*, being negatively influenced by coniferous woodlands, and urban environments. Our updated assessment revealed a further decline of the species, which should now be considered as one of the rarest mammals of Europe, counting <50 adult individuals, confirming the recent IUCN re-assessment that classifies the species as Critically Endangered, and thus urging timely conservation actions. Our spatial gap analysis also revealed that the most important roost lies outside of a neighbouring protected area, and so do the main foraging grounds of the bats from that colony. We thus highlight that the extension of the current Natura2000 network may timely secure protection to key foraging habitats and roosting areas of the last Sardinian long-eared bats. Taken together, our results not only provide critical insights for the conservation of *P. sardus* but also highlight the urgent need to enhance the current Natura2000 network, although the rate of decline in some species risks outpacing the speed of administrative processes.

## 89. Do land use changes really affect the distribution of common hamster - *Cricetus cricetus* in Romania? Insight from potential distribution models

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**Keywords:** *Cricetus cricetus*, SDMs, land-use-changes Romania

The common hamster *Cricetus cricetus*, classified as Critically Endangered by the IUCN, faces severe threats despite its protected status under the EU Habitats Directive. Forced to adapt to agricultural landscapes as an alternative to its originally steppe-like habitats, the common hamster is now facing a new challenge on its existence: the reduction of its remaining habitats, heavily affected by land use changes and fragmentation. The current knowledge on its distribution in Romania is not satisfactory, and we tried to (i) fill the distribution gap using SDMs and (ii) explore the impact of land use changes that occurred in the last three decades. We compiled a dataset of 248 occurrence records which we then used to generate an ensemble model. Land use change analyses were conducted by splitting the occurrence dataset, based on the recording year, into four time periods (1990–1999, 2000–2006, 2007–2011, 2012–present) and analysing them against the corresponding land use change vectors from the Copernicus website. The model identified non-irrigated arable land and pastures as the most prevalent land cover types within the hamster's predicted range. A key finding was the alarming rate of land use change within the hamster's habitat rather than the surface area affected by these changes. Notably, the most dramatic shifts occurred immediately after the fall of the communist regime and, more recently, between 2013 and 2018. This acceleration of land use change raises significant concerns about the long-term viability of the common hamster in Romania. This enforces the need for more accurate assessments and targeted conservation measures. We therefore urge for a change in the hamster's conservation status from Annex IV to Annex III of the EU Habitats Directive. This reclassification would facilitate the designation of special conservation sites and the implementation of specific habitat management measures crucial for the species' recovery.

## 90. Activity of the Garden dormouse (*Eliomys quercinus*) in karst habitats in Croatia captured using camera traps, with recommendations for further monitoring

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**Keywords:** small mammals, garden dormouse, camera trapping, Dinaric karst

Garden dormouse (*Eliomys quercinus*) is rapidly declining in Europe, also raising concern for the population isolated in the Dinaric Alps, Croatia. In the period 2021 – 2023, through an EU-financed project, the Republic of Croatia developed national monitoring programs for four strictly protected small mammal species listed in Annex IV of the EU Habitats Directive. Camera trapping was one of the primary monitoring methods used during the project, both on the ground and in the canopy. Camera traps were set up to record for 10 to 24 days. Aside from the four targeted species, many others were documented, including the Garden dormouse. Its presence was recorded in three out of ten 10x10 km quadrants set within the expected range of the Garden dormouse. All observations were made between May and August, almost exclusively during the night, with only one recording captured shortly after dawn. Most camera traps that documented the Garden dormouse (11 out of 12) were primarily set up for the research of the Balkan snow vole complex (*Dinaromys bogdanovi* s.l.) and were positioned in limestone karst habitats on the ground, near crevices. In two quadrants in the coastal part of the Velebit Mts., Garden dormice were confirmed only at elevations between 180 and 850 m a.s.l., but on the southern slopes of Svilaja Mt., deep within the Dalmatian mainland, they were documented for the first time, at elevations between 740 and 1100 m a.s.l. Our results confirm that camera traps set on the ground level are the most promising choice for further Garden dormouse monitoring in karstic habitats of Croatia.

