XIII CONGRESSO ITALIANO DI TERIOLOGIA

DIPARTIMENTO DI BIOSCIENZE E TERRITORIO, UNIVERSITÀ DEL MOLISE PESCHE (ISERNIA)

COMITATO ORGANIZZATORE: Leonardo Ancillotto, Paola Bartolommei, Sandro Bertolino, Andrea Bonacchi, Mirko Di Febbraro, Dario Capizzi, Simone Giovacchini, Stefano Grignolio, Laura Limonciello, Anna Loy, Enrico Mirone, Emiliano Mori, Chiara Paniccia, Damiano Preatoni, Marco Scalisi, Laura Scillitani, Lucas Wauters.

COMITATO SCIENTIFICO: Giovanni Amori, Leonardo Ancillotto, Paola Bartolommei, Sandro Bertolino, Dario Capizzi, Riccardo Castiglia, Mirko Di Febbraro, Piero Genovesi, Stefano Grignolio, Anna Loy, Emiliano Mori, Alessio Mortelliti, Damiano Preatoni, Marco Scalisi, Laura Scillitani, Lucas Wauters.

PROGRAMMA

Mercoledì 3 luglio 2024

08:30 - 09:00	**Registrazione**
09:00 - 09:40	**Saluti Istituzionali:** **Luca Brunese – Rettore Università degli Studi del Molise** **Gabriella Stefania Scippa – Direttrice Dipartimento di Bioscienze e Territorio** **Sandro Bertolino – Presidente ATIt**
09:40 – 16:00	**Sessione – Nuove tecniche per lo studio, gestione e conservazione dei mammiferi** **Chair: Alessio Mortelliti**
09:40 - 10:20	*Invited speaker:* **Stuart Newson** (British Trust for Ornithology, UK) '*Developing and running a sustainably funded European-scale bioacoustic data management platform: the BTO Acoustic Pipeline'*
10:20 - 10:40	Gili F., Bertolino S., Rolando A. '*Challenges and opportunities in using mobile devices to record bats*'
10:40 - 11:00	Fesce E., Restif O., Plowright R., BatOneHealth Consortium '*How do bats maintain infections? Mathematical modelling to disentangle mechanisms driving the temporal cycles of infection in Australian bats*'
11:00 - 11:30	***Coffee break***
11:30 - 11:50	Mortelliti A., Brehm A.M., Boone S., Humphreys B.R., Merz M.R., Yen I. '*The mighty minds of mammals: a 8-year investigation on the behavioral structure of mammalian communities*'
11:50 - 12:10	Bartolommei P., Manzo E., Bonacchi A., Gasperini S., Dell'agnello F., Dell'omo G., Spano G., Cozzolino R. *'An automated tool for studying individual attendance of small mammals at a feeding box in the wild*'
12:10 - 12:30	Granata M., Di Paolo F., Luciano L., Hofmeester T.R., Bertolino S. '*Comparing non-invasive methods to study small mustelids in the Italian Alps*'
12:30 - 12:50	Fonda F., Bergamin R., Bartolommei P., Greco I., Manzo E., Rovero F., Mortelliti A. '*Cost-effectiveness of lures in attracting mammals: results of a large-scale camera-trapping field experiment*'
12:50 - 14:20	**Pausa pranzo**
14:20 - 14:40	Maglia I., Focardi S., Pontiggia P., Franzetti B. '*Potential pitfalls stemming from the use of the Random Encounter Model based on camera traps for the estimation of ungulate populations*'

14:40 - 15:00	Marconi M., Buonafede E., Greco I., Salvatori M., Pistolesi A., Cappai N., Rovero F. '*Trail- versus random-based systematic camera trapping to study mammalian species and communities*'
15:00 - 15:20	Tamagnini D., De Angelis D., Chatar N., Crampton D., Meloro C., Soibelzon L., Arnaudo M. E., Michaud M., Tambusso P. S., Varela L., Maiorano L. *Elucidating bear eco-evolutionary dynamics using ecological and morphological evolutionary landscapes*'
15:20 - 15:40	Colangelo P., Di Civita M., Bento C.M., Franchini P., Meyer A., Orel N., das Neves L.C.B.G., Mulandane F.C., Almeida J.S., Senczuk G., Pilla F., Sabatelli S. '*Genome-wide diversity and population structure in the African buffalo (*Syncerus caffer*) in Mozambique*'
15:40 - 16:00	Fornarini C., Challender D., Hilton-Taylor C., Hoffmann M., Kennerley R., Mallon D., Solari S., Woinarski J. C. Z., Rondinini C. '*Global trends in mammal extinction risk since 1996*'
16:00 - 16:30	***Coffee break***
16:30 - 18:10	**Sessione – Verso una migliore conoscenza dei mammiferi italiani: tassonomia, ecologia e conservazione** **Chair: Riccardo Castiglia**
16:30 - 17:10	Invited speaker: **Jeremy B. Searle** (Emeritus Professor, Department of Ecology and Evolutionary Biology, Cornell University, USA) *'Genetics of Italian small mammals: differentiation in both the south and north'*
17:10 - 17:30	Bellè A., Sacco A., Bertolino S. *'Bat activity and species richness along an altitudinal gradient in the Western Alps'*
17:30 -17:50	Gasperini S., Napoleone F., Bartolommei P., Bertagni G., Cannucci S., Serafini L., Burrascano S. '*Small mammals response to forest environmental heterogeneity in relation to specie niche breadth and vegetation disturbance'*
17:50 - 18:10	Lazzeri L., Belardi I., Pacini G., Fattorini N., Fini G., Pallari N., Ferretti F. *'Prey-predator interactions in a Mediterranean protected area'*
18:10 - 19:00	**SOCIALIZZ-ATIt**

Giovedì 4 luglio 2024

09:00 -15:10	**Sessione – Verso una migliore conoscenza dei mammiferi italiani: tassonomia, ecologia e conservazione**

	Chair: Riccardo Castiglia
09:00 – 09:20	Lecis R., Chirichella R., Dondina O., Orioli V., Azzu S., Canu A., Torretta E., Bani L., Apollonio M., Scandura M. '*Roe Deer vs Northern Chamois: contrasting connectivity patterns revealed by gene flow in an alpine area'*
09:20 – 09:40	Mirante D., Ancillotto L., Zampetti A., Coiro G., Pisa G., Santocchi C., Santini L. '*Fine-Tuning Coexistence: Wildlife's Short-Term Responses to Dynamic Human Disturbance Patterns'*
09:40 – 10:00	Ossi F., Bruat A., Dal Farra S., Cagnacci F. '*Of wolves and deer: how does a prey respond when a predator is back?'*
10:00 – 10:30	Sganzerla F., Brivio F., Scillitani L., Grignolio S. *'Assessing the impact of recreational activities on terrestrial mammals'*
10:30 – 10:50	Agostini G., Loy A., Gentile G., Giovacchini S., De Sanctis C., Mirone E., Papaleo L., Petrella A., D'Alessio N., Colangelo P. '*A non-invasive genetics insight into population structure and recolonization dynamic of the Eurasian otter (Lutra lutra) at the boundary of its Italian core range'*
10:50 – 11:10	Barca V., Morandi P. F., Stokel G., Vit M., Susmel S., Filacorda S. *'Analysis of trace elements in Eurasian otter (Lutra lutra) spraints in Friuli Venezia Giulia: a sentinel species in continuous expansion'*
11:10 – 11:40	***Coffee break***
11:40 – 12:00	Cavazza S., Brogi R., Zanni M., Berzi D., Luccarini S. Cappai N., Bongi P., Del Frate M., Apollonio M. *'Wolf spatial behavior variability along the recolonization: insights from central Italy and Alpine regions'*
12:00 – 12:20	Giovacchini S., Chavko L., Jamwal P.S. , De Sanctis C. , Mirone E. , Di Febbraro M. , Loy A.*'Range dynamic and carrying capacity of Eurasian otter in the expansion area of Central Italy'*
12:20 – 12:40	La Morgia V., Martini I., Tosatto E., Mazza E., Santovito A., Bertolino S **'***Effects of climate change on hare species distribution patterns: novel insights from long-term data'*
12:40 – 13:00	Rizzi S., Schäfer F., Schirmer S., Kerth G. '*Choosing shitty boxes: conspecific faeces odour influences roost exploration and occupation in Bechstein's bats'*
13:00 – 14:30	**Pausa pranzo**
14:30 – 14:50	Roseo F., Bragalanti N., Zanghellini P., Zeni M., Gervasi V., Pedrini P., Groff C., Bombieri G. *'Wolf predation patterns on livestock in Trentino: an analysis of dynamics and prevention strategies'*

	14:50 – 15:10	Solano E., Castiglia R., Amori G., Gentile G., Capizzi D., Bertolino S., Kranebitter P., Ladurner E., Lapini L., Colangelo P. *'Phylogeography and population genetics of Arvicola italicus'*
	15:10 – 18:20	**Sessione – Specie alloctone: dalla prevenzione alla gestione** **Chair: Piero Genovesi**
	15:10 – 15:50	Invited speaker: **Giovanni Vimercati** (Department of Biology, Unit Ecology & Evolution, University of Fribourg, Switzerland) *'Functionality and application of EICAT+, a standardized framework to classify positive impacts of alien species'*
	15:50 – 16:10	Bertolino S., Carnevali L., Mori E., Capizzi D., Monaco A. *'Alien mammals in Italy: pathways of entry and impacts'*
	16:10 – 16:30	Dell'Agnello F., Capizzi D., Baccetti N., Benocci A., Carli E., Copiz R., Dapporto L., De Santis M., Frondoni R., Giannini F., Gotti C., Lazzaro L., Raganella E., Sozio G., Spano G., Stasolla G., Sposimo P. *'Eradication of the Black rat from the Italian islands: evidence from 25 years of nature conservation projects'*
	16:30 – 16:50	Nicoloso S., Giannini F., Gaggioli A., Sammuri G. *'LETSGOGIGLIO: the first successful ungulate eradication story in Italy'*
	16:50 – 17:20	*Coffee break*
	17:20 – 17:40	Bianchi G., Bonini R., Franco A., Cappai N. *'Masked intruders: monitoring and trapping raccoons (*Procyon lotor*) in Foreste Casentinesi National Park'*
	17:40 – 18:00	Fesce E., Romeo C., Santicchia F., Wauters L., Lurz P. W. W., White A., Ferrari N. *'Are we underestimating our parasites? The effect of* Strongyloides robustus *on the replacement of red squirrels by alien grey squirrels'*
	18:00 – 18:20	Gallozzi F., Attili L., Colangelo P., Giuliani D., Sposimo P., Dell'Agnello F., Capizzi D., Lorenzini R., Solano E., Castiglia R. *'First multiple islands survey of VKORC1 missense mutations in the Mediterranean reveals widespread rodenticide resistance in house mice'*
	18:20 – 19:00	**Assemblea ATIt**
	20:00 – 23:00	**Cena sociale e AestasiATIt**

Venerdì 5 luglio 2024

09:00 – 13:20	**Sessione - Mammiferi in città: una convivenza possibile?** **Chair: Anna Loy**

09:00 – 09:40	Invited speaker: **Seth Magle** (Urban Wildlife Institute, Lincoln Park Zoo) *'The Urban Wildlife Information Network: Building a Global Alliance For Coordinated Urban Wildlife Research'*
09:40 – 10:00	Ancillotto L., Mori E. *'What you see is not what you get: extinctions and extinction debt in urban mammals'*
10:00 – 10:20	Mori E., Maggioni M., Guerri G., Morabito M., Viviano A., Martini S., Dondina O., Lazzeri L., Monti F., Sogliani D., Scarfò M., Zaccaroni M., Ancillotto L. *'Camera-traps and the city: behavioural ecology of wild mammals in urban areas'*
10:20 – 10:40	Dondina O., Orioli V., Tirozzi P., Bani L., Viviano A. *'Small-mammals community analysis to guide green areas implementation and management in functional urban ecosystems'*
10:40 – 11:00	Scaravelli D., Festa F., Leopardi S., De Benedictis P. *'From caves to town: Schreibers' bent-winged bat* Miniopterus schreibersii *in urban ecosystems'*
11:00 – 11:20	***Coffee break***
11:20 – 11:40	Tranquillo C., Bisi F., Santicchia F., Preatoni D.G., Martinoli A., Wauters L.A. *' 'Moving through the city: space use of Eurasian red squirrels in urban and rural environments'*
11:40 – 12:00	Viviano A., De Meo I., Burchielli A., Sergiacomi C., Paletto A. '*Behavioural ecology and social perception of urban coypus'*
12:00 – 12:20	Frangini L., Bernicchi L., Barca V., Riva V.A., Braghiroli S., Molinari L., Franchini M., Madinelli A., Pesaro S., Ferfolja S., Filacorda S. *'Spatial behaviour of golden jackal (*Canis aureus*) in relation to anthropogenic features: first insights with telemetry'*
12:20 – 12:40	Brivio F., Antonucci A., Angelucci S., Brogi R., Apollonio M. *'Insights into wolf activity rhythms in a gradient of human-dominated landscape'*
12:40 – 13:00	Grignolio S., Latini R., Ciucci P., Tosoni E., Gentile D., Scillitani L., Bertolucci C., Brivio F. *'Losing fear of humans may increase diurnality in human-habituated bears?'*
13:00 – 13:20	Padulosi E., Scaravelli D., De San Pedro M.E., Pastrana S., Diaz F., Procopio D.E. *'Two drones to rule them all: using drones for effective stray dog populations monitoring in urban environments in Puerto Deseado, Argentina'*
Chiusura	

PRESENTAZIONI ORALI

(SESSIONE NUOVE TECNICHE PER LO STUDIO, GESTIONE E CONSERVAZIONE DEI MAMMIFERI)

Developing and running a sustainably funded European-scale bioacoustic data management platform: the BTO Acoustic Pipeline

Newson S.E.[1], Gillings S.[1], Ashton-Butt A.[1], Atkinson P.W.[1], McCambridge H.[1]

1. British Trust for Ornithology, The Nunnery, Thetford, Norfolk, England, IP24 2PU

For many taxa, traditional biodiversity monitoring schemes rely heavily on detection and identification of species by sound. Yet the skills required to perform species identification often limit the scale of monitoring and who can take part. Improvements in knowledge and advances in species identification in audio using machine-learning offer great potential for large-scale passive acoustic monitoring (PAM). Although machine learning techniques are becoming more accessible, deploying end-to-end monitoring using PAM and machine learning still requires significant and sustained investment in skills, infrastructure and computational capacity. Here we present the British Trust for Ornithology (BTO) Acoustic Pipeline, a platform aiming to support scalable European-scale processing of audio data for species detection and monitoring of multiple species groups for a range of end users. We will outline how we use a freemium funding model to ensure long-term viability, allowing income from commercial users who require large-scale confidential data management to subsidise community-run conservation-focussed projects with limited financial support. We will explore how targeted work has been used to collect recordings of free-flying bats that are used to train the pipeline, and for small terrestrial mammals which can be identified as ‘by-catch’ during bat surveys. We give case studies illustrating how this approach is being used to support rewilding initiatives and research projects. We will conclude by summarising opportunities and ongoing challenges in scalable passive acoustic monitoring.

Challenges and opportunities in using mobile devices to record bats

Gili F.[1], Bertolino S.[1], Rolando A.[1]

1. Department of Life Sciences and Systems Biology, University of Turin, Via Accademia Albertina 13, 10124 Turin (Italy).

Public involvement in scientific research is increasingly recognised as crucial for biodiversity and environmental monitoring, providing substantial advantages in terms of data volume, coverage, timing, and cost. The spread of mobile devices has further encouraged such participatory initiatives by enabling extensive data collection and analysis through readily accessible technologies. However, the integration of citizen science in bat monitoring has been somewhat restrained, primarily due to the high costs associated with professional acoustic survey equipment. Our study aimed to evaluate the efficacy of using mobile device built-in microphones to record low-frequency bat calls, thereby examining the feasibility of this approach for large-scale citizen science projects.

Sampling was conducted in urban and suburban areas within Turin and Seville. The performance of mobile devices in recording low-frequency bat calls was compared to that of a professional bat detector through simultaneous field deployments, assessing the quantity, quality, and detectability of recordings. Thirteen mobile device models from leading brands (Apple, Samsung, Xiaomi, Huawei) were selected, with automatic recording settings enabled wherever possible. Cross-correlation analysis was used to quantify the similarity between spectrogram-like representations of bat calls recorded by mobile devices and the same calls recorded by bat detectors. Differences in call peak frequency were also compared. An additional test was carried out to assess the detectability of bat calls at various distances using playback sequences. Finally, the applicability of the method was evaluated through a citizen science pilot project, requesting volunteers to follow a standardized protocol for recording bats near their homes using their smartphones or tablets.

Echolocation or social calls of nine European bat species were recorded by mobile devices during the study. In simultaneous monitoring sessions, mobile devices recorded bat calls at numbers that were comparable to, or sometimes even surpassed, those recorded by professional bat detectors. Cross-correlation analysis revealed that the quality of bat calls recorded by mobile devices matched those recorded by bat detectors, with minimal differences in call peak frequency. The detectability test showed that iOS devices and some Android models performed well at greater distances, occasionally outperforming bat detectors. The citizen science pilot further validated the method across 35 mobile device models over 80 sampling sessions, with all models proving capable of effectively recording bats.

The study confirmed the efficacy of mobile devices in bat acoustic monitoring, demonstrating their performance is comparable to professional bat detectors within the 8-24 kHz range, despite variability across different models and operating systems. The ability to monitor at least nine European bat species with mobile devices suggests potential for identifying additional species both in Europe and globally, especially via social calls. Technological advancements could further expand the detectable species range. To optimise this method for use in participatory monitoring initiatives, potential improvements include developing mobile apps enabling automatic monitoring on all operating systems, incorporating preliminary detectability tests on each device, and gathering reference recordings of species that are likely to be detected. Overall, this study underscores the potential of mobile devices as a no-cost, accessible tool for large-scale bat monitoring. Integrating mobile devices into existing monitoring networks or establishing new dedicated programmes could not only enhance data collection, but also boost public knowledge and awareness about bats, ultimately promoting informed decision-making and better conservation strategies.

How do bats maintain infections? Mathematical modelling to disentangle mechanisms driving the temporal cycles of infection in Australian bats

Fesce E.[1,2], Restif O.[1], Plowright R. [3], BatOneHealth Consortium

1. Department of Veterinary Medicine, University of Cambridge, Cambridge, United Kingdom
2. Department of Veterinary Medicine and Animal Sciences, Universität degli Studi di Milano, Lodi, Italy
3. Department of Public and Ecosystem Health, Cornell University, Ithaca, NY, USA

Zoonotic pathogens, (pathogens that can be transmitted from animals to humans), represent an increasing public health concern. Cross-species transmission can only occur when particular conditions of reservoir host ecology, infection dynamics and species distributions align, making spillovers (the transmission of a pathogen from a vertebrate animal to a human) at the same time a global public health concern and a complex and poorly understood phenomenon. Pathogen circulation in reservoir host populations is one of the factors contributing to spillover risk, therefore, understanding the mechanisms driving infection dynamics can help us in preventing spillovers to occur.

In Australia, the recent changes in land use caused a rapid modification in bat behaviour that coincided with the emergence of Hendra virus (HeV). HeV is maintained in wildlife by bats of the *Pteropus* genus (flying foxes) and can be transmitted from bats to horses and from horses to humans. Bats do not show marked signs of infection, but in humans and horses the symptomatology is very severe, with a high fatality rate (57% and 80% respectively), pointing out the need to avoid HeV spillovers. HeV spillovers usually occur in winter and often coincide with an increase in viral shedding in urines from bats, suggesting a temporal trend in pathogen circulation in reservoir host populations. Several factors can contribute to drive the observed temporal dynamics, and different maintenance routes have been theoretically hypothesized to explain the cyclicity of infection.

To disentangle the mechanisms driving the pathogen dynamics in reservoir host, we applied a set of mathematical models to an historical dataset collected in Boonah (Queensland, Australia) between July 2013 and June 2014. We used a system of four differential equations (SEIR model type) to simulate infection dynamics in the host population, and we included time dependent parameters to simulate the seasonality of infection and periodicity of births.

We showed that the sole population dynamic of bats, with the introduction in the system of susceptible new-borns, can not explain the annual cycles of HeV shedding, and either a waning of the immunity in adult bats or the development of a chronic infection with cyclic viral reactivation must be hypothesized to explain the observed infection dynamics.

Our results support the hypothesis that cyclicity in HeV shedding can be driven by environmental stressors, like winter food shortages, that can affect bat immune response to pathogens. These findings evidence the need to reduce anthropogenic stressors that might exacerbate HeV shedding from bats. Furthermore, given the adaptability of the modelling framework, the method proposed can be applied to other infections/bat species.

The mighty minds of mammals: a 8-year investigation on the behavioral structure of mammalian communities

Mortelliti A.[1,2], Brehm A.M.[1], Boone S.[1], Humphreys B.R.[1], Merz M.R.[1], Yen I.[1]

1. Department of Wildlife, Fisheries and Conservation Biology, University of Maine, Orono, USA
2. Department of Life Sciences, University of Trieste, Trieste, Italy

Within a species, individuals vary consistently in their personality, with some individuals being more timid, curious or active than others. But do species differ in terms of the personality composition of their individuals? Are deer mice (*Peromyscus maniculatus*) more curious than red-backed voles (*Myodes gapperi*)? Are woodland jumping mice timider than deer mice? And are any differences among species in communities altered by human-induced habitat modifications? Identifying differences among the personality compositions of species will contribute to our understandings of the evolution of personalities as well as the extent to which human-activities alter the behavioral structure of mammalian communities.

We hypothesise that within a small mammal community, species will differ in terms of the personality composition of their individuals and that these differences will be context-dependent (i.e. higher or lower depending on the habitat type). To achieve our objective we used data from a 8-year study conducted in Maine (USA), wherein the personality of each individual small mammal (N=3500 individuals belonging to 7 different species) was measured through standard behavioral assays conducted in three habitat types: four intensively managed forests and two reference unmanaged forest sites. We used discriminant function analysis to compare personalities and found significant differences among species. Further, we found that human-induced land-use change exacerbated these differences, thus modifying the behavioral structure of mammalian communities.

An automated tool for studying individual attendance of small mammals at a feeding box in the wild

Bartolommei P.[1], Manzo E.[1], Bonacchi A.[1], Gasperini S.[1], Dell'Agnello F.[1], Dell'Omo G.[2], Spano G.[3], Cozzolino R.[1]

1. Fondazione Ethoikos, Convento dell'Osservanza snc, 53030, Radicondoli, Siena, Italy
2. *Ornis italica*, Piazza Crati 15, 00199 Rome, Italy
3. Area Marina Protetta Tavolara Punta Coda Cavallo, Via S. Giovanni 14, 07026 Olbia, Italy

Studying animals in their natural habitats is crucial for gaining an ecologically valid comprehension of population dynamics and individual behaviour. However, mammals are often elusive and difficult to observe in the wild. In recent decades, there has been a growing reliance on automated radio telemetry systems and passive integrated transponder (PIT) tags as tools for investigating spatial and social behaviour, individual and population parameters of mammals.
We developed an automated radio-frequency identification (RFID) system named SMOVIROD to individually identify PIT-tagged small mammals. The hardware part of the system, operated by batteries, has mechanical switches which detect the tagged animal entering into a feeding box and activate an RFID detector with an antenna placed at the entrance of the food chamber to record the time of their visit. The software allows to adjust various parameters (e.g. time schedule, delay and duration of the detection period, data download). In September-November 2022 we tested a prototype during a pilot study aiming at collecting information on attendance to the feeding box (the type used for distributing rodenticides) by individual house mice *Mus musculus* living in Isolotto Rosso, a small islet in north-eastern Sardinia. First, we live-trapped and individually marked mice with a subcutaneous PIT tag, then we positioned 33 devices spaced in a grid about 13 m apart, covering most of the island surface. The devices were baited with non-toxic pellets. The bait was refilled every 2-3 days for the first 20 days, then no refill was done in the following 20 days. Lastly, in the following month, the newly-refilled bait was covered by a metal mesh to prevent consumption.
Here, we present the preliminary data obtained on mice attendance to the feeders and we discuss the effectiveness of the system. Devices recorded visits of 70% of all marked individuals (N=114). All devices, but one, were visited by mice, for a total of 9206 visits. Devices were attended by a mean of 10.8 mice, with a mean of 286.8 visits. Each house mouse visited a mean of 4.3 devices and was recorded 115.6 times. The number of device attendance by mice decreased rapidly with decreasing bait availability. This decrease was slower when baits were wrapped in metal mesh. Mice moved a mean distance of about 50 m, covering a mean home range (MPC 100%) of 815 m^2.
The prototype of the SMOVIROD system has shown potential as a valuable tool to study the feeding activity, movement, survival, sociality, and individual feeding strategies of small mammals, enabling long-term monitoring of individuals (and population) in their natural environments at a detailed time scale. In addition, the system has demonstrated to be cost-effective, simple to deploy and with minimal impact on animal welfare.

Comparing non-invasive methods to study small mustelids in the Italian Alps

Granata M.[1], Di Paolo F.[1], Luciano L.[1], Hofmeester T.R.[2], Bertolino S.[1]

1. Department of Life Sciences and Systems Biology, University of Turin, Turin, Italy
2. Department of Wildlife, Fish, and Environmental Studies, SLU, Umeå, Sweden

Small mustelids are increasingly recognized as a group of species requiring global conservation attention. While they are generally believed to be abundant and widespread, a dramatic decline was reported both in North America and Europe. In Italy, only 3 papers were dedicated to weasels (*Mustela nivalis*) and stoats (*Mustela erminea*) over the last three decades, with the most recent ones dating back to the mid-2000s. In the past, small mustelids were primarily studied using live trapping methods, while today non-invasive techniques are often preferred. In this study, we compared 4 popular non-invasive methods with these specific objectives: 1) Identifying the most effective methods to study small mustelids in the Alps; 2) Gaining insight into their ecology in the Alpine environment; 3) Testing the "umbrella effect" of small mustelid monitoring for rodents.

After superimposing a 700 x 700 m grid on the study area (Maritime Alps Natural Park, NW Italy), we selected 12 cells each of deciduous forest, coniferous forest, and Alpine prairies. From June to October 2023, we surveyed all 36 cells over three separate 45-day sessions. In each cell, we employed: an "Alpine Mostela", a foldable PVC box containing a camera trap and a PVC 9 cm Ø tube; an external trail camera, positioned 30 cm above the ground; a transect of 3 footprint tunnels, placed at a 20 m distance, and checked every two weeks; and a scat survey, conducted for at least one hour per cell every two weeks. To get independent detections for each method, we located all devices at least 150 m from the others. Salmon oil was used as bait in half of the cells. To compare the detection probability of the camera-based methods, we considered both camera type and the use of bait. We estimated the occupancy probability of small mustelids taking into account habitat and session. We also investigated their distribution and activity patterns. Lastly, we used a GLM to test the umbrella effect of the camera-based methods on small rodents.

We recorded 70 videos of stoats and 10 videos of weasels, along with 20 probable *Mustela* scats (awaiting genetic confirmation). No results were obtained from footprint tunnels. The daily detection probability of stoats was higher with unbaited Mostelas (detectability $p = 0.10$, 95% CI 0.06-0.16) and baited external cameras ($p = 0.07$, 95% CI 0.04-0.11) compared to baited Mostelas ($p = 0.02$, 95% CI 0.01-0.07) and unbaited external cameras ($p = 0.04$, 95% CI 0.02-0.07). We also found a positive effect of unforested habitats on stoat occupancy (Est. ± SE = 3.61 ± 1.17, $z = 3.08$, $p = 0.002$). Due to the limited sample size, we couldn't conduct the same analysis for weasels. However, we still found the weasel in 25% of the broad-leaved forest and 16.7% of the coniferous forest cells, whereas the stoat was found in 41.6% of the coniferous forest and 75% of the Alpine prairie cells. The stoat displayed a diurnal bimodal activity pattern, while the weasel showed a more unimodal pattern. Lastly, we detected every rodent species recently recorded in the park. The use of bait had a positive effect on the number of videos of small rodents (Est. ± SE = 1.73 ± 0.41, $z = 4.09$, $p > 0.001$).

In this study, both unbaited Mostelas and baited external cameras demonstrated reliable performance in detecting stoats. However, with the Mostela accomplishing slightly better results with much fewer non-target videos, it emerged as the preferred choice for long-term stoat monitoring. We found more weasels in forested habitats during mid-day, while stoats were more prevalent in non-forested habitats during the early morning and late evening. However, given the limitation of our small sample size, particularly concerning weasels, these findings warrant further investigation. Consequently, new monitoring protocols in our study area incorporating both Mostelas and external cameras are necessary. Footprint tunnels will be likely excluded from future projects, while we intend to continue with scat sampling. Ultimately, we hope that these results will inspire other researchers to work with these understudied species, evaluate the effectiveness of novel monitoring methods, and generate new evidence for the conservation of weasels and stoats in Italy.

Cost-effectiveness of lures in attracting mammals: results of a large-scale camera-trapping field experiment

Fonda F.[1], Bergamin R.[1], Bartolommei P.[2], Greco I.[3], Manzo E.[2], Rovero F.[3], Mortelliti A.[1]

1. Department of Life Sciences, University of Trieste, Via Licio Giorgieri 10, 34127 Trieste (Italy)
2. Fondazione Ethoikos, Convento dell'Osservanza snc, 53030 Radicondoli (Italy)
3. Department of Biology, University of Florence, Via Madonna del Piano 6, 50019 Sesto Fiorentino (Italy)

While there is widespread agreement that camera trapping is revolutionizing the way we study wildlife, the use of attractants is still controversial. In particular, to the best of our knowledge, the cost-effectiveness of different attractants used in camera trap surveys has never been assessed. To contribute in filling this knowledge gap we 1) compare the effectiveness of a suite of attractants in detecting widely distributed mammals in Europe and 2) evaluate the cost-effectiveness of these attractants, by calculating the costs associated to reach a specific management objective.
We conducted the field experiment in the spring of 2023 in four study areas in central and northern Italy, encompassing a variety of environments, from lowland forest to alpine beech forest. We deployed camera traps at 60 *sites*, each consisting of three treatment lure *stations* (camera trap + treatment) with one control camera *station* with no lure, placed in a square configuration (side 100 m). The treatments included sardines, a commercial lure for canids and *Martes* spp. and peanut butter. Cameras were left active at each site for 14-21 days and detection histories of each species were generated using 24h time bins. To model detection probability, we fitted single season multi-method occupancy models for each species, comparing (i) the null model with detection probability constant across treatments and control station, (ii) the 'method' model, detectability specific to treatment, and (iii) models with covariates that could affect detection probability (i.e. 'time since deployment' and 'study area'). We further conducted a power analysis to compare the cost-effectiveness of the different treatments. Specifically, we estimated the number of sites to be surveyed and the costs required to detect a decline of 25% in the occupancy of each species.
Through a total of 1047 trap nights of activation, we detected 15 mammalian species, of which 13 were included in the analysis. The most widespread species was the roe deer (detected in 51 sites, across all study areas) and the least widespread was the golden jackal (detected in 8 sites, only in the Karst and Alps study area, 30 sites in total). The 'method' model was the top-ranking model in the case of 7 species, including two canids (golden jackal and red fox), three mustelids (badger and *Martes* spp.), two Artiodactyla (red deer and roe deer) and a Rodent (porcupine). The results of the power analysis show how differences in required sampling effort (and costs) between the different attractants and no attractants can be dramatic. As an example, in the case of the *Martes* spp. monitoring protocol, using peanut butter will require 82 sites (6744 €) as compared with a camera without attractant requiring 486 sites (or 39244 €).
Through our large-scale field experiment we found that for seven species detectability varied with the type of attractant used. Specifically, sardines proved to be the most effective attractant for canids and the porcupine, peanut butter was most effective for mustelids but was avoided by the roe deer, whereas the commercial attractant was the most effective with red deer. Through the power analysis combined with the cost function analysis we were able to show striking differences in the cost-effectiveness of the different methods, which strongly emphasizes the critical importance played by the choice of whether to use an attractant or not and the type of attractant to be used.

Potential pitfalls stemming from the use of the Random Encounter Model based on camera traps for the estimation of ungulate populations

Maglia I.[1], Focardi S.[2], Pontiggia P.[3], Franzetti B. [4]

1. Università degli Studi di Roma Tor Vergata – via Cracovia 50, 00133 Roma
2. CNR-ISC – Institute for Complex Systems – Via Madonna del Piano 10, 50019 Sesto Fiorentino
3. Field Engine Wildlife Research and Management LLC – 26 Davison Rd., Moodus, 06469 CT United States
4. Istituto Superiore per la Protezione e la Ricerca Ambientale – via V. Brancati 48, 00144 Roma

Camera traps (CT) have revolutionised wildlife research by providing a non-invasive method of collecting large amounts of data with limited effort. These data can be used to study animal behaviour in natural settings, to determine species richness, relative abundance, distribution patterns but also to estimate animal populations. However, there are inherent pitfalls and biases that can significantly affect the accuracy and reliability of the results obtained from camera trap surveys. This work specifically examines camera trap detection efficiency and how this may affect the reliability of Ungulate population estimates obtained by the Random Encounter Model (REM) model procedure implemented in the Agouti platform. This online platform enables the processing and storage of images and the necessary measurements for estimating densities through an automatic R package that implements the REM model.

The study was carried out in the 60 km^2 fenced nature reserve of Castelporziano (Roma, Italy). In Spring and Autumn 2022 we conducted a field experiment to assess the detectability of CTs by register any detection failures at varying distances from a test CT using 3 control cameras. A conventional CT survey was conducted in September 2022 and April 2023. 81 camera traps were deployed for 30 days at the nodes of an 800m-wide square grid randomly placed across the study area. The node spacing ensures that there is at least one camera per average home range of the three targeted ungulates (wild boar, roe deer and wild boar). In September 2022, a nocturnal distance sampling survey (NDS) was carried out on foot, covering 110 km of transects and using up to three thermal imaging cameras at the same time.

The experiment carried out showed that the average detection probability at the CT site was less than 1 for all species in this study area. Analyses conducted with the data derived from Agouti and the available R routines also revealed that no animals were observed within 2 metres of the camera traps in either season, confirming an imperfect detection on the CT. REM provided density estimates for wild boar that were higher but not significantly different from those obtained with NDS while the roe and fallow deer densities were significantly lower than those of NDS, even if left-truncation is applied. Overall, density estimates obtained using REM were almost twice less precise (higher CVs) than that obtained with NDS.

Although the detectability of any species, regardless of its complexion and social behaviour, results in less than 1, this can be easily accounted for in the available routine analyses by estimating the effective detection distances and angles and/or by left-truncating the data. However, our results suggest that there may be issues with accuracy and reliability (of the estimated 99 fallow deer by REM in September 2022, 133 were removed during the 2022-23 culling season).

To properly assess management outcomes or the effects of a disease, reliable population estimates are necessary. If camera traps are used to collect data, it is advisable to assess the actual detectability of the camera traps, as well as independent estimates of animal speed, and to validate the results over time.