91. First record of a dark pelage form of the Romanian hamster (*Mesocricetus newtoni*) in Bulgaria

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**Keywords:** Romanian/Dobrudja hamster, anthropogenic pressures, melanistic, Balkans

The Romanian or Dobrudja hamster (*Mesocricetus newtoni*) is found only in Bulgaria and Romania, within a small, restricted range. Due to its limited distribution, studies on its biology and ecology are scarce. On July 21, 2024, at 10:15 a.m., during habitat mapping of the Romanian hamster in the Pleven region (Northern Bulgaria) a young female with an unusual color polymorphism was captured in a Sherman trap, baited with cucumber, carrot, and a seed mix. In particular, the individual exhibited dark colouration on both dorsal and ventral sides, with a more pronounced black lateral cheek stripe and breast spot. The paws and nose were of lighter coloration. A review of scientific literature and museum collections in Bulgaria suggests this is the first recorded case of such colour polymorphism within the species' range. Also to date, no similar cases have been reported in the other three *Mesocricetus* species (*M. auratus* in the wild, *M. raddei*, *M. brandti*). The rarity of this trait across the genus suggests an unusual phenomenon requiring further investigation. It is possible that intense anthropogenic pressures, such as rodenticide use, intensive agriculture, and monoculture farming, are contributing to habitat loss and population decline. Reduced genetic diversity and increased inbreeding may lead to higher homozygosity, reduced fitness, and a rise in colour anomalies. This work was supported by the project "Securing the Recovery of the Endangered Saker Falcon in Bulgaria and Southern Romania" (LIFE 20 NAT/BG/001162) and partially funded by the Bulgarian Ministry of Education and Science under the National Research Program "Young Scientists and Postdoctoral Students – 2" (DCM No. 8/20.09.2024). Fieldwork was conducted under permits issued by the Bulgarian Ministry of Environment and Water (NSZP-50/17.02.2021 and NSZP-440/01.08.2024).

## 92. Population density assessment of the Endangered European Souselik (*Spermophilus citellus*) in Western Romania

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**Keywords:** Burrow entrance, DISTANCE, Natura 2000

The European souselik (*Spermophilus citellus*), a small, endangered mammal endemic to Central and South-Eastern Europe, continues to face significant population declines despite legal protection under the Bern Convention and the Habitat Directive. In Romania, the species' conservation status remains unfavourable and inadequate, as indicated by two consecutive assessments under Article 17 of the Habitat Directive. This study assessed souselik density within the Mureş Floodplain Natural Park and ROSCI0108 Lower Mureş Floodplain in western Romania. Line transect counts of active burrows were conducted in 2022 and 2023. In 2022, grids of linear transects were used across three core areas for the species, covering 11.69 km of transects and 437 active burrow entrances. In 2023, random line transects were conducted in one of these areas and five new locations where the species is only patchily distributed, totalling 10.27 km of transects and 164 active burrow entrances counted. Detection probability was higher in grid transects, while encounter rates were higher in line transects compared to grid transects. Using DISTANCE analysis, similar burrow entrance densities were obtained: 34.53/ha (95% CI: 28.45–41.97; SE = 3.43) for grid transects and 38.7/ha (95% CI: 27.45–54.55; SE = 6.66) for line transects. We estimated the population density using published indexes, yielding values of 4.83 ind/ha (grid) and 5.42 ind/ha (line), suggesting the population is in the lower category B of relative abundance. This study provides valuable insights into the population density of *Spermophilus citellus* and contributes to conservation monitoring efforts for the species in Romania.

### 93. Trend analysis of the endangered European ground squirrels in Northeastern Hungary

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**Keywords:** Rodents, grassland, conservation, extinction

The European ground squirrel (*Spermophilus citellus*) is a highly threatened, strictly protected species in Hungary, associated with dry grassland habitats and declining at an alarming rate. Its population has been declining in Hungary for decades. We examined the population trend of the European ground squirrel in the Hortobágy National Park (HNP) Directorate (Northeastern Hungary) between 1970 and 2024. We used all available published and unpublished data, mainly from the Biotics Database of the National Park Directorate. Within the study area, 176 former ground squirrel populations were identified, about half of which are now extinct. Analysis showed that habitat loss and degradation were the leading causes of this decline. Factors such as agricultural expansion, infrastructure development, and climate change have had a significant impact on suitable habitats. The findings highlight the urgent need for conservation actions. Effective habitat protection measures, including establishing protected areas and restoring degraded habitats, are crucial. In addition, promoting sustainable agricultural practices, such as minimising the use of pesticides and maintaining wildlife-friendly farming methods, is essential for the long-term survival of the ground squirrel population. This research provides valuable insights into the decline of the European ground squirrel. It will inform the development and implementation of effective conservation strategies within the HNP and beyond.