Trail- versus random-based systematic camera trapping to study mammalian species and communities

Marconi M.[1], Buonafede E. [1], Greco I.[1], Salvatori M.[1,2], Pistolesi A.[1], Cappai N.[1], Rovero F. [1]

1. Dipartimento di Biologia, Università di Firenze, via Madonna del Piano 6, Sesto Fiorentino (FI), Italia
2. MUSE – Museo delle Scienze, Ambito Biologia della Conservazione, Corso del lavoro e della Scienza 3, Trento, Italia

Camera-trapping is widely used to study mammal species and communities due to its cost-effectiveness and non-invasive nature. Systematic placements of camera traps over potentially large areas thus provide for a robust approach to monitor mammals. While depending on precise study aims, most commonly the camera placement targets trails, due to a number of reasons such as easier logistics, animals' tendency to travel along trails, or the need to assess tourist activities. However, this sampling design might lead to biased outcomes. In contrast, randomized placement strategy not only should overcome this bias but would also allow the estimation of animal density using random encounter models and its extensions.

To contribute to addressing this issue we conducted systematic and simultaneous monitoring of mammals through both random- and trail-based camera-trapping in the Foreste Casentinesi National Park during the late summer and fall of 2023. The camera positioning was based on a systematic grid with 60 cells of 4 km^2, and we located in each cell one camera on a path or forestry road and another one randomly. The sampling period lasted 30 days, and we used a single camera model across. After processing all the images, we evaluated species richness and, for each species, computed the number of trapping events, the Relative Abundance Index (RAI), the naïve occupancy and the diel activity pattern. We also estimated occupancy and detection probability at community and species levels using a multi-species occupancy model. We then compared the results between the two sampling designs.

Sampling protocols yielded a similar richness of wild medium-to-large species, 14 and 13 species respectively for the trail- versus the random-based study, only exception being the alien racoon *Procyon lotor* only detected by the trail-based sampling. Notably, domestic animals and humans were captured only along trails (2466 events) except for 68 detections. In contrast, the camera trap site-specific species richness was significantly higher along trails (mean=7.814±0.230 SE) than at random sites (mean=4.305± 0.241 SE). The overall number of independent trapping events and RAIs of wild mammals were also significantly higher at trails (events= 3202, RAI = 178.484) than random sites (814 events, RAI = 47.742). When assessing RAIs calculated for each site and species, we found that differences were especially high for carnivores. The multi-species occupancy modelling mirrored these results as it highlighted higher values in the estimates of detection probability and occupancy on trails for almost all the wild species. The diel activity patterns for each species were similar between placement protocols. The only substantial differences emerged for fallow deer (*Dama dama*) and wild boar (*Sus scrofa)*, both showing a more cathemeral activity off trails.

Our results show that trail-based sampling increases mammals' detection probabilities, especially for carnivores, and allows the quantification of human disturbance, thus improving community analyses with a relatively lower effort. Interestingly, trail-based and random sampling generated similar activity patterns, implying that the temporal avoidance of human disturbance is a behavioural strategy that mammals maintain even outside trails. Random placement, however, allows the use of techniques for estimating animal densities, and might be more suited to evaluate environmental preferences of species when engaged in activities other than movement, such as feeding or resting. The choice of sampling design therefore strongly depends on study aims and on target metrics, as well as on logistic constraints.

Elucidating bear eco-evolutionary dynamics using ecological and morphological evolutionary landscapes

Tamagnini D.[1], De Angelis D.[1], Chatar N.[2,3], Crampton D.[4], Meloro C.[4], Soibelzon L.[5,6], Arnaudo M. E.[5,6], Michaud M.[2], Tambusso P. S.[7,8], Varela L.[7,8], Maiorano L.[1]

1. Department of Biology and Biotechnologies "Charles Darwin", University of Rome "La Sapienza", Rome, Italy
2. Functional Anatomy and Vertebrate Evolution Lab, Department of Integrative Biology University of California Berkeley, United States of America
3. Evolution and Diversity Dynamics Lab, Université de Liège, Belgium
4. Research Centre in Evolutionary Anthropology and Palaeoecology, School of Biological and Environmental Sciences, Liverpool John Moores University, Liverpool, UK
5. División Paleontología Vertebrados, Museo de La Plata, Facultad de Ciencias Naturales y Museo, Universidad Nacional de La Plata, La Plata, Argentina
6. Consejo Nacional de Investigaciones Científicas y Tecnicas (CONICET), CABA, Argentina
7. Departamento de Paleontología, Facultad de Ciencias, Universidad de la República, Montevideo, Uruguay
8. Departamento de Canelones, Servicio Académico Universitario y Centro de Estudios Paleontológicos (SAUCE-P), Universidad de la República, Sauce, Uruguay

Bears (Ursidae, Carnivora) are considered keystone species in several ecosystems, besides their potential impact on early human migrations and habitat use. Fitness variations linked to phenotypic and/or ecological adaptations might be rendered using evolutionary landscapes meant to show differences in selective advantage of specific traits. Bears, thanks to their phenotypic, dietary, and behavioral adaptations, represent an ideal case study for elucidating existing eco-evolutionary optima and potential trade-offs in large-sized mammals. Here we investigate the conformation of morphological and ecological evolutionary landscapes within this clade.

To do so, three dimensional geometric morphometrics was applied to a total of 69 bear crania belonging to 23 living and extinct species to collect shape data. Furthermore, ecological variable scores were obtained relying on species occurrences from online databases (PaleobioDB, GBIF) and pre-existing literature, combined with paleoclimatic data (PALEO-PGEM).

Our results suggest that strongest morphological and ecological adaptive peaks are mainly occupied by extinct derived morphotypes (i.e., short-faced bears). Both morphological and ecological landscapes show that many living species (e.g., genus *Ursus*) occupy a weakest selective optimum, whereas extant specialists (e.g., polar bears, pandas) are far from the strongest peaks.

These evidences suggest that most of living bears are characterized by non-extreme morphologies and ecological niches that probably give them higher ecomorphological flexibility than their fossil counterparts, which occupied stronger selective peaks at the expenses of an increased extinction risk (e.g., potential occurrence of ratchet-like mechanisms in short-faced bear evolution).

Genome-wide diversity and population structure in the African buffalo (*Syncerus caffer*) in Mozambique

Colangelo P.[1], Di Civita M.[2,3], Bento C.M.[4], Franchini P.[5,6], Meyer A.[5], Orel N.[5], das Neves L.C.B.G.[7,8], Mulandane F.C.[7], Almeida J.S.[9], Senczuk G.[2], Pilla F.[2], Sabatelli S.[3]

1. CNR, Research Institute on Terrestrial Ecosystems, Italy
2. University of Molise, Department of Agricultural, Environmental and Food Sciences, Italy
3. Sapienza University, Department of Biology and Biotechnologies "Charles Darwin", Italy
4. Natural History Museum, Eduardo Mondlane University, Mozambique
5. Department of Biology, University of Konstanz, Germany
6. Department of Ecological and Biological Sciences, University of Tuscia, Italy
7. Biotechnology Centre of Eduardo Mondlane University, Mozambique
8. Department of Veterinary Tropical Diseases, Faculty of Veterinary Sciences, South Africa
9. Mozambique wildlife alliance, Mozambique

The African buffalo, *Syncerus caffer*, is a key species in African ecosystems. Like other large herbivores, it plays a fundamental role in its habitat acting as an ecosystem engineer. Over the last few centuries, African buffalo populations have declined because of range contraction and due to direct or indirect human activities. In Mozambique, historically home to large buffalo herds, the combined effect of colonialism and subsequent civil wars has created a critical situation that urgently needs to be addressed.

In this study, we focused on the analysis of genetic diversity of *S. caffer* populations including 72 buffaloes from six areas of Mozambique under conservation management. DNA extracted from blood was used to amplify mtDNA control regions (d-loop) and to produce a genome-wide SNP panel. Using d-loop, we investigated the phylogeographic patterns and the historical demography of the species in Mozambique. We then used the SNP markers to assess the population structure and admixture, reconstruct recent demographic dynamics, estimated gene flow between areas and examine genome-wide signature of inbreeding.

Mitochondrial based analyses indicate that in the past the African buffalo was characterized by a lack of phylogeographic structure and underwent demographic expansion until approximately 200k years ago, witnessing the possible presence in the past of a large and potentially panmictic population in Mozambique. On the contrary, analysis of SNPs indicates that currently, buffaloes in Mozambique present a significant population differentiation between southern and central areas. We found an unexpected genotype in the Gorongosa National Park, where buffaloes experienced a dramatic population size reduction, that shares a common ancestry with southern populations of Catuane and Namaacha. All studied populations of *S. caffer* present a signature of erosion of genetic diversity, with a high level of inbreeding and numerous regions of the genome in homozygosity.

Our results suggest the past occurrence of a connection between southern and central Mozambique and that the current observed population structure could reflect recent events of anthropogenic origin. All the populations analysed showed high levels of homozygosity, likely due to extensive inbreeding over the last few decades, which could have increased the frequency of recessive deleterious alleles. Improving the resilience of *S. caffer* in Mozambique is essential for preserving the ecosystem integrity. The most viable approach appears to be facilitating translocations and re-establishing connectivity between isolated herds. However, our results also highlight the importance of assessing intraspecific genetic diversity when considering interventions aimed at enhancing population viability such as selecting suitable source populations.

Global trends in mammal extinction risk since 1996

Fornarini C.[1], Challender D.[2], Hilton-Taylor C.[3], Hoffmann M.[4], Kennerley R.[5], Mallon D.[6], Solari S.[7], Woinarski J. C. Z.[8], Rondinini C.[1]

1. Global Mammal Assessment Lab, Department of Biology and Biotechnologies 'Charles Darwin' (BBCD), Sapienza University of Rome
2. Interdisciplinary Centre for Conservation Science (ICCS) & Oxford Martin School, UK
3. IUCN, Biodiversity Assessment and Knowledge Team, The David Attenborough Building, Cambridge, UK
4. Conservation and Policy, Zoological Society of London, London NW1 4RY, UK
5. Durrell Wildlife Conservation Trust, Channel Islands, UK
6. IUCN Species Survival Commission, Cambridge, UK
7. Mastozoology Group, Institute of Biology, University of Antioquia, Medellín, Colombia
8. Northern Australian Hub of National Environmental Research Program and Threatened Species Recovery Hub of National Environmental Science Program, Charles Darwin University, Darwin, NT 0909, Australia

Biodiversity has undergone a fast decline over the past three centuries, driven by the increasing anthropogenic pressures on ecosystems. In this context, the IUCN Red List of Threatened Species plays a crucial role in promoting biodiversity conservation and informing policy making. The Red List Index (RLI) tracks variations in the conservation status of taxa over time. It shows the aggregated extinction risk across groups of species, only considering genuine improvements or deteriorations in status, resulting from increasing threats or implemented conservation actions, that justify moving species between IUCN threat categories.

The objective of this study was to apply the RLI to evaluate the global change in the extinction risk of mammals from 1996 to date, both aggregated for all mammals, and disaggregated for specific groups of species, which were identified by natural systems, biogeographical realms, main habitats, and taxonomic orders.

For species where changes between categories were related to *i)* improved knowledge, *ii)* improved Red List criteria and methodology, *iii)* revised taxonomy, *backcastings* were carried out, whereby earlier categorisations (1996-2008) were retrospectively adjusted using corrected information, the latest criteria system, and the most recent taxonomy. This enabled a full comparison of Red List categories over time. Afterwards the effect of independent drivers (biological traits, anthropogenic impacts, and environmental and ecological predictors) on the probability of change in extinction risk was assessed.

Globally, the mammal RLI declined monotonically over the past 30 years. Over 800 species have shifted one or more categories closer to extinction. The 1996 RLI was lowest for Primates, and they approached extinction faster than all the other orders. Generally, large-bodied species showed lower RLI values, and were more threatened with extinction than small mammals. Mammals distributed in the tropics (South America, Sub-Saharan Africa, and South-East Asia) experienced declines at a faster rate compared to European and North American species, primarily due to habitat loss and hunting.

PRESENTAZIONI ORALI

(SESSIONE VERSO UNA MIGLIORE CONOSCENZA DEI MAMMIFERI ITALIANI: TASSONOMIA, ECOLOGIA E CONSERVAZIONE)

Genetics of Italian small mammals: differentiation in both the south and north

Searle J.B.[1], Hauffe H.C.[2], Kotlík P.[3], Vega R.[4], Yannic G.[4]

1. Cornell University, Ithaca, USA
2. Fondazione Edmund Mach, San Michele All'Adige, Italy
3. Canterbury Christ Church University, Canterbury, UK
4. University of Savoie Mont Blanc, Le Bourget-du-Lac, France

Over the past 35 years, I have studied genetic variation in small mammals in Italy in collaboration with many colleagues. In this synthesis, I will particularly focus on our published work for which the listed collaborators were principal authors. Populations of small mammals are readily isolated from each other by geographic barriers, reflecting limited dispersal capability. This can be seen in the genetic structure of several species of small mammals in Italy, and the differentiation is most notable in the extreme south and north of the country. Calabria is currently part of the southern Italian mainland, but in the Middle Pleistocene and earlier there were periods when it was a group of islands and the very distinctive Calabrian genetic lineages of bank vole (*Clethrionomys glareolus*) and pygmy shrew (*Sorex minutus*) likely reflect island evolution, with later expansion within southern Italy. For the pygmy shrew, mitochondrial and Y-chromosome sequence data were analysed while for the bank vole genomic data are available. In the north of Italy, the genetic differentiation can be related to geographic subdivision created by the alpine massif, with highland and lowland areas either at the macro- or micro-geographical scale. The genetic differentiation that I will describe is more recent than that described for southern Italy. For the Valais shrew (*Sorex antinorii*), the mitochondrial sequence variation described likely relates to geographic subdivision determining the location of refugia at the Last Glacial Maximum. For the house mouse (*Mus musculus*), the chromosomal variation is even more recent – likely originating within the last 4000 years, with this anthrodependent taxon being brought in by humans. All-in-all, the geographic features of Italy make it a fascinating area for the study of genetic variation in small mammals.

Bat activity and species richness along an altitudinal gradient in the Western Alps

Bellè A.[1,2], Sacco A.[1], Bertolino S.[1]

1. Department of Life Sciences and Systems Biology (DBIOS), University of Turin, via Accademia Albertina 13, 10123 Turin, Italy
2. Institute for Alpine Environment, Eurac Research, Drususallee/Viale Druso 1, I-39100 Bolzano/Bozen, Italy

Bats are known to inhabit mountain regions at high altitudes, yet studying their presence and activity in the Alpine environment presents several challenges. Globally, few studies have investigated how bat communities change with increasing altitude, and even fewer have used a methodology capable of capturing all bat activity during the night, such as passive bat-detectors. The influence of temperature and water availability on bat species richness is well documented, with two possible trends observed along altitudinal gradients: a mid-elevational peak in mountains with dry, arid bases and a monotonous decrease in mountains with wet, warm bases. However, it remains unclear which of these models best explain bats distribution in the Alps. The objective of this study is to determine the composition of bat communities along an altitudinal gradient in the Western Alps and identify the main environmental factors driving their altitudinal distribution. Specifically, our aims were to: (I) identify spatial patterns and peak of bat activity and feeding activity along the altitudinal gradient, (II) determine the peak of bat species richness, and (III) assess which environmental factors influence the composition of bat populations.

We established two altitudinal transects in two valleys (T1 and T2) within the Gran Paradiso National Park (GPNP). Each transect comprised 9 sampling points placed every 300 m altitude, from 700 m up to 3100 m a.s.l. At each sampling point, a bat-detector, Wildlife Acoustics Song Meter Mini Bat, was deployed for two whole nights per month. Nine field sessions were carried out between March and November 2023. During analysis, recorded sequences were manually identified at the species level whenever possible, using the Kaleidoscope 5.4.9 and BatExplorer 2.2.6.0 software. The number of call sequences served as a measure of species or species group activity at each site, with each sequence standardised to a duration of 5 seconds. Additionally, feeding sequences were counted. At each session, the bat-detector was paired with a temperature logger (iButton Thermochron). We also collected data for habitat characterization.

A total of 282 nights of recordings were acquired, capturing a total of 34,594 bat sequences. The most active species recorded across the sites was *Pipistrellus pipistrellus* with 27,041 sequences, followed by *Hypsugo savii* with 2,226 sequences and the genera *Myotis* with 1,760. Throughout the field sessions, there was an increase in bat activity corresponding to rising temperatures. Additionally, we identified a mid-altitudinal peak in activity and feeding activity between May and September, centered at 1600 m a.s.l. This pattern was consistent across both altitudinal transects. Notably, a similar mid-altitudinal peak at 1600 m was observed also for species richness from May to September for T1 and from May to July to T2. The sites located at 3100 m recorded the least activity with only 18 total sequences, mainly *Nyctalus/Vespertilio* group, and the first bat sequence was not recorded until August.

The increase in altitude where bat calls were detected, reaching 3100 m in August and September, suggests a higher presence of bats at higher altitudes during the warmer months. Interestingly, during these months, the peak of bat activity and species richness was not observed at the lower altitudes of 700 m, as seen in the colder months (March/April and October/November), but rather at intermediate altitudes of 1600 m, where bats were most active in foraging. These findings may be attributed to a greater abundance of prey resulting from the abundant presence of water sources at these intermediate altitudes compared to lower ones. Similar to what has been observed in other continents, this study may indicate how temperature and the availability of water sources can influence the distribution of bat species along an altitudinal gradient, even in the Western Alps.