## 94. Daily movements in cities: GPS tracking of urban and rural Eurasian red squirrels

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**Keywords:** City-parks, GPS, movement, squirrel, urbanisation

The rapid and ongoing expansion of urban areas worldwide is challenging wildlife, which often adapts to these novel human-dominated environments by shifting their phenotypic traits. Behavioural changes are among the first responses that animals adopt to cope with urban challenges, allowing some individuals to persist and adapt to urban green spaces. Specifically, movement patterns can be greatly influenced by the fragmented and patchy structure of green spaces in cities, leading to behavioural differentiation between urban individuals and their rural conspecifics. Here, we GPS-tracked Eurasian red squirrels, *Sciurus vulgaris*, in multiple urban and rural study sites to investigate differences in their daily movements between these area types. This study is among the first to use GPS collars on squirrels, made suitable for this species by recent technological advances. Squirrels were tracked during their diurnal activity period in winter and autumn, with GPS fixes recorded every 15 minutes for 3 days to obtain detailed daily movement data. We calculated the daily distance travelled, the maximum daily displacement and the straightness index to inform about the tortuosity or directionality of the daily movement path. Results suggest that the daily movements differ between urban and rural individuals, highlighting the effects of green space fragmentation and barriers present in cities. Moreover, the high frequency of GPS fixes provided important information about the detailed paths taken by individuals in certain urban parks, identifying critical points that may affect individual survival, such as frequently used road crossing points. These insights are fundamental for providing recommendations for urban wildlife conservation and for the development of structures that facilitate their movements such as squirrel bridges over busy roads.

## 95. Native raccoon dogs use spatial and temporal partitioning to minimise contact with feral and free-roaming cats in urban parks in Tokyo

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**Keywords:** Carnivores, behaviours, urban area, partitioning

As wild carnivores have extended their ranges into metropolitan Tokyo, understanding their ecology in urban habitats has become a research priority. Here, we analysed temporal and spatial intra-guild interactions between native raccoon dogs (*Nyctereutes procyonoides*) and other carnivore species in Musashino Central Park (MCP) and Koganei Park (KP) in urban Tokyo. From 270 video clips obtained from five camera traps set in each park between September 30 and November 30, 2022, 175 detected raccoon dogs, one detected an invasive masked palm civet (*Paguma larvata*) and one an invasive raccoon (*Procyon lotor*). In addition, 93 clips detected domestic cats. No clips detected two or more carnivore species simultaneously. In KP, almost all raccoon dog detections occurred in green space areas (wooded, bush, and waterside habitats) and not in clearings, indicating their reliance on natural habitats. Raccoon dogs were never recorded in the same location as cats (indicating spatial avoidance), although they were active at the same time of night (with a 29.1% overlap), with evening and midnight activity peaks. Raccoon dogs were never detected during the daytime, when people were active in both parks. In contrast, in MCP, raccoon dogs and cats used the same locations, but rarely (1% overlap) appeared at the same time (indicating temporal avoidance). Green space habitat in KP (80.6ha) was substantially greater than in MCP (10ha), suggesting that raccoon dogs and cats engage primarily in spatial partitioning when co-using more extensive areas of suitable habitat, but when constrained to a smaller habitat area, they achieve mutual avoidance through partitioning their peak activity regimes. We thus demonstrate that raccoon dogs become entirely nocturnal in urban parks to avoid people and use spatial and temporal partitioning to minimise competition with feral and free-roaming domestic cats fed by local people.

## 96. Bat conflicts in cities and forests

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**Keywords:** Bat research, Hungary, nature conservation

Coexistence gives rise to friction between bats and humans. Bats are the ones that primarily bear the consequences of these conflicts. Mainly, house-dwelling bats such as *Pipistrellus* sp., *Nyctalus noctula* or *Cnephaeus (Eptesicus) serotinus* find gaps left open during construction. Bats are curious creatures by nature. They are able to discover any crack or opening due to missing materials that would work as a potential roost site or place for a maternity colony. In such cases, we can help them with the placement of different types of nests and the closure of the openings. Thus, we can prevent the owners from illegally clearing them away. The method and the date are essential factors. Only experts can size up the colony and determine the date of its removal. Unfortunately, an improperly carried out removal can result in the dissolution of the colony and even in the death of the animals. As a possible solution, nests built within the insulation would provide a viable alternative, since it enables formation of new habitats in places where bats are desirable. Besides that, it is important to protect the native species, too, that are also negatively affected by the regulations. For these reasons, around our foundation, we placed clusters of nests expecting species, such as the *Barbastella barbastellus*, *Myotis bechsteinii* or *Nyctalus leisleri* to find a suitable habitat that will safeguard their survival and prosperity.