Small mammals response to forest environmental heterogeneity in relation to specie niche breadth and vegetation disturbance

Gasperini S.[1], Napoleone F.[2], Bartolommei P.[1], Bertagni G.[2], Cannucci S.[3,4], Serafini L.[2], Burrascano S.[2]

1. Fondazione Ethoikos, Convento dell'Osservanza snc, 53030, Radicondoli, Siena, Italy
2. Department of Environmental Biology, Sapienza University of Rome, P. le Aldo Moro 5, 00185, Rome, Italy
3. Department of Life Sciences, University of Siena, Via Pier Andrea Mattioli, 4, 53100, Siena, Italy
4. NBFC, National Biodiversity Future Center, 90133, Palermo, Italy

Environmental heterogeneity is supposed to cause an increase in species richness while reducing species population abundances due to the area-heterogeneity trade-off. However, the effects of environmental heterogeneity may vary across mammal species with different niche breadth, and along the environmental heterogeneity gradient.
We analysed two taxonomically close and sympatric rodent species with differences in their niche breadth: the forest specialist *Apodemus flavicollis* and the generalist *A. sylvaticus*.
We set our study along an environmental heterogeneity gradient determined by different developmental stages within a deciduous oak forest managed through coppicing with standards. We sampled 12 grids to assess *Apodemus* species densities through spatially-explicit capture-recapture analyses on a three years campaign. We defined the degree of environmental heterogeneity of each grid based on direct measurements of stand structural attributes, vascular plant species composition and functional traits.
We distinguished between overstorey and understorey heterogeneity, since the second is much higher in recently harvested forest stands. We tested the responses of the *Apodemus* species densities to these components of heterogeneity through linear mixed models.
We found different responses to environmental heterogeneity across the two species and along the gradient of heterogeneity. The generalist species *A.sylvaticus* responded negatively to overstorey heterogeneity, i.e., tree species diversity; the specialist species *A.flavicollis*, instead, was favoured by tree diameter heterogeneity. As understorey heterogeneity took over, responses changed in sign and strength. In the highly heterogeneous conditions caused by recent coppicing, the generalist species density increased with the heterogeneity of food resources (i.e., seed mass), while the specialist did not seem to be particularly influenced by understorey heterogeneity.
Our study evidence that the response of the two species to environmental heterogeneity can actually depend on the species niche breadth and on the degree of environmental heterogeneity, both of which may influence the extent of the area-heterogeneity trade-off. Our results contribute to the knowledge of small mammal ecology and set the spotlight on the relationship between these species and the environmental heterogeneity, which is not always linear or positive.

Prey-predator interactions in a Mediterranean protected area

Lazzeri L.[1], Belardi I.[1], Pacini G.[1], Fattorini N.[1,2], Fini G.[1], Pallari N.[1], Ferretti F.[1,2]

1. Research Unit of Behavioural Ecology, Ethology and Wildlife Management, Department of Life Sciences, University of Siena. Via P.A. Mattioli 4, 53100, Siena, Italy
2. NBFC, National Biodiversity Future Center, Palermo 90133, Italy

In recent decades, there has been a growing focus on understanding the interactions between apex predators and their prey, particularly in North American ecosystems. However, limited attention has been given to human-dominated landscapes like European ones, which have seen the recent recolonization of apex predators such as the wolf *Canis lupus*.
This study (2016-2023) examines the interactions between wolves and their prey in the Maremma Regional Park, a Mediterranean protected area recently recolonised by the wolf. The park hosts abundant populations of wild ungulates, including wild boar *Sus scrofa*, fallow deer *Dama dama*, and roe deer *Capreolus capreolus*. The main objectives were to assess inter-annual variations in the wolf's food habits and prey selection and assess spatiotemporal relationships with prey to understand potential responses to the predator's presence. We used a monthly collection of wolf scats and intensive camera trapping for these aims, plus, yearly densities ungulate estimates inferred through the pellet group count method.
The microscopic analysis of wolf scats (N=3129) revealed that large herbivores dominated the wolf diet (> 80% occurrence). Interestingly, the wolf exhibited a clear prey-switching pattern over time. In the initial resettlement period (1-2 years), fallow deer were the primary prey, positively selected by the predator. Subsequently, wild boar replaced fallow deer as the main prey, with a decline in fallow deer use over the years. Prey switching did not correlate with prey densities; instead, a negative relationship was observed between selection indices and wild boar density, while fallow deer showed a weak positive association.
Spatiotemporal analysis of the data obtained through intensive camera-trapping showed that the wild boar had the highest overlap with the wolf. Indeed, initially the fallow deer exhibited crepuscular/nocturnal activity, but then it increased steadily its diurnal activity throughout years since wolf settlement, hence reducing its temporal overlap with this predator. The roe deer exhibited an interactive effect with less activity during the brighter nights and avoidance in more wolf-used sites.
In conclusion, this study highlights species-specific spatiotemporal responses to an apex predator presence, ranging from strong temporal avoidance (fallow deer) to weak responses mediated by lunar cycle (roe deer) and to absent spatiotemporal responses (wild boar). Furthermore, the results suggest anti-predator behaviours can trigger prey switching in a generalist predator. These findings emphasize the importance of a diverse prey community in sustaining resilient large carnivore populations and underscore the importance of studying these interactions which are even crucial to management, and conservation implications.

Roe Deer vs Northern Chamois: contrasting connectivity patterns revealed by gene flow in an alpine area

Lecis R.[1], Chirichella R.[2], Dondina O.[3], Orioli V.[3], Azzu S.[1], Canu A.[1], Torretta E.[4], Bani L.[3], Apollonio M.[1], Scandura M.[1]

1. Dipartimento Medicina Veterinaria, Università di Sassari, Via Vienna 2, 07100, Sassari, Italy
2. Dipartimento Scienze Umanistiche e Sociali, Università di Sassari, Via Roma, 07100, Sassari, Italy
3. Dipartimento Scienze dell'Ambiente e della Terra, Università Milano Bicocca, 20126, Milano, Italy
4. Dipartimento Scienze dell'Ambiente e della Terra, Università di Pavia, Via Ferrata 1, 27100, Pavia, Italy

Comparative landscape genetic studies provide insights on how landscape elements might impact gene flow patterns of species inhabiting the same area. Population genetic structure of two sympatric ungulates, roe deer (*Capreolus capreolus*) and Northern chamois (*Rupicapra rupicapra*) was investigated in the Adamello-Brenta regional park and its surroundings (Trentino, northern Italy).
Chamois and roe deer samples were collected in the same range and genotyped by two species-specific panels of polymorphic microsatellites. Genotypes of the two populations were used to conduct aspatial and spatially explicit analyses. A landscape genetics approach was used to test the effect of Isolation-By-Distance (IBD) and Isolation-By-Resistance (IBR) on the genetic variation patterns of the two species.
While the roe deer population was unstructured, a clear population structure was detected in chamois, with one group inhabiting the eastern, and the other group spread in the western part of the study area. Landscape genetics analysis confirmed these scenarios and revealed a different effect of landscape on gene flow. An IBD model best explained genetic variation in roe deer, which tends to use valleys as dispersal corridors to mix up, while IBR was found as the process underlying genetic variation patterns in chamois, suggesting arable lands, coniferous forests, watercourses, and main roads as potential barriers.
This study highlights the different impact of natural and anthropic landscape elements on gene flow in two sympatric species, resulting from their different ecological requirements and landscape use.

Fine-Tuning Coexistence: Wildlife's Short-Term Responses to Dynamic Human Disturbance Patterns

Mirante D.[1], Ancillotto L.[2,3], Zampetti A.[1], Coiro G.[1], Pisa G.[4], Santocchi C.[4], Santini L.[1]

1. Department of Biology and Biotechnologies “Charles Darwin”, Sapienza University of Rome, Rome, Italy
2. Institute of Terrestrial Ecosystem Research (IRET), National Research Council (CNR), via Madonna del Piano 10, 50019 Sesto Fiorentino, Italy
3. National Biodiversity Future Center, Palermo, Italy
4. Environmental Management and Education (GEA), via delle Bandite 33, 01038 Soriano nel Cimino, Italy.

Anthropogenic disturbance elicits adaptive responses in wildlife, generally aimed at risk-avoidance, ultimately imposing constraints on their spatial and temporal niches. Previous studies have largely focused on long-term adaptive responses to stable human pressure, but rapid adjustments in wildlife’s diel and habitat use patterns in response to fine-scale variations in human presence have so far been overlooked.

In this study we estimate short-term spatio-temporal deviations in local habitat use and diel activity of medium and large mammal species in response to rapid variations in human disturbance. We employed a year-long camera-trapping within a small private reserve, and recorded spatio-temporal information on all sources of anthropogenic disturbance in the area. By controlling for the average habitat use and diel activity, we explored fine-scale spatiotemporal adjustments in seven mammal species.

We found evidence of spatial and/or temporal avoidance across all species, with variations in magnitude and direction coherent with species-specific traits and expected levels of human-tolerance. All species exhibited temporal avoidance of human activities, with porcupine and roe deer eliciting particularly strong responses, and wild boar exhibiting the weakest. Notably, foxes concurrently displayed temporal avoidance and spatial attraction, likely driven by the presence of anthropogenic trophic resources.

Our study underscores the role of behavioral plasticity in enabling wildlife to adjust daily habitat use and activity patterns to varying levels of human pressure across space and time. Understanding these nuanced behavioral strategies can help to promote wildlife-human coexistence and mitigating the adverse impacts of human presence on wildlife fitness.

Of wolves and deer: how does a prey respond when a predator is back?

Ossi F.[1,2], Bruat A.[3], Dal Farra S.[1], Heurman M.[4], Cagnacci F.[1,2]

1. Fondazione Edmund Mach, via Mach 1, San Michele all'Adige, Italy
2. NBFC, National Biodiversity Future Center, Palermo 90133, Italy
3. University of Utrecht, Heidelberglaan 8, 3584 CS Utrecht, Netherlands
4. Wageningen University, Droevendaalsesteeg 3a, 6708 PB Wageningen, The Netherlands

In recent decades, the grey wolf (*Canis lupus*) has rapidly recolonized much of the European continent, including the Alps. This 'new' presence could affect ecosystem equilibrium via top-down regulatory processes (i.e. predation), and therefore it is relevant to assess how prey species respond to the return of this large carnivore. Here we investigated whether the recent return of wolves to Trentino has affected the behavioral ecology of roe deer (*Capreolus capreolus*), a small ungulate that is an elective prey of the wolf in many European ecosystems. In several areas of Trentino, roe deer populations are exposed to supplementary feeding programs managed mainly for hunting purposes. These sites, where roe deer tend to congregate, could become particularly risky in the presence of wolves. We therefore analyzed the pattern of roe deer use of these anthropogenic resources in relation to the presence of wolves, taking advantage of long-term monitoring of supplemental feeding sites, which allowed us to compare roe deer behavior before and after wolf establishment.
We used camera traps to monitor 7 supplementary feeding sites during both winter (December-January) and spring (March-April), in 2017-2018-2019 (years of wolf absence) and 2022-2023 (years of wolf presence, initially sporadic and then with an established pack presence). We used a combination of circular statistics and Generalized Linear Mixed Models (GLMMs) to assess whether the circadian pattern of visits to these sites, as well as the daily number of visits, their duration and the size of the visiting roe deer group, varied as a function of wolf presence, while controlling for seasonality (winter vs. spring).
We found that the presence of wolves induced a significant shift towards diurnality in the 24h cycle, but only in winter. The number of daily visits to feeding sites decreased significantly in the presence of wolves and from winter to spring, while the time spent at each visit was unaffected by the presence of wolves. Finally, roe deer were more likely to visit feeding sites alone than in groups when wolves were present.
The roe deer showed a multifaceted response to the ecosystem modification imposed by the appearance of its main predator, confirming the high behavioral plasticity of this small ungulate. The tendency to become more diurnal in winter, the reduction in the number of daily visits to feeding sites, and the observed pattern of mostly solitary visits to these sites may represent a series of tactics aimed at reducing individual exposure to risk. At the same time, roe deer have to make trade-offs between this risk and other needs, first and foremost foraging for energy, which is probably the reason why roe deer did not change the duration of visits to feeding sites when accepting the risk of visiting them. Also, exposure to human disturbance, which increases in the spring in the study area, may explain the lack of a circadian switch in use patterns during this season, with roe deer maintaining their crepuscular and nocturnal behavior as a trade-off between exposure to human disturbance and the risk of wolf predation. Finally, we acknowledge that some of our results, namely the decrease in visits to feeding sites, could also be attributed to a decrease in roe deer abundance in the area due to wolf predation. Accurate density estimation, e.g. by camera trapping, combined with individual monitoring by GPS tracking, may reveal how demographic and behavioral processes interact in shaping the observed patterns, and provide indications for adapting current management plans.

Assessing the impact of recreational activities on terrestrial mammals

Sganzerla F[1]., Brivio F.[2], Scillitani L.[3], Grignolio S.[1]

1. Dipartimento di Scienze della Vita e Biotecnologie, Università di Ferrara
2. Dipartimento di Medicina Veterinaria, Università di Sassari
3. MUSE – Museo delle Scienze di Trento

The surge in nature-based recreational activities worldwide has raised concerns regarding their impacts on wildlife. While such activities yield economic benefits and may foster conservation awareness, they also pose threats to animals, which might perceive the human presence similarly to predation risk. Many studies have investigated the effects of recreation on different aspects of animals' behavior, physiology, and population dynamics, finding contrasting results. A thorough review focusing on mammals was lacking so far.

We conducted a broad bibliographic search and examined 211 articles, producing a review about the effect of recreational activities on mammals living on land. We analysed trends in publications over time with respect to where studies were carried out and what species they focused on. We then used a multivariate model to detect which features of the study designs have higher probabilities to detect an effect of recreational activities on mammals.

A huge bias affects the research topic, both on a taxonomical and geographical level: large mammals in Europe and North America dominate study focus, while many biodiversity-rich regions and non-charismatic species are neglected. However, our analysis of the publication trends suggests that these biases are reducing in the last 20 years. The result of the multivariate analysis shows that, although studies measuring physiological responses are scarce in the literature, these are more likely to detect disturbances than behavioral ones. Moreover, studying individually recognizable animals is associated with a higher likelihood of detecting the effects of the disturbance. Experimental studies did not perform better than observational studies.

Harnessing this knowledge is crucial for generating a better understanding of the effects of recreational activities on mammals in future studies. As nature-based recreation continues to expand globally, addressing geographical and taxonomic gaps in the literature is crucial for enhancing understanding of human-wildlife interactions and fostering the development of more sustainable tourism practices. Adopting suitable study protocols is essential for efficiently managing economic resources in scientific research and can help define better conservation strategies.

A non-invasive genetics insight into population structure and recolonization dynamic of the Eurasian otter (*Lutra lutra*) at the boundary of its Italian core range

Agostini G.[1], Loy A.[1,2,3], Gentile G.[2], Giovacchini S.[2,3], De Sanctis C.[2], Mirone E.[2], Papaleo L.[2], Petrella A.[4], D'Alessio N.[5], Colangelo P.[1]

1. Research Institute on Terrestrial Ecosystems, National Research Council, 00015 Montelibretti, Rome, Italy
2. Envix Lab, Department of Biosciences and Territory, University of Molise, 86090 Pesche, Isernia, Italy
3. IUCN SSC Otter Specialist Group, Gland, Switzerland
4. Istituto Zooprofilattico Sperimentale della Puglia e della Basilicata, Foggia, Italy
5. Dipartimento di Sanità Ambientale, Istituto Zooprofilattico Sperimentale del Mezzogiorno, Portici, Italy

Once widespread throughout the rivers of the Italian peninsula, during the past century the Eurasian otter (*Lutra lutra*) suffered a drastic decline, surviving with two disjunct cores in Southern Italy. Since the beginning of this century the species started to recover in its former range, leading to the re-joining the two isolated populations and to its return to the Abruzzo, Lazio and Molise National Park (PNALM) after 40 years from the extinction, and after 10 years from its return to the Sangro river downstream the lake Barrea's dam in the PNALM area. To explore the dispersal dynamic and potential factors that may limit gene-flow between the population upstream the dam and the surrounding areas, we collected samples in three river basins, and from Southern Italy such as the province of Salerno (Campania), Gargano (Apulia), and Ionian Coast (Apulia and Basilicata). DNA was extracted from 50 specimens, including *spraints*, anal jellies and tissues, and used to amplify a panel of 11 microsatellite loci. Spatial Principal Component Analysis (sPCA) and admixture highlight that the genetic diversity of our sample is geographically structured with similarity mainly driven by geographical proximity. Interestingly, specimens near the mouths of Foro, Sinello and Pescara rivers showed a high genetic similarity with specimens from Southern Italy. Within PNALM the observed heterozygosity (H_o=0.50) was moderate, but in line with literature. Gene-flow from PNALM towards both the Aterno-Pescara and Sangro-Volturno basins was relatively high. Identity analysis allowed them to identify 18 unique genotypes (15 males and three females) upstream the dam in the PNALM. In addition, sibship analysis suggested that seven individuals belonged to two full-sib clusters. If compared to populations from the surrounding areas the level of inbreeding upstream the dam was not particularly high. Effective population size (N_e) and census size (N_c) estimates upstream the dam suggested that the population is composed of at least 31 individuals if we consider the lower bound of the confidence interval. Results revealed the occurrence of a weak geographical structure, suggesting a stepping-stone recolonization process of river basins from Southern Italy. In addition, the high genetic similarity between specimens from the coastal areas of Abruzzo and Gargano suggests otters followed different recolonization routes and possibly dispersed along coastal areas, using the sea as corridors. Genetic diversity of PNALM population upstream the dam was low, consistent with a founder effect. The N_e estimate could indicate the presence of few breeding adults. However, the 18 unique genotypes detected upstream the dam and N_c estimate suggest the population in this area could host a higher number of individuals than initially assumed, and as suggested by sibship analysis, is likely made up of different demes. Finally, gene-flow estimates suggest that, despite the possible limitation of gene-flow due to the dam, otters can move in and out the PNALM area both from north and south. Although the otter nucleus upstream the dam in the PNALM is showing a favorable conservation status, its genetic diversity is low, making it vulnerable to demographic and environmental stochastic factors that might be amplified by road kills and accidental mortality. Accordingly, there are highly recommended interventions to favor movements of otters between upstream and downstream the dam, and mitigation measures to limit road collision risk.

Analysis of trace elements in Eurasian otter (Lutra lutra) spraints in Friuli Venezia Giulia: a sentinel species in continuous expansion

Barca V.[1], Morandi P. F.[1], Stokel G.[1], Vit M.[1], Susmel S.[1], Filacorda S.[1]

1. Department of Agri-Food, Environmental and Animal Sciences, University of Udine, Via Sondrio 2/A, 33100 Udine

The Eurasian otter (*Lutra lutra* Linneaus, 1758) is a medium-sized piscivorous mustelid inhabiting freshwater streams across Europe and Asia. As an apical predator of aquatic and riparian ecosystems, it is an important flag and keystone species for these environments. Widely distributed in Italy at the beginning of the '900, the population collapsed leading to the extinction in many regions, including Friuli Venezia Giulia (hereafter, FVG). This significant reduction of its historical range is a consequence of several factors, including environmental pollution, habitat loss and fragmentation, and direct persecution. However, in recent years the neighbouring Austrian and Slovenian populations are growing and expanding, promoting the recolonization of two northeastern regions of the peninsula, Alto Adige and FVG. Recolonization of old territories has occurred from the expansion of these populations through two main ecological corridors. These two river basins, where the species is found to be stable and breeding, are associated with two mining sites, now disused, but active until the 90s: the Pb/Zn mine of Raibl, in Italy, and the Hg mine of Idrija, in Slovenia. Even though the two mines have been in disuse for almost 30 years, several monitoring studies found important concentrations of trace elements in associated riverine systems. As a long-lived apex predator, having restricted home ranges and high site fidelity, the otter may be annually exposed to localized sources of pollution, and, for this reason, used as a sentinel species to measure the quality and state of health of the ecosystems in which it inhabits. The objective of this study is, therefore, to update the knowledge of the otter distribution in FVG, aiming to consistently enhance our understanding of its spreading dynamics, and investigate trace element concentrations in spraint samples, to obtain a more comprehensive picture of the contamination status of the riverine ecosystem.

For the otter monitoring two distinct techniques were employed: sign of presence detection and camera trapping. A 10x10 km grid was used, from which 48 quadrants were selected and classified based on historical and current otter presence information. Four sites per selected quadrant were monitored conducting intensive, semi-intensive transect, or bridge checks, depending on the quadrant classification. To confirm otter presence, and study its behaviour and reproduction dynamics, seven camera traps were strategically placed in representative quadrants, based on results of previous monitoring. Spraint samples were collected in three areas: downstream of mining sites in Raibl and Idrija within the Slizza and the Isonzo basins, respectively, and in a reference area within the Fella-Tagliamento basin, an additional expansion pathway inhabited by the species. Atomic Emission Spectroscopy (AES) and Atomic Absorption spectroscopy (AAS) techniques were employed to measure 27 trace elements and total mercury content, respectively, on a total of 29 samples. This marks the first application of such environmental monitoring methods in our region.

Results from the 2021-2022 monitoring period show a continuous growth in the otter population, as evidenced by the considerable increase in detected signs of presence compared to the last survey. Results from the chemical analyses confirmed the presence of various trace elements in the study area, with higher concentration observed in the two areas associated with mining sites compared to the Tagliamento river basin area. Particularly, elevated concentrations of As and Hg were observed in samples from the Vipacco river, in the Isonzo basin, and of Cd, Pb, and Zn in the Slizza stream. The comparison between the estimated daily ingestion rates of five trace elements and the toxicity reference values from literature further reveals that Pb contamination levels in the Slizza stream are sufficiently elevated to potentially induce sub-lethal effects and reproductive issues in otters. Interestingly, despite this, monitoring data suggest a viable and expanding core otter population in the Slizza basin. Our results highlight, therefore, the otter's role as a sentinel species, able to tolerate, at least locally and temporarily, high contamination levels, thus serving as an early indicator for the overall health of the river ecosystem, reflecting abiotic and biotic conditions.

Wolf spatial behavior variability along the recolonization: insights from central Italy and Alpine regions

Cavazza S.[1], Brogi R.[1], Zanni M.[1], Berzi D.[1], Luccarini S.[1] Cappai N.[2], Bongi P.[1], Del Frate M.[1], Apollonio M.[1]

1. Department of Veterinary Medicine, University of Sassari, via Vienna 2, Sassari, Italy
2. Foreste Casentinesi National Park, Pratovecchio (AR), Italy

The recovery of the wolf in Italy after a long-lasting persecution has led to a non-uniform distribution across the country. From central-southern Italy, where wolves had persistently remained, the colonization extended to Northen Apennines and the Alps only in the last decades with a wave moving from West to East. Consequently, central Italy now hosts a population established from a longer time, probably resulting in a higher density of packs and individuals. Analyzing the spatial behavior of wolves in areas recolonized in different times allows an analysis of potential variations in behavioral ecology related to different phases of recolonization, offering valuable insight into the species' future in Italy and Europe. This work aims to elucidate this issue and to present initial results on the spatial behavior of wolves in the eastern Alps through GPS tracking.

Between 2019 and 2023, we fitted GPS collars on 13 wolves from two Italian regions undergoing recolonization in different periods: central Italy (four pack members and one floater) and Alps (six pack members and two floaters). We employed continuous-time movement modeling to estimate wolves' home range size and average speed, while accounting for autocorrelation and the tortuosity of movement data.

The average home range size of pack members in central Italy was 32.985 km^2 (± 24.460), whereas in the Alps it was substantially larger at 208.332 km^2 (± 64.244). Additionally, average speeds were observed to be 28.684 km/day (± 5.027) for wolves in central Italy and 32.907 km/day (± 5.810) for those in the Alps. Finally, we estimated home range size and speed of a floater male in central Italy (386.045 km^2 and 28.665 km/day, respectively) and of a floater female in the Alpine region (479.788 km^2 and 29.544 km/day, respectively). A seasonal pattern was evident among pack members, particularly breeders, whereas this pattern was less pronounced among floaters and non-breeders within a pack.

The larger home ranges observed in the newly colonized Alpine region resembled those reported in central Italy decades ago, highlighting the huge variability of wolf spatial behavior along the recolonization process. Despite the local environmental factors (e.g., human disturbance, prey availability) may have also played a role, our results suggest that wolves may modify their spatial behavior to cope with the increased intra-specific spatial competition characterizing the late recolonization phases. Such behavioral patterns may have major consequences on the demography of Italian and European wolf populations in the near future. Understanding the variation of wolf spatial behavior in areas where recolonization has occurred or is occurring and the possible reasons behind it is thus crucial from both conservation and management perspectives.

Range dynamic and carrying capacity of Eurasian otter in the expansion area of Central Italy

Giovacchini S. [1], Chavko L. [2], Jamwal P.S. [1], De Sanctis C. [1], Mirone E. [1], Di Febbraro M. [1], Loy A. [1,3]

1. University of Molise, contrada Fonte Lappone, Pesche (IS), Italy
2. Sapienza University of Rome, piazzale Aldo Moro 5, Roma, Italy
3. CNR-IRET, Porano (TR), Italy

The Eurasian otter (*Lutra lutra*) is a semi-aquatic mammal that underwent a dramatic decline in Italy in the last century, due to water pollution, human persecution, and habitat loss. The decline peaked in the 1970's, when the species was confined to about 30 river basins in Southern Italy. Strict protection and banding of harmful pollutants in the '90s promoted a still ongoing recovery in its former range. The Eurasian otter is listed in the Annex II and IV of Habitat Directive (92/43/EEC), thus it is mandatory for EU members to report every six years on population and distribution trends, and identify priority conservation actions and areas. According to the national action plan, priority areas include the range boundary and the potential expansion areas that could be colonized in the short-medium term.

With this work, we aimed at updating the current distribution of the species along the range boundary in South-Central Italy, and identifying areas and drivers of its potential expansion in the short term in neighbouring river basins. Current distribution was assessed through a field standard survey covering 20 river basins in Abruzzo, Marche, and Lazio regions, starting from the upper range boundary of the species (Sangro and Volturno river basins), covering 129 10x10m LAEA grid cells, for a total of 458 sampling sites. Presence data were combined with occurrences available across the whole species range in South-Central Italy and combined with 21 environmental variables to produce an ensemble Species Distribution Model (SDM) through the R package Biomod2. The resulting suitable areas were analysed to provide the Area Of Habitat (AOH) recently recommended by the IUCN to replace Areas Of Occupancy (AOO) in the Red List assessment, and to compute the carrying capacity (K) of the study area. Finally, a subset of suitable areas was used as input nodes and combined with a resistance map to produce a lateral (across river basins) connectivity model through Circuitscape. The resistance map was produced by assigning a permeability value to otter dispersal movements across river basins to 24 variables, including a 700 m marine buffer along the coasts.

Field surveys revealed otter presence at 55 out of the 458 visited sites (12%), along 9 river basins, establishing a new boundary along the rivers Tronto (Marche) and Liri (Lazio\Abruzzo). Ensemble modelling (TSS=0.966, ROC=0.827) identified larger river stretches, wetlands, and shrub vegetation as the most important factors related to otter presence. Total AOH summed to 6,546 km^2 within the current range, and 8,996 km^2 in neighbouring river basins, for a total K=1,554 otters for both the current range and the short-term expansion areas. Connectivity modelling identified the coastal areas as the best connection pathways, whereas the inland matrix across drainages showed medium-low connectivity values. In general, Adriatic shorelines provided better connections compared to the Tyrrhenian coasts. Results evidenced an acceleration of expansion trend in the last few years, the key role of lowland and coastal areas in promoting otter dispersal and range expansion, and the Tiber River basin as the most relevant expansion area in the short-medium term.

Effects of climate change on hare species distribution patterns: novel insights from long-term data

La Morgia V.[1,2], Martini I.[2], Tosatto E.[2], Mazza E.[2], Santovito A.[2], Bertolino S.[2]

1. ISPRA, Istituto Superiore per la Protezione e la Ricerca Ambientale, sede di via Ca' Fornacetta 9, Ozzano Emilia (BO), 40064, Italia
2. Dipartimento di Scienze della Vita e Biologia dei Sistemi, Università degli Studi di Torino, via dell'Accademia Albertina 13, Torino, 10123, Italia

Climate change can deeply affect the distribution patterns of hare species, an area of ecological dynamics that has received relatively little attention. Previous research has lacked sufficient exploration of how climate change influences the distribution patterns of hare species. To address this gap, we investigated the distribution of mountain (*Lepus timidus*) and European (*L. europaeus*) hares in a valley of the Gran Paradiso National Park, providing new insights into critical ecological relationships. By examining the effects of climate change on the distribution patterns of hare species, our research aims to enhance our understanding of ecosystem dynamics in response to a changing climate.

Using non-invasive genetic techniques based on mtDNA and resampling the same locations after 12 years (2009–2021), our study analyzes changes in hare species distribution patterns over time. We sampled 47 areas at altitudes ranging from 1544 to 3010 m. To investigate the complex relationship between habitat types and altitude, and to elucidate any shifts in hare species distributions, we estimated the proportion of pellets with European hare mtDNA via standard methods, and through a Bayesian approach incorporating previous knowledge on the presence of hares in alpine environments. Results revealed an increase in the proportion of samples with European hare mtDNA from 2009 (– expected mean of the posterior distribution = 0.124, 95% CrI – credibility interval = 0.072-0.187) to 2021 (= 0.187, 95% CrI = 0.145-0.232), and a decrease in mountain hare presence at lower altitudes (1544-2270 m) where the European hare was dominant. Conversely, the mountain hare becomes more prevalent with increasing altitude and dominant above 2500 m, particularly in pioneer vegetation and rocky terrain. The estimated mean altitude of the mountain hare was larger than that of the European hare, especially in 2021 (pairwise difference = 274, 95% CrI = 16-543). We also observed European hares at higher altitudes, inhabiting landscapes typically considered unsuitable for this lowland species. The overlap between the distribution areas of both hare species was extensive. Over time, there was a noticeable increase in the proportion of European hare samples, accompanied by a shift in the co-occurrence pattern, with European hares increasingly found at intermediate to high altitudes.

As climate change progresses, alterations in temperature and precipitation patterns are fundamentally altering the geographical range and habitat suitability for hare species. These changes include the expansions of the European hare into previously inhospitable areas, while the mountain hare range is contracting in historically occupied regions. Moreover, the overlap between the two species could favor hybridization processes. By providing novel insights into the impacts of climate change on hare species distribution patterns, our research enhances our ability to predict the consequences of climate change on wildlife populations. This underscores the importance of implementing adaptive management strategies to mitigate potential ecological disruptions and safeguard biodiversity in the face of ongoing environmental changes.

Choosing shitty boxes: conspecific faeces odour influences roost exploration and occupation in Bechstein's bats

Rizzi S.[1], Schäfer F.[2,3], Schirmer S.[1], Kerth G.[1]

1. Zoological Institute and Museum, University of Greifswald
2. University of Würzburg, 3 FÖA Landschaftsplanung

Every organism has to process a multitude of different stimuli during its lifetime in order to obtain information about the environment. For nocturnal or crepuscular organisms that have little or no access to visual cues, auditory and olfactory cues are fundamental in providing information about the physical and social environments. Despite bats accounting for around 20% of mammal species and being highly social, little is known about the role of olfaction in their behaviour. For example, whether odours play a role in roost selection and how cues of previous conspecific presence influence bats' social dynamics remain largely unclear. A better understanding of this topic would provide a more comprehensive knowledge of the link between social behaviour and sensory ecology in bats. We thus designed a study aimed at investigating the role played by conspecific faeces odours in Bechstein's bats' (*Myotis bechsteinii*) exploration and selection of new potential roosts.

We performed a pairwise choice test by providing free-ranging female Bechstein's bats with experimental pairs of bat boxes, each containing either same-colony ('own' treatment) or foreign-colony droppings ('foreign' treatment). All adult female bats were equipped with RFID tags, and we continuously monitored the experimental boxes through automatic RFID loggers. We then quantified behaviours related to roost exploration and occupation. We analysed the influence of treatment, faeces age and their interaction on all behavioural responses using Bayesian Generalized Linear Mixed Models.

Our results show that bats were not able to perceive the faeces' odour from outside the boxes. However, we found a preference for boxes with faeces from their own colony both in roost exploration and occupation. Moreover, exploration decreased with increasing faeces age, while box occupation showed the opposite trend. We also detected a significant positive interaction between our treatment and the age of the faeces, with same-colony faeces being preferred with very fresh droppings (and overall), but foreign faeces overtaking them when droppings became older.

Our findings indicate that Bechstein's bats do not rely on olfactory cues to locate potential roosts. Nonetheless, odours seem to play a relevant role in roost selection, influencing both roost exploration and occupation. Female Bechstein's bats seem to detect unfamiliar conspecific feces at new roosts and avoid them, most probably to minimize the risk of aggression and the potential transmission of parasites or pathogens. These behavioural responses could thus reinforce social segregation between neighbouring colonies. Our study contributes to shedding more light on the long-debated topic of the role of faeces' odour in roost evaluation and selection.

Wolf predation patterns on livestock in Trentino: an analysis of dynamics and prevention strategies

Roseo F.[1], Bragalanti N.[2], Zanghellini P.[2], Zeni M.[2], Gervasi V.[3], Pedrini P.[1], Groff C.[2], Bombieri G.[1]

1. MUSE - Museo delle Scienze, Ufficio Ricerca e Collezioni, Ambito Biologia della Conservazione, Trento, Italy.
2. Settore Grandi Carnivori, Servizio Faunistico, Provincia Autonoma Trento, Trento, Italy.
3. ISPRA - Istituto Superiore per la Ricerca e la Protezione Ambientale, Ozzano dell'Emilia, Italy

Over the last century, wolves have made a remarkable comeback in the Eastern Italian Alps, reaching over 30 packs in less than a decade. Specifically in Trentino, despite raising relevant political and social conflicts, as well as causing concrete damages to livestock, no study has to date looked at the impact of wolves on this sector, nor has investigated the effectiveness of the damage prevention measures adopted in the area.

We investigated wolf depredation dynamics on livestock in the province of Trento by examining all verified cases recorded from 2013 to 2022. Specifically, we analysed spatio-temporal trends and hotspots of wolf predations, identified recurring characteristics of depredation events concerning the type and management of depredated livestock, and assessed the presence/absence along with the type of protection measures at the depredation site.

Between 2013 and 2022, 576 wolf depredations on livestock were recorded in Trento province, for a total of 2256 livestock heads affected. Depredation patterns align with the trend of wolf population's expansion in the area, increasing over time both in number and in the areas affected by depredation events. The greatest number of attacks occurred in August and at night. Sheep and goats are mostly affected (64%), followed by cattle (26%), of which young animals under 15 months of age are the most affected age group (67% of cattle preyed upon). However, considering the total livestock annually available in the alpine pastures, sheep, goats and donkeys resulted to be most selected by wolves and hence the most vulnerable types of livestock. On the other hand, cattle represent the least vulnerable category. The spatial analysis identified the geographic areas and *malghe* most impacted by chronic and massive depredations, both for the entire study period (2013-2022) and the most recent period of greatest management interest (2020-2022). This analysis shows that, between 2020 and 2022, the most impacted areas were Lessinia, Baldo, Bondone, and Primiero. We found that 30 *malghe* were affected by intense wolf depredations in the period 2013-2022. Overall, in 81% of the attacks the depredated livestock was not protected by any prevention measure.

Our results highlight the complexity of wolf depredation on livestock even at local scale, which can have diverse impacts (chronic or massive) and can differ depending on factors such as the abundance and category of livestock, the pasture management, the presence and type of protection measures, the history of wolf presence in the area and the environmental context in which the *malga* is located. Further specific analyses could assess the role of these factors in determining the frequency of predation and their variations over time and space. In general, our study provides useful information on wolf depredation dynamics at the local level, which can be used to improve current strategies for conflict mitigation and identify areas and specific pastures at high priority of intervention to reduce conflicts.