97. Golden Jackals' winter-feeding habits: A One Health perspective

Aleksandra Penezić, Ana Vuletić, Milica Kuručki, Ilija Pantelić, Neda Bogdanović & Duško Ćirović

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**Keywords:** Golden jackal, diet, One Health

The golden jackal (*Canis aureus*) is an autochthonous canid species in Serbia, with its population numbers among the highest in Europe. Following decades of continuous range expansion, the golden jackal now occupies nearly the entire country, adapting well to various habitats, including human-allocated ones. Previous studies have highlighted the species' opportunistic feeding behaviour, allowing it to adjust its diet to the seasonal availability of resources. This study examines the composition of golden jackals winter diet in Serbia's to understand their ecological role and interactions with human activities during the resource-scarce winter months. In collaboration with hunting associations, we analysed stomach contents from 86 legally hunted jackals collected during the winter months (December–February) of 2023 and 2024. Sixteen individuals had empty stomachs. Domestic ungulate carcasses were the dominant food category, occurring in 44 stomachs (62.9 % FO) and contributing 68.1% of total biomass, underscoring a heavy reliance on carrion. Small mammals were the most common live prey category (24.1 % O, 10.6 % B). Other dietary components included poultry, plant material, game species, and carnivores, though these were of lesser importance. The jackals' dependence on improperly disposed carcasses raises environmental and public health concerns, including the potential transmission of pathogens to domestic animals and humans. This highlights the need for a One Health approach to address these risks through improved carcass disposal and waste management practices, thereby mitigating human impacts on wildlife feeding behaviour and reducing public health risks.

## 98. Genetic differentiation of Yellow-Necked mice (*Apodemus flavicollis*) in the urbanised forests of Belgrade, Serbia

Aleksa Rončević, Ivana Budinski, Marija Rajičić, Milan Miljević, Branka Bajić & Jelena Blagojević

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**Keywords:** Small mammals, genetic diversity, microsatellite

Urbanisation transforms natural environments into urban landscapes. Habitat fragmentation, degradation, and loss threaten native populations, reducing their size and making them more vulnerable to stochastic processes. Limited gene flow and increased genetic drift become particularly pronounced in species ecologically tied to these fragmented habitats. The yellow-necked mouse (*Apodemus flavicollis*), inhabiting forest ecosystems, is a suitable model organism for studying the effects of habitat fragmentation in a large city. We used ten microsatellite loci to investigate the genetic diversity and structure of *A. flavicollis* populations affected by urbanisation. Between 2019 and 2024, 303 individuals were sampled in Belgrade, from four urban and four peri-urban forest sites and one non-urban (natural) forest. We hypothesised that urban populations would be more isolated and have reduced genetic diversity and that populations on the opposite sides of the Sava River (natural barrier) would show greater genetic differentiation. Our results revealed high levels of heterozygosity (0.726-0.853) across populations. Pairwise  $F_{st}$  values ranged from 0.0047 to 0.032, and although low, they were significant among all population pairs. The Mantel test did not reveal significant correlation between the genetic and geographic distance, suggesting that observed differentiation might be result of urbanisation, rather than distance. Bayesian clustering analysis identified five genetic clusters. Four clusters corresponded to urban populations closest to the city centre, while the fifth encompassed all peri-urban and the non-urban populations. Despite the significant influence of urban barriers on genetic differentiation, the Sava River, as a natural barrier, did not significantly restrict gene flow and had no detectable impact on genetic diversity in *A. flavicollis*. These findings highlight the significant role of urbanisation in shaping population genetic structure and underscore the resilience of *A. flavicollis* to natural barriers in contrast to anthropogenic fragmentation.

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94. Daily movements in cities: GPS tracking of urban and rural Eurasian red squirrels - Rossella Destro, Elisa Sacchet, Claudia Tranquillo, Damiano Preatoni, Adriano Martinoli & Lucas A. Wauters

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96. Bat conflicts in cities and forests - Kornél Imre & József Mészáros Médzi

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\*98. Genetic differentiation of Yellow-Necked mice (*Apodemus flavicollis*) in the urbanised forests of Belgrade, Serbia - Aleksa Rončević, Ivana Budinski, Marija Rajičić, Milan Miljević, Branka Bajić & Jelena Blagojević

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