Phylogeography and population genetics of *Arvicola italicus*

Solano E.[1,2], Castiglia R.[3,2], Amori G.[1], Gentile G.[1], Capizzi D.[4], Bertolino S.[5], Kranebitter P.[6], Ladurner E.[6], Lapini L.[7], Colangelo P.[1,2]

1. CNR IRET, Istituto di Ricerca sugli Ecosistemi Terrestri (RM)
2. NBFC-National Biodiversity Future Center
3. Università La Sapienza, Dipartimento di Biologia e Biotecnologie (RM)
4. Regione Lazio, Direzione Ambiente, Roma
5. Università di Torino, Dipartimento di Scienze della Vita e Biologia dei Sistemi (TO)
6. Museo di Scienze Naturali dell'Alto Adige (BZ)
7. Museo Friulano di Storia Naturale (UD).

The taxonomy of the genus *Arvicola* has been widely investigated in the last years using an integrated approach. The genus has a palearctic distribution and the most recent studies in Europe identifying three species: *A. sapidus* (Iberian Peninsula and France), *A. amphibius,* which comprises the Euroasiatic clade (EU) and the Western-European clade (WE) and *A. italicus* a nearly endemic Italian species, originated in consequence of long-term isolation within the peninsula. The aim of the present study was to describe the genetic structure and variability in *A. italicus* and the genetic identity of populations in northeast Italy. This area holds biogeographic importance and may serve as a potential contact zone between *A. italicus* and *A. amphibius*. Thirty-six Italian water voles were analyzed from six regions, displaced from south to north. Two mitochondrial markers were isolated and sequenced. A Bayesian phylogenetic analysis of 300 individuals was performed and the genetic divergence among the major clades was estimated. Additionally, a Median Joining Network (MJN) of Italian haplotypes was built. Furthermore, on 27 samples, nuclear genotypes were obtained amplifying 8 autosomal microsatellites loci that were analysed by performing a spatial analysis of principal components (sPCA). The phylogenetic tree confirms the monophyly of the genus *Arvicola* and reveals four main clades corresponding to the four species considered. Two lineages corresponding to the northwestern and southcentral Italian populations form a well-supported clade, attributable to the species *A. italicus*. A third lineage including part of the northeastern Italian samples, cluster instead within *A. amphibius*, in basal position but with a low support. The remaining individuals from Alto Adige resulted in *A. amphibius* within the EU clade. The MJN shows in Italy four haplogroups, corresponding to three Italian lineages and the fourth to *A. amphibius.* Microsatellite data support a distinction between *A. amphibius* and *A. italicus*. Within *A. italicus*, the admixture shows the northwestern population as the most differentiated whereas northeastern and southcentral show limited evidence of admixture. Our findings provide a first insight into the genetic diversity and population structure of the endemic *A. italicus* and highlights in Italy a complex phylogeography and taxonomy patterns. The results show that *A. italicus* displays high intraspecific diversity, especially in the southern population. This pattern is consistent with what is expected for an endemic small mammal in Italy, with its genetic diversity decreasing from south to north. The phylogenetic analysis identified a distinctive lineage in northeastern Italy, which diverge from *A. italicus* and *A. amphibius* for values that lie on the threshold between intraspecific and interspecific divergence. Despite this result, this northeastern population shows evidence of admixture of nuclear loci with the southcentral populations, supporting the attribution of these specimens to *A. italicus*. This pattern suggests that *A. italicus* in NE Italy retained an ancestral haplotype and underwent a long period of isolation with respect to the southern populations, without genetic exchange until recent times. We observed a low genetic diversity in the northern populatio which can be challenging for animals living in fragmented habitats and susceptible to habitat loss and the importance of identifying suitable conservation measures for this endemic small mammal have been emphasized. Finally, this study documented the presence of *A. amphibius* in northeastern Italy. Besides interesting phylogeographic consideration, the occurrence of two different species in northeastern Italy indicate that this area has high biogeographic value as a putative contact zone between species and lineages.

PRESENTAZIONI ORALI

(SESSIONE SPECIE ALLOCTONE: DALLA PREVENZIONE ALLA GESTIONE)

Functionality and application of EICAT+, a standardized framework to classify positive impacts of alien species

Vimercati G.[1]

1. Department of Biology, Unit Ecology & Evolution, University of Fribourg, Chemin du Musée 15, 1700, Fribourg, Switzerland

Species introduced through anthropogenic activities beyond their native range, known as alien species, have various environmental impacts worldwide. Considerable attention has been devoted to documenting and predicting the degree to which alien species negatively impact native biodiversity, both globally and locally. Consequently, several assessment schemes have been designed to classify these species according to the type and magnitude of their negative impacts. The EICAT (Environmental Impact Classification for Alien Taxa) framework, developed by Blackburn and colleagues in 2014, assesses negative impacts based on different levels of impact magnitude. Over the years, EICAT has been extensively applied to compare impacts across numerous regions and taxonomic groups. Its success is due to a simple and evidence-based assessment implementation, which led to its official adoption by the IUCN in 2020 as a global standard for the impacts of alien species.

Under certain circumstances, alien species can also positively impact biodiversity, for instance through food and habitat provisioning or dispersal facilitation. However, standardized and evidence-based systems to classify positive impacts were absent, thus preventing us from fully capturing the multifaceted environmental changes induced by the introduction of alien species. This gap was filled in 2022 by Vimercati and colleagues with the development of the EICAT+ framework, which uses five semiquantitative scenarios to categorize the magnitude of positive impacts. EICAT+ also describes the underlying mechanisms by which alien species may benefit native populations, such as dispersal facilitation, food provisioning, or enemy release. Under EICAT+, high levels of impact magnitude are assigned to taxa that promote local population re-establishment or prevent local population extinction of at least one native species. The framework can be applied to all alien taxa, from plants to animals, fungi, and even microorganisms, and at different spatial and organizational scales. When used in combination with EICAT, EICAT+ provides systematic and transparent data regarding the multifaceted changes that alien taxa cause on native taxa. These data are paramount to enrich our understanding of the consequences of biological invasions, test scientific hypotheses, and inform nature conservation decisions.

For example, Bescond--Michel and colleagues have recently used EICAT+ along with the IUCN EICAT framework to assess the number and magnitude of positive and negative environmental impacts of alien ungulate species on a global scale. By categorizing impact magnitude into two levels of strength (weak and strong), these authors also asked whether insularity and trophic position of species affected by alien ungulates influence both their negative and positive impacts. Of the 29 alien species of ungulates, totalling 2,021 impact observations, a predominance of negative impacts (1,615) was found. Negative impacts also exhibited a greater magnitude compared to positive impacts. Notably, native species from insular locations experienced stronger impacts than those located on the mainland, a pattern consistent across both negative and positive impacts. Regardless of impact direction, alien ungulate species were more likely to cause strong impacts through indirect mechanisms compared to direct ones, particularly affecting secondary consumers over primary consumers. The combined use of EICAT and EICAT+ enabled Bescond--Michel and colleagues to conduct a taxonomically controlled bidirectional impact assessment that had never been attempted before. By providing novel insights into the complex influence of alien ungulates on global change, their research can assist policy decisions on biodiversity conservation, particularly in island contexts and for species occupying high trophic levels.

Alien mammals in Italy: pathways of entry and impacts

Bertolino S.[1], Carnevali L.[2], Mori E.[3,4], Capizzi D.[5], Monaco A.[2]

1. Department of Life Sciences and Systems Biology, University of Turin, 10123 Turin, Italy
2. Istituto Superiore per la Protezione e la Ricerca Ambientale, 00144 Roma
3. CNR IRET, 50019, Sesto Fiorentino (Florence), Italy
4. National Biodiversity Future Center, 90133, Palermo, Italy
5. Regione Lazio, Direzione Ambiente, 00173 Roma, Italy

Species introduced outside their native range (alien species) are a primary driver of global environmental change, a continuously rising phenomenon. To mitigate their impacts, it is necessary to develop effective strategies that avoid new introductions and limit already established harmful ones. Analyzing the pathways through which alien species arrive in a country and the impacts they produce can enhance comprehension of the phenomenon and assist in prioritization and mitigation processes. This study aims to review the entry pathways of alien mammals into Italy and assess the impacts they have demonstrated within the country, as well as those observed in other countries. We compiled a list of species introduced in Italy, focusing on those with established populations or at least with data on reproduction. For these species, we collected information on pathways of introduction and impacts produced in the country and in other areas of introduction to better evaluate the potential impacts of these species. To gain a deeper understanding of the drivers of mammal introduction, we also evaluated the pathways of native mammal species translocated within Italy. For species introduced several times, we considered all known pathways. We considered an impact as supported if there was at least one study worldwide providing evidence of a decline in native populations due to the alien species. Regarding the transmission of diseases, we considered cases where an alien species introduced new parasites into the introduced range.

We collected information on 24 species: 10 Rodentia, 6 terrestrial Cetartiodactyla, 5 Carnivora, 3 Lagomorpha. Six species are included in the Union list (EU Regulation 1143/2014*). Ammotragus lervia* emerged as the species with the highest recorded impact categories (4) on species and ecosystems. It was followed by a group of species with three impact categories each: *Callosciurus erythraeus, Cervus nippon, Dama dama, Mus domesticus, Neovison vison, Nyctereutes procyonoides, Rattus rattus, Sciurus carolinensis*, and *Sylvilagus floridanus*. Additionally, four species – *Callosciurus erythraeus, Myocastor coypus, Rattus norvegicus*, and *Rattus rattus* – have evidence supporting impacts on both crops and human-manufactured items. The most common impact observed was the transmission of disease, attributed to 13 species, followed by species competition and grazing/herbivory/browsing, each reported for 8 species, and by predation from 6 species. Nine species were associated with impacts on crops, while impacts on human - manufactured items were reported for 4 species. We collected data on 50 known pathways of introductions: 17 releases (34.0%), 17 escapes (34.0%), 10 stowaways (20.0%), and 6 unaided (12.0%). Examining the second level of pathways (subclasses), we found that 8 introductions (16.0%) were due to hunting management, 6 (12.0%) were associated with fauna improvement, 6 (12.0%) resulted from natural dispersal across borders, 5 (10.0%) were due to escape from zoos, and 4 (8.2%) were attributed to escape or release of pet species. Regarding translocations of native species (23 cases), the main pathways included hitchhiking on ships/boats (7 cases, 30.4%), hunting (4, 17.4%), and biological control (3, 13.0%). However, the pathway was considered uncertain in 10 cases (43.5%).

Italy hosts a significant number of alien species, primarily stemming from voluntary releases or escapes. While hunting management was the primary pathway of introduction in the past, the current risks largely depend on the pet trade, zoos, and other private enclosures. Implementing regulations on the pet trade and enhancing enclosure security could mitigate the risk of escapes. Dispersal from other countries presents an ongoing and challenging pathway to manage. The potential transmission of diseases to other species, exemplified by cases such as the grey squirrel, represents a significant yet often overlooked impact of alien species.

Eradication of the black rat from the Italian islands: evidence from 25 years of nature conservation projects

Dell'Agnello F.[1], Capizzi D. [2], Baccetti N.[3], Benocci A.[4], Carli E.[2], Copiz R.[2], Dapporto L.[5], De Santis M.[2], Frondoni R.[2], Giannini F.[6], Gotti C.[3], Lazzaro L.[5], Raganella E.[3], Sozio G.[2], Spano G.[7], Stasolla G.[3], Sposimo P.[2]

1. NEMO Nature Environment Management Operators Srl, Viale Mazzini 26, 50132, Firenze, Italy
2. Regione Lazio, Direzione Ambiente, via di Campo Romano 65, 00173 Roma, Italy
3. Istituto Superiore per la Protezione e la Ricerca Ambientale, Ozzano Emilia (BO), Italy
4. Museo di Storia Naturale dell'Accademia dei Fisiocritici, Piazzetta S. Gigli 2, 53100 Siena, Italy
5. University of Florence, via Madonna del Piano 6, 50019 Sesto Fiorentino (FI), Italy
6. Parco Nazionale Arcipelago Toscano, Località Enfola 16, 57037, Portoferraio (LI), Italy
7. Area Marina Protetta Tavolara Punta Coda Cavallo, Via S. Giovanni 14, 07026 Olbia, Italy

The Black rat, included by the IUCN in the list of the 100 most harmful invasive species in the world, has a deleterious impact on ecosystems, human activities and public health. In island ecosystems, the impact of rats on breeding seabirds, on flora and vegetation and on many other taxa (such as invertebrates, reptiles, passerines and other land birds, bats, etc.), as well as on the overall ecosystem, has been widely documented worldwide and has also been confirmed in the Mediterranean and Italian small islands. This is why, over the last 25 years, several nature conservation projects have been implemented, which, through IAS eradication actions financed mainly under the European Union's LIFE programme, have contributed to the restoration of island ecosystems (particularly vulnerable biodiversity hot-spots) and to the protection of threatened native species.

By reviewing all the research and monitoring activities that have accompanied these projects, we intend to highlight first of all the benefits achieved over time for the main conservation target species (mainly Procellariformes seabirds) and for other, much less studied groups such as invertebrates, mammals and vegetation affected by the presence of the black rat. In comparison with the benefits, the negative impacts found on non-target species and the so-called *surprise-effects* recorded on some islands will also be discussed.

Here we present: an updated review of the average increase in the reproductive success of Scopoli's Shearwater and Yelkouan Shearwater on all the islands subjected to interventions, with a consequent increase in the number of young that have fledged and in the population size; on the island of Montecristo, the appearance of 3 new species of non-migratory butterflies (*Celastrina argiolus, Gonepteryx cleopatra, Lycaena phlaeas*) and the reappearance of *Pararge aegeria* after 40 years since the last report; the post-eradication discovery of a new species of snail *Weltersia obscura* that had never been described before; the increase in populations of geckos and endemic subspecies of lizards (*Podarcis* spp.); on the Pontine islands, only one year after eradication, significant increases in terms of richness and specific diversity of invertebrates and vegetation were observed. Finally, although not an autochthonous species, we report the population explosion of the Etruscan shrew (*Suncus etruscus*) in Pianosa, Tavolara and the Tremiti Islands. With regard to possible negative impacts, we report the direct or secondary intoxications suffered by some individuals of non-target species such as goats, rabbits, seagulls and owls, and the *surprise-effects* that occurred on islands where other allochthonous species were present: in particular, there was an increase in the population of the House mouse (*Mus domesticus*) on Ventotene and Pianosa.

This review shows that, thanks to the numerous projects undertaken across the country to restore island ecosystems and mitigate the impact of the black rat on native species, considerable benefits have been achieved for the conservation status of target and non-target species and communities, relative to the limited and circumscribed negative impacts recorded over time. But as monitoring of eradication results is still sporadic and limited, the positive impacts of eradication are likely to be greater than reported here. Our results therefore highlight the importance of eradicating invasive mammals on islands to protect the world's most threatened fauna.

LETSGOGIGLIO: the first successful ungulate eradication story in Italy

Nicoloso S.[1], Giannini F.[2], Gaggioli A.[1], Sammuri G.[2]

1. DREAm Italia, Via Enrico Bindi 14 51100 Pistoia (PT) Italy
2. Parco Nazionale Arcipelago Toscano, Loc. Enfola n. 16 57037 Portoferraio (LI) Italy

The ungulates' occurrence on the Mediterranean islands can be traced back to the historical period when humans made the transition from hunter-gatherer to breeder-farmer status. Among the innovative development processes carried out by humans during that period were also the first domestications; the European mouflon comes from at least a partial domestication phase, supporting its inclusion in the species *Ovis aries*. In the 7th to 6th millennium b.C, the mouflon was introduced to Corsica and Sardinia and from there, mainly from Sardinia, it was carried to smaller islands, to the Italian Apennines and Alps, but also to many other European areas (Germany, Austria, ex Czechoslovakia) and beyond, such as the Hawaiian Islands. This species is considered one of the most damaging to the insular communities, delicate ecosystems evolved in the absence of large herbivores, and for this reason not capable of sustaining the impact derived by overgrazing (especially on endemic species), trampling, soil compaction and structure modification with consequent increased erosion, as well as the potential intrusion of pathogens caused by bark removal for feeding purposes. On Giglio Island, the mouflon has been present since 1955, when a few individuals from a hunting reserve were released in a fenced-in structure. Soon, as maintenance was abandoned, the fences came down and the animals spread outside the origin area.

Since 2009 the Arcipelago Toscano National Park activated a control plan for the species through shooting, and in 2021, with the LIFE LETSGOGIGLIO project, the operative protocol aims to the eradication of the species from the entire island territory using, in addition to the existing methods, capture techniques (drop nets, snare, corral trap, Up-Net) and drive hunting with tracking dogs.

During the period between 2009 and 2020, 97 mouflons were removed as part of the control plan, with a median of 6.5 animals per year. During the first months of 2021, 6 radio-collars were fixed to the 6 Judas animals as part of the application of the Let's Go Giglio Operational Protocol, Judas animals turned out to be crucial in understanding the population behaviour. In early 2024 the operations allowed the translocation of 54 animals (25 females, 29 males) and the culling of 57 animals (30 females, 27 males), resulting in a total of 120 animals removed form the island in only 3 years of Life Let's Go Giglio project (6 females and 3 males died of natural and other causes throughout the project). All the translocated animals were sterilised and placed in closed structures to avoid the formation of new nuclei of the species on national territory.

Heavy social pressures that occurred during the first culling activities made necessary a recalibration of the project, reducing culling activities in favour of trapping and translocation. These contrasting actions, which resulted in real activist protests, led to a protracted timeline and increased costs to achieve the objectives. Despite strong enforcement actions, which also led to inevitable project interruptions, the actions continued in total adherence to the protocol and applicable laws. The use of combined techniques made possible the evaluation of different efficiency levels in order to use this knowledge in other similar contexts.

Masked intruders: monitoring and trapping raccoons (*Procyon lotor*) in Foreste Casentinesi National Park

Bianchi G.[1], Bonini R.[1], Franco A.[2], Cappai N.[3]

1. G.E.A. - Gestione, Educazione e Ambiente Società Cooperativa, Bibbiena (AR), Italy
2. Università degli Studi di Milano, La Statale, Milano (MI)
3. Parco Nazionale delle Foreste Casentinesi, Monte Falterona e Campigna, Pratovecchio Stia (AR), Italy

In the Foreste Casentinesi National Park, the presence of the raccoon (*Procyon lotor*) emerged for the first time in 2013. In accordance with European Regulation 1143/2014, actions have been implemented to manage this invasive alien species. Since 2021, following the detection of some individuals positive for *Baylisascaris procyonis* (nematode parasite) in the territories surrounding the protected area, monitoring and capture operations of the species have been intensified.
Since 2016 the National Park (PNFC) drafted and applied an eradication plan based on monitoring with camera trapping and capture and removal of raccoons. From September 2021 to December 2023 the PNFC has entrusted the operations to a professional company (Cooperativa G.E.A.), guaranteeing a monitoring and sampling effort according to the National Plan guidelines. The sampling scheme was based on the ecology of the species and was implemented as follows: camera traps were in the field for at least 30 days, active from 18 p.m. to 9 a.m., 60 seconds video, strategically positioned across the main waterways, in cells 2.5 x 2.5 km. We monitored with camera trapping in September 2021, April 2022 and April 2023; the capture effort was refined based on the results of such monitoring and using sightings collected by citizens. The trap model was Tomahawk 608.2SS-Pro Series-Flush Mount, a specific trap for raccoon/feral cats. The traps were raised from the ground with metal legs to make them selective and avoid the entry of other animals such as badgers and porcupines, and also to prevent the cages themselves from being subject to periodic increases in the level of the streams. During the trapping sessions, the traps were activated at sunset and checked at dawn every day.
Regarding camera trapping, in 2021-2022 the presence of raccoon was found in 9.99% of videos; in 2023, however, the percentage was 2.6%, in line with the evolution and goals of the eradication project. Bycatches were sporadic and in 2023 involved only 4 domestic cats, two martens and one fox. Attendance at trap sites also involved badgers and porcupines to a considerable extent, but they never attempted to enter the traps, demonstrating the actual selectivity of the traps used and the methods applied. The eradication program led to the capture of N= 27 individuals between September 2021 and December 2023, with a capture effort of 1512 trap-night. Sex ratio, age classes and monitoring effort were counted. Capture success strongly decreased with years: we captured 19 individuals, 12 adults and 4 young, in 2021/2022 and 8 individuals in 2023, of which 3 females and 5 males. Maximum capture success was in summer and spring, minimum in autumn (in winter the catches were interrupted).
The control of an invasive alien species, aims at minimizing harm to biodiversity and averting health issues for both the human population and other species, demanding a comprehensive and multidisciplinary strategy. The EU Biodiversity Strategy 2030 includes a commitment to manage consolidated invasive alien species and to reduce by 50% the number of threatened species present in the Red List by 2030. Therefore, the conservation of ecological balances, the management of invasive alien species which often threaten and strongly interfere with these balances constitute a priority action, especially for a National Park.

Are we underestimating our parasites? The effect of *Strongyloides robustus* on the replacement of red squirrels by alien grey squirrels

Fesce E.[1], Romeo C.[2#], Santicchia F.[3], Wauters L.[3], Lurz P. W. W.[4], White A.[5], Ferrari N.[1]

1.Wildlife Health Laboratory (WHL), Department of Veterinary Medicine and Animal Sciences (DiVAS), Università degli Studi di Milano
2. Globe Institute – Center for Evolutionary Hologenomics, University of Copenhagen
3. Environment Analysis and Management Unit, Guido Tosi Research Group, Department of Theoretical and Applied Sciences, Università degli Studi dell'Insubria, via J. H. Dunant 3, 21100 Varese, Italy
4. The Royal (Dick) School of Veterinary Studies and the Roslin Institute, University of Edinburgh
5. Department of Mathematics, Heriot-Watt University and the Maxwell Institute for Mathematical Sciences, Edinburgh

Biological invasions, the introduction, establishment, and spread of species outside their native range, represent a global and increasing problem for biodiversity conservation and for human activities. The successful establishment of an alien species alters the existing ecological equilibrium, and the direct or indirect competition between alien and native species can impact on the latter, even causing their extinction. Furthermore, alien species can affect pathogen transmission between host populations, and disease-mediated competition can play a role in species replacement. In particular, highly pathogenic introduced parasites are considered to play a major role in disease mediated competition, increasing the probability of replacement of native species by alien ones.
In Europe, Great Britain, Ireland and Italy, native red squirrels (*Sciurus vulgaris*) are threatened by the introduction and spread of grey squirrels (*S. carolinensis*) mainly due to trophic competition. Furthermore, in Great Britain the presence of squirrelpox virus (a highly pathogenic pathogen) accelerates the replacement of red squirrels by grey squirrels. In Italy the squirrelpox virus is not present, but red and grey squirrels can both be infected by a gastrointestinal parasite, *Strongyloides robustus*, that was introduced with grey squirrels and has low pathogenicity. Little is known about the potential role of such pathogens with lower pathogenicity in disease-mediated invasions.
We analysed through mathematical modelling whether *S. robustus* could lead to the disease-mediated replacement of red squirrels by grey squirrels. We found that in the hypothetical condition of the sole presence of the parasite, this one can lead to a rapid exclusion of red squirrels even without any trophic competition between the two host species (in 14 years from the introduction of the infected grey squirrels). Similarly, direct competition alone between the two squirrel species, without the introduction of the parasite, can cause red squirrels to be excluded (in 13 years from the introduction of the uninfected grey squirrels). If we account for both mechanisms, trophic interspecific competition and parasite-mediated competition, operating together, we obtain the fastest exclusion of red squirrels, with the population going extinct in 10 years.
The present work shows that low pathogenic pathogens, like the nematode *S. robustus*, can drive the replacement of native species by alien ones. Moreover, since low pathogenic parasites are the vast majority of pathogens and are also widespread, these results suggest that disease-mediated competition might be more common than previously considered.

First multiple islands survey of *VKORC1* missense mutations in the Mediterranean reveals widespread rodenticide resistance in house mice

Gallozzi F.[1,2], Attili L.[1,3], Colangelo P.[2,4], Giuliani D.[1], Sposimo P.[5], Dell'agnello F.[5], Capizzi D.[6], Lorenzini R.[3], Solano E.[2], Castiglia R.[1,4]

1. Università degli studi di Roma "La Sapienza", Dipartimento di Biologia e Biotecnologie "Charles Darwin", via Borelli 50, 00188, Rome, Italy
2. National Research Council, Research Institute on Terrestrial Ecosystems, via Salaria km 29.300, 00015, Montelibretti (Rome), Italy
3. Istituto Zooprofilattico Sperimentale del Lazio e della Toscana "M. Aleandri", Centro di Referenza Nazionale per la Medicina Forense Veterinaria, Grosseto, Italy
4. National Biodiversity Future Center, 90133 Palermo, Italy
5. Nature and Environment Management Operators Srl (NEMO), piazza Massimo D'Azeglio 11, 50121 Florence, Italy
6. Latium Region, Directorate Environment, via di Campo Romano 65, 00173 Rome, Italy

The Mediterranean basin is one of the oldest continuously inhabited areas in the world as well as a very important biodiversity hotspot. Due to intense anthropic activity, human commensal rodents are a constant presence on the Mediterranean islands causing damage to native biodiversity. To protect native wildlife, more than one hundred rodent eradications have been attempted until now by using anticoagulant rodenticides (ARs). Despite their high efficiency, resistance to ARs has been observed in many countries and it is mostly related to missense mutations (SNPs) in the VKORC1 gene. The presence of resistant individuals reduces the efficiency of rodent control and increase the risk of poisoning in non-target species. In this study, we performed the first survey of ARs resistance in the house mouse *Mus domesticus* in multiple human-inhabited island systems in the Mediterranean.

We collected 83 mice from the islands of Ventotene, Pantelleria, San Domino, San Nicola, Lipari, Vulcano, Panarea, Salina, Stromboli, Alicudi and Filicudi. All these islands are inhabited and have ARs. DNA was extracted from tissue samples and the VKORC1 gene was amplified through PCR. Sequences were aligned and visually checked for the presence of SNPs.

We found eight missense SNPs in seven of the eleven islands we sampled. Pantelleria is the island with the highest frequency and variety of SNPs with five different mutations (Tyr139Cys, Ser149Ile, Gln151His, Gln155Lys, Lys157Asn). Three missense SNPs were found in Ventotene Island (Tyr139Cys, Ser149Asn, Gln155Lys). We found Tyr139Cys also in San Domino Island and Gln155Lys both in San Domino and in the neighbouring island of San Nicola. We found three missense mutations in the Aeolian Archipelago, which are: Arg61Gln in Salina and Lipari, Tyr139Cys in Lipari and Val114Phe in Alicudi. Mice from Filicudi, Stromboli, Vulcano and Panarea all showed wild type sequences.

Tyr139Cys, Ser149Ile, Ser149Asn and Glu155Lys have already been detected in rodents in previous studies, while Arg61Gln, Val114Phe, Gln151His and Lys157Asn are newly described ones. Specifically, Tyr139Cys is known to confer resistance to different ARs also in heterozygous condition and it was already found in Ventotene with an allelic frequency of 2.6% in 2019. We found the same SNP at a significantly higher frequency (17.9%) after a 4-year long ARs-mediated rat eradication. This could be due to the selective pressure of ARs that allowed the mice carrying the mutation to survive. Resistance to ARs is a crucial issue that must be carefully addressed before undertaking rodent eradications. Having knowledge about the presence of resistant rodents on islands would be a powerful tool for control/eradication planning, maximizing success rate and allowing an informed decision of the most effective AR to use, also considering the use of more potent anticoagulants (e.g. brodifacoum, flocoumafen) but, in the current state of knowledge, substantially out of the range of resistance. Such practices would also minimize secondary poisoning and other deleterious effects for non-target species and the environment.

PRESENTAZIONI ORALI

(SESSIONE MAMMIFERI IN CITTÀ: UNA CONVIVENZA POSSIBILE?)

The Urban Wildlife Information Network: Building a Global Alliance For Coordinated Urban Wildlife Research

Magle S.[1]

1. Wildlife Institute, Lincoln Park Zoo, Chicago, Illinois

Most of the world's population now live in cities, and interest in understanding nature and wildlife in urban areas is growing rapidly. However, nearly all urban wildlife research takes place in a single city, usually on a single species, and each study uses its own unique methods and protocols, making comparisons between studies impossible. As such, while local knowledge is growing rapidly, in many ways we are no closer to a universal understanding of the phenomenon of wildlife in cities, or how to manage and, in some cases, conserve these species. To better understand variation in urban biodiversity both within and among cities, the Urban Wildlife Information Network (UWIN) was formed in 2017. Since then, what was initially a multi-city camera trap network in the midwestern United States has expanded in multiple dimensions, from deploying autonomous recording units for passive sampling of urban birds to advancing understanding of human-wildlife interactions and how to manage them within and among cities. The network now has more than 60 partners in 6 countries around the world. I will share the motivation behind creating this network, the structure of UWIN, and the benefits of partnership. A few recent manuscripts resulting from UWIN will be very briefly reviewed, including manuscripts evaluating the effects of factors such as climate change, wealth, and gentrification on urban mammals. I will conclude by outlining future directions for UWIN including (I hope) a partnership with several Italian cities.

What you see is not what you get: extinctions and extinction debt in urban mammals

Ancillotto L.[1,2], Mori E.[1,2]

1. Consiglio Nazionale Delle Ricerche, Istituto Di Ricerca Sugli Ecosistemi Terrestri, Via Madonna del Piano 10, 50019 Sesto Fiorentino, Firenze, Italy.
2. National Biodiversity Future Center, 90133 Palermo, Italy.

Many wild species thrive in urban environments, with increasing amounts of scientific literature focusing on the ecological processes that shape urban wildlife, such as the so-called urban filter. Besides few clear patterns in species dynamics in cities, most literature on the topic focuses on few taxonomic groups, leaving huge gaps in our ability to understand, and possibly overcome, extinction processes in cities. Most papers on urban wildlife focus on birds, invertebrates and carnivores, with few studies following multi-taxa approaches. Here we use the cities of Rome and Florence, and their mammalian faunas, as a model system to define patterns of local extinction and persistence within large urban areas, testing the hypothesis that past spatial spread and association to different habitats may drive the fate of species at local level. Moreover, we test whether land use composition and its changes in time affected mammal diversity and species' occurrence within the study area i.e., whether urban mammal assemblages suffer from extinction debt.

We conducted a systematic search and collection of mammal records from Rome and Florence (central Italy), including all records from either scientific or grey literature, as well as those from museums and citizen science platforms (iNaturalist.org and Facebook groups). We then organized data into checklists, corresponding to the three main periods describing the urban development history of each city. For each recorded species, we calculated indicators of spatiotemporal persistence in each area, and we assigned each taxon to a favoured habitat type. We then used linear modelling to assess the probability of extinction as a function of ecological preferences and historical species' local spread (for Rome), as well as the probability of current occurrence as a response to past and present land cover composition (for Florence).

We retrieved 6342 and 1297 records of mammals from Rome and Florence, respectively, spanning from 1832 and 1896 to 2023, and belonging to 63 species. In both cities, several species have locally disappeared in the last two centuries, with examples from most taxonomic groups. Trends of spatial spread through time were consistent across orders, with few exceptions related to Chiroptera and Rodents. Species associated with wetlands and less widespread showed significantly higher probability of extinction. Species richness and single-species modelling revealed stronger associations between mammals and past land cover composition, suggesting that extinction debt is heavily affecting urban mammal assemblages.

The species' turnover and the subtle relationships with land cover we detected suggest that time-series analyses are essential to reveal how trait-based filtering of species in cities may occur at different temporal scales. Our long-term analyses also revealed a complex variety of relationships between land use dynamics and species' occurrence in the urban landscape. We highlight that current richness at urban sites is largely due to the lag between habitat loss and species' responses, indicating that many species actually represent sorts of "living dead" populations that will be lost if no action is taken to re-establish profitable habitat. Taken together, our results advance our understanding of species' dynamics – a key asset for wildlife conservation in the Anthropocene – and may foster the development of more wildlife-friendly and sustainable cities in the future.

Camera-traps and the city: behavioural ecology of wild mammals in urban areas

Mori E.[1,2], Maggioni M.[2,3,4], Guerri G.[5], Morabito M.[5], Viviano A.[1], Martini S.[1], Dondina O.[6], Lazzeri L.[7], Monti F.[8], Sogliani D.[9], Scarfò M.[10], Zaccaroni M.[4], Ancillotto L.[1,2]

1. Consiglio Nazionale Delle Ricerche, Istituto Di Ricerca Sugli Ecosistemi Terrestri, Via Madonna del Piano 10, 50019 Sesto Fiorentino, Firenze, Italy.
2. National Biodiversity Future Center, 90133 Palermo, Italy.
3. Dipartimento di Scienze della Terra e del Mare, Università di Palermo, Via Archirafi 22, 90123 Palermo, Italy.
4. Dipartimento di Biologia, Università degli Studi di Firenze, Via Madonna del Piano 6, 50019 Sesto Fiorentino (Firenze), Italy.
5. Istituto per la BioEconomia (IBE), Consiglio Nazionale delle Ricerche, Via Madonna del Piano 10, 50019, Sesto Fiorentino (Firenze), Italy.
6. Università degli Studi di Milano Bicocca, Department of Earth and Environmental Sciences, Piazza della Scienza 1, 20126 Milan, Italy.
7. Dipartimento di Scienze della Vita, Università degli Studi di Siena, Via P.A. Mattioli 4, 53100 Siena, Italy.
8. Istituto di Ricerca sugli Ecosistemi Terrestri IRET, Consiglio Nazionale delle Ricerche, Campus Ecotekne, 73100 Lecce, Italy.
9. Department of Biology and Biotechnology, University of Pavia, Via A. Ferrata 9, 27100 Pavia, Italy.
10. Department of Life Sciences and Systems Biology, Via Accademia Albertina 13, 10123 Turin, Italy.

Assessing the spatiotemporal overlap amongst animal species living in sympatry helps to shed light on mechanisms of interspecific coexistence. This is particularly evident in urban areas, where human pressure is the highest, and animals may develop and adopt spatiotemporal strategies to face new threats. We assessed the spatiotemporal coexistence of mammals in an urban area of Central Italy (Florence) through camera trapping.

A total of 35 camera trap stations were opportunistically identified as georeferenced locations since April 2023; camera traps were deployed in several types of urban green spaces (reforestations, recreational parks, riparian habitats) and control non-urban sites. Stations were separated from one-another by at least 800 m to limit the risk of pseudo-replications. Cameras were placed at a height of ~30–50 cm from the ground level and were activated 24 h/day to take 1 video/event. Cameras were checked once every 10 days to download data and replace batteries. Camera traps were kept active at each site for ~60 days. Temporal activity patterns and their interspecific overlap were estimated for wild predators (wolves, red foxes, badgers and stone martens), ungulates (roe deer, fallow and wild boar), small-sized mammals (European brown hares, Eastern cottontails, coypus, crested porcupines, Eurasian red squirrels, black rats, Norway rats and Western hedgehogs), domestic species (dogs, cats and rabbits) and humans.

We recorded different behaviors in urban areas, with most species increasing their nocturnal activities with respect to literature data and other extra-urban camera-traps in the surrounding natural areas. A significant nocturnal temporal overlap (Rayleigh tests, $p < 0.05$) was detected between the predators and almost all the prey species (59–93%). The highest temporal (91%) overlaps were reported between the European badger and the crested porcupine. For wolf-ungulate pairs, the highest temporal overlap (79%) was reported for the wild boar, its main prey. We did not observe moon phase effects on species usually showing moonlight avoidance in natural sites, possibly as an adaptation to artificial lights.

Our findings support a significant role of interspecific temporal partitioning in shaping coexistence amongst wildlife, humans and domestic species, whose differences might also be influenced by the spatial distribution of different food resources.

Small-mammals community analysis to guide green areas implementation and management in functional urban ecosystems

Dondina O.[1,2], Orioli V. [1,2], Tirozzi P. [1,2], Bani L. [1,2], Viviano A.[3]

[1] Department of Earth and Environmental Sciences, University of Milano-Bicocca, Piazza della Scienza 1, 20126 Milan, Italy
[2] NBFC, National Biodiversity Future Center, Palermo 90133, Italy
[3] Istituto di Ricerca sugli Ecosistemi Terrestri IRET, National Research Council, Via Madonna del Piano 10, 50019 Sesto Fiorentino, Italy

Diversified small mammal communities provide multiple ecosystem services making pivotal their conservation both in natural and urban ecosystems. Moreover, small mammals are effective indicators of environmental quality/functionality representing excellent candidates for driving biodiversity-friendly management guidelines. The aim of this study was to analyze the effect of urbanization on small mammal communities to provide guidelines to move toward functional urban ecosystems.

To reach this aim, we placed 436 hair-tubes within 52 1km^2-cells along a green areas' fragmentation gradient in three Italian cities: Milan, Florence, and Rome. Hair-tubes were placed both on the ground and on tree branches and were checked five times between June and November 2023. Sampled hairs were analyzed under a microscope for species identification. We used multivariate linear models to analyze the effect on the number of species detected in each sampling cell of: (i) the distance from the city center, (ii) the size of the green areas intersected by the cell (Area) and (iii) their degree of fragmentation (Aggregation index). Analyses were performed on the number of synanthropic and wild (i.e., non-synanthropic) species separately. We also investigated a possible nested pattern of the analyzed communities using the NODF metric separately considering each city.

Overall, we detected 14 species (Milan: 10, Florence: 10, Rome: 8), one of which listed in Annex IV of the Habitats Directive. The number of synanthropic species in the sampling cells depended solely on whether they host low-fragmented green areas. In contrast, the number of wild species was positively affected by the distance from the city center and negatively by the size of the green areas intersected by the sampling cells. The nestedness analyses showed that in none of the sampled cities the small mammal community was significantly structured according to a nested pattern. Results from linear models suggested that synanthropic species select green areas with regular shapes (high Aggregation index) regardless of their distance from the city center. These areas are probably large urban/peri-urban parks that are generally characterized by low-natural habitats and abundant anthropogenic food resources and refuge sites. Conversely, wild species occupied small woodland patches away from the city centers. In these small areas, generally less managed and characterized by a higher degree of naturalness (such as abundant shrub layers, deadwood, etc.), wild species likely managed to maintain vital metapopulations through dispersal phenomena within an "archipelago" patch system.

The small mammal communities' composition seems to result from spatial segregation between wild and synanthropic species driven by habitat selection and/or competitive interactions. This evidence is reinforced by the absence of a nested pattern in the investigated communities, suggesting a limited role of selective extinction and colonization mechanisms in structuring communities, which are generally the processes occurring in natural contexts. All these findings suggest that to move towards functional urban ecosystems, Nature-Based Solutions should be implemented in the form of small unmanaged woodland patches scattered along a trajectory from peri-urban areas to city centers. Furthermore, creating small semi-natural unmanaged areas within large urban/peri-urban parks through restoration actions could bring back wild species to areas that are currently largely inaccessible to them.

From caves to town: Schreibers' bent-winged bat *Miniopterus schreibersii* in urban ecosystems

Scaravelli D.[1,2] Festa F.[3,4], Leopardi S. [3], De Benedictis P. [3]

1. Dep. Biological, Geological, and Environmental Sciences, University of Bologna. Email: dino.scaravelli@unibo.it
2. Museo Ornitologico di Forlì, via Pedriali 12, 47121 Forlì
3. National Reference Centre for Rabies, Istituto Zooprofilattico Sperimentale delle Venezie, Legnaro, Italy.
4. Dep. of Biology and Biotechnologies "Charles Darwin", University of Rome "La Sapienza", Rome, Italy

The Schreibers' bent-winged bat *Miniopterus schreibersii* is a slender medium-sized bat that according to IUCN it's a Near threatened species, decreasing in some areas.
M. schreibersii is considered one of the species most typically related to the underground environment, where it mainly occupies large cavities to house its colonies with large numbers of reproducers. In general, it is precisely the cavities with large spaces and medium-high temperatures that host the species.
We have recently studied colonies which in the various phenological phases are found in urban areas, colonizing a castle, for the intermediate pre-reproductive phase and two buried rivers where they carry out both pre-birth and actual reproduction phases.
The study is also connected to the important role of vectors that the species can represent for viruses of zoonotic importance. In one of these colonies, located near the city of Arezzo, the presence of the West Caucasian Lyssavirus was identified**.**
Each site shows different use and timing characteristics, however shared by the presence of water under the aggregation points. The bat presences progressively increase up to several hundred individuals during springtime and only in one case do they remain for the births, while in the other two cases they leave for other yet unknown shelters. The sampling carried out shows a clear prevalence of females but males are still present, although in different percentages, in the various currencies in which the sampling was carried out. The introduction of individual marking techniques using pit tags has already allowed the confirmation of the presence of marked animals at different times of the season and in the following year, showing the full functionality of the method. Investigations into the potential vector role and phenology of the species in these specific areas continue.

Moving through the city: Space use of Eurasian red squirrels in urban and rural environments

Tranquillo C.[1], Bisi F.[1], Santicchia F.[1], Preatoni D.[1], Martinoli A.[1], Wauters L.A.[1,2]

[1]Environment Analysis and Management Unit, Guido Tosi Research Group, Department of Theoretical and Applied Sciences, Università degli Studi dell'Insubria, via J. H. Dunant 3, 21100 Varese, Italy
[2]Evolutionary Ecology Group, Department of Biology, University of Antwerp, Campus Drie Eiken Universiteitsplein 1, 2610 Wilrijk, Belgium

Natural ecosystems worldwide are being altered by the expansion of urban development, which causes an increase in habitat loss and fragmentation, ultimately impacting wildlife. Hence, challenges that characterize cities could affect phenotypic expression of species that persist in them, resulting in different responses displayed in urban areas compared to natural habitats. Behavior changes represent the first mechanism when a rapid human-induced environmental change occurs. Indeed, urban green areas structure, small patches in highly fragmented landscapes, is likely to alter the space use of individuals.

Urban green spaces seem to be relatively favorable for tree squirrels, which are usually present in city parks. Hence, we used the Eurasian red squirrel (*Sciurus vulgaris*) as a model species, investigating home-range and core-area sizes in two rural and two urban sites in Varese. Squirrels were fitted with an adjustable necklace VHF transmitter weighing less than 7g. Animal locations were recorded during autumn and winter for two consecutive years.

Differences in home-range size and core-area size between urban and rural sites suggest that urban landscapes, characterized by small patches, can shape squirrels' home-range size. This trend is potentially favored by barriers in the urban matrix and by the differences in the dominant tree species present in urban green spaces than in rural forests, which is likely to provide a higher energy intake in cities, resulting in smaller home ranges. Moreover, in both environments, we found bigger home range sizes in males than in females.

Understanding movement patterns of red squirrels within cities is important to detect the most used passages between available patches, providing instruments to produce indications for an urban planning that aims to conserve this species in cities. For example, identifying actions to reduce habitat fragmentation, finalized to decrease road kill mortality, which often negatively affects this species in cities. The present work is part of a larger spatial study on red squirrels, which also included intensive tracking sessions for all tagged individuals and the monitoring of some individuals fitted with GPS collars in a third urban area, to delve into the still poorly known aspects of wildlife space use and movements in cities.

Behavioural ecology and social perception of urban coypus

Viviano A.[1], De Meo I.[2], Burchielli A.[3], Sergiacomi C.[4], Paletto A.[5]

1. Consiglio Nazionale delle Ricerche, Istituto di Ricerca sugli Ecosistemi Terrestri, Sesto Fiorentino (Firenze), Italy
2. Consiglio per la ricerca in agricoltura e l'analisi dell'economia agraria (CREA), Research Centre for Agriculture and Environment, Firenze, Italy.
3. Department of Biology, University of Pisa, Pisa, Italy.
4. University of Florence, DAGRI, Florence, Italy.
5. Consiglio per la ricerca in agricoltura e l'analisi dell'economia agraria (CREA), Research Centre for Forestry and Wood, Trento, Italy.

The coypu (*Myocastor coypus*) is a rodent native to South America, which has been introduced to many countries as being valued for the fur industry, and subsequently, has become invasive after escaping captivity. The coypu population is rapidly growing in both rural and urban areas with deep impacts on newly colonized environments. Monitoring and management of coypu is a key issue in Europe since this species has been included in the EU Invasive Alien Species Regulation 1143/2014. The management of coypus in urban areas is crucial considering potential conflicts with human activities. The aim of this study is to investigate the time budget of coypus in an urban environment, as well as to assess citizens' knowledge, perceptions and opinions towards the presence and management of coypu in a case study area in Italy (Urban Park of Serravalle, Empoli municipality).
Time budget was evaluated through camera-trapping, carried out for one year in the surroundings of the pond located in the center of the Park. An online questionnaire was administered to a sample of citizens of the municipality (over 18 years old), to test for their attitude toward coypus.
Coypus were confirmed to be predominantly nocturnal (1407 videos), with a peak in early night (HR test, $p<0.01$) and an increased diurnality in cold months. Coypus spent most of their time foraging (25%), exploring the environment (23%), and swimming (21%), in all age classes recorded (adults, subadults and kits). The markedly nocturnal rhythms imply that the moments of greatest activity occur when the presence of humans and domestic dogs in the Park was the lowest (overlap < 50% with both species). Instead, a large overlap with the red fox *Vulpes vulpes* was found, although coypus can easily evade the predator by foraging near water and burrows providing an effective escaping route. The questionnaire was completed by 281 visitors of the park. The outcomes showed a high level of knowledge of respondents: 99.3% of total respondents had heard of coypu before this survey, while 93.9% were able to distinguish the coypu from the Eurasian beaver *Castor fiber*. The results also highlighted that the majority of respondents were happy to meet this species, or they were indifferent to its presence (38.7% and 34.1%, respectively). Most of the respondents were against the removal of coypus from the study area (44.6%), while those who were in favor of this form of population control were 28.9%.
In general, citizens preferred sterilization, with respect to capture and suppression. Results of this study could support managers in improving the effectiveness of management actions through an information program involving people living near the Park.

Spatial behaviour of golden jackal (*Canis aureus*) in relation to anthropogenic features: first insights with telemetry

Frangini L.[1], Bernicchi L.[1], Barca V.[1], Riva V.A.[1], Braghiroli S.[2], Molinari L.[3], Franchini M.[1], Madinelli A.[1], Pesaro S.[1], Ferfolja S.[1], Filacorda S.[1]

[1]Department of Agri-Food, Environmental and Animal Sciences, University of Udine, Via Sondrio 2/A, 33100 Udine, Italy;
[2]Regione Emilia-Romagna, Direzione Generale Agricoltura Caccia e Pesca;
[3]Wolf Apennine Center, Ente Parco Nazionale dell'Appennino Tosco-Emiliano

Understanding the spatial ecology and habitat requirements of a colonizing species is the main step to gain information on the species' behaviour which is useful to delineate adequate management and conservation strategies. The golden jackal (*Canis aureus*) has been showing a notable expansion in Europe over the last five decades and, in Italy, the highest population densities are reported in Friuli Venezia Giulia (hereafter, FVG) Region. Among the many factors which have been described as important for its expansion, ecological plasticity has been considered as crucial. Indeed, jackals can exploit even areas nearby human settlements where they may find anthropic food resources. Within this context, telemetry represents a useful tool to study selection of cryptic species such as jackals for areas closer to human settlements. Using the first telemetry data obtained from collared individuals in Italy, the goal of our study was to investigate the spatial ecology of the golden jackal, with special focus dedicated on habitat selection. Our results should provide better understanding on the ecology of a colonizing species in the light of its expansion within a highly anthropized environment, such as the Italian lowland.

Our study was conducted mainly in two distinct areas: the first represented by the FVG region, and the second one in central Italy by the Emilia-Romagna (ER). We fitted nine individuals (three females, six males) with satellite (GPS) collars in 2019-2023. Three individuals were defined as dispersers, since they moved from their pre-reproductive territories (> 20 km far away) toward new areas. Four jackals were live captured with Belisle snares or box traps, and the latest five were recovered by wildlife rescue centers. The GPS fix schedule was set to acquire 3-4 locations per day for jackals in northern Italy, meanwhile for jackals in ER we set to acquire GPS locations every two hours for the first two weeks after which we relaxed to a GPS location every six hours. We investigated the selection for anthropogenic areas (suburban areas, dumps, animal breeding settlements) with the hypothesis that jackals select for closer distances to anthropogenic features to exploit human-derived food. We used Resource Selection Function (RSF) comparing the Euclidean distance between GPS locations to anthropic areas to ten-time randomly generated locations within 95% Utilization Distributions (UDs) of each jackal. We calculated the 50% and 95% UDs using the Brownian Bridge Movement Model. All computations were performed through the Software R (v. 3.5) and using 'amt' and 'adehabitatHS' packages.

The monitoring periods for each individual were highly variable, from a minimum of 36 days to a maximum of 342 days. Overall, we obtained 4,065 locations. Three out of nine jackals died due to road collisions and poaching, two for unknown causes, three individuals were still alive when the collars ran down the battery, and in one individual the collar displayed a malfunction and stopped working. A high variability was shown in both the 50% and 95% UDs (mean = 4.90 km^2 for 50%; mean = 58.14 km^2 for 95% UD). The pattern of habitat selection by golden jackals significantly deviated from random at 95% UD ($p < 0.05$) for eight individuals out of nine. Considering distances from human settlements, some individuals (n = 3) showed avoidance for short distances, others (n = 3) showed a unimodal selection pattern with selection for distances nearby 500-600 m, while two individuals showed selection for close distances. The habitat selection analyses provided interesting results: jackals displayed different behaviours likely due to their environmental scenarios they lived in, as well as individual traits. Jackals monitored on the karst areas, characterized by large areas with natural elements where they could find shelter and trophic resources, seemed to avoid human settlements, likely because they were considered as risky areas. One individual living in the plain with intensive agricultural lands, but still with patches of natural elements where he could hide, showed selection for "intermediate" distances (600 m), likely as a result roaming in a highly human dominated landscape. The same pattern was shown by one individual monitored again in the karst, which may provide some insights on the "light" attraction for anthropogenic features. The most important results were displayed by two young individuals in the Padania plain, in areas with few or absent natural patches. Jackals are selected for close distances from anthropogenic features, likely because in a very poor environment in terms of naturalness, they are forced to exploit human resources. Despite our observations strengthen previous results highlighting the ecological plasticity of jackals, deeper analyses are needed investigating if day/night differences occur in the selection, as well as using more detailed maps accounting for different human activities (e.g., farms, aquacultures, etc.) and infrastructures (e.g., roads).

Insights into wolf activity rhythms in a gradient of human-dominated landscape

Brivio F.[1], Antonucci A.[2], Angelucci S.[2], Brogi R.[1], Apollonio M.[1]

[1] Department of Veterinary Medicine, University of Sassari, via Vienna 2, I-07100 Sassari, Italy
[2] Maiella National Park, Wildlife Research Center, Viale del Vivaio, 65023 Caramanico Terme, PE, Italy

The human impact on natural systems has become increasingly pronounced worldwide, particularly evident in large parts of Europe. Over recent decades, urbanization and agricultural intensification have coincided with the rewilding of rural areas, resulting in the recovery and growth of wildlife populations. Notably, the Grey wolf (*Canis lupus*) exemplifies this phenomenon by expanding into human-dominated landscapes at one of the fastest rates observed among wildlife species, getting into closer proximity to human activities. Understanding the behavioral responses of wolves to this proximity is crucial for their conservation and for effectively managing the possibly emerging conflicts with human activities.

Numerous studies have shown that wildlife cope with heightened human-induced threats (e.g., disturbance and mortality) experienced in newly colonized anthropogenic landscapes by temporally avoiding or minimizing direct contact with humans. Accordingly, we hypothesized that wolves would exhibit increased nocturnal activity when moving in human-dominated landscapes. To test this hypothesis, we analyzed a large dataset of activity and GPS-location data from 16 wolves (8 males and 8 females) monitored in the Majella National Park from June 2010 to August 2017. By integrating accelerometer data from collars with the average human footprint index – used as a proxy for urbanization- calculated within each wolf's monthly home range, we investigated circadian activity rhythms of pack members and floaters across a gradient of human footprint. While focusing on the impact of human presence, we controlled for other variables, such as weather conditions and individual characteristics, which could influence animal activity rhythms.

Our analysis revealed a significant influence of human footprint on the circadian activity rhythms of wolves. When moving in more anthropised areas, wolves were more active and concentrated almost all of their activity during the night, with a single peak around midnight. Conversely, in areas with lower human footprint levels, wolves exhibited two peaks of activity around dawn and dusk. Floaters displayed higher activity levels compared to pack members but exhibited similar circadian activity rhythms. Additionally, we observed that weather conditions affected wolf activity, with activity levels decreasing in both low and high temperatures and increasing with precipitation levels.

Our findings indicate wolves can modify their activity patterns to temporally avoid humans when in close proximity, exhibiting predominantly nocturnal behavior in human-dominated landscapes, while displaying bimodal crepuscular activity rhythms in more natural environments. These findings suggest that human temporal avoidance is a strategy adopted by this species to expand and persist in human dominated landscapes. As shown for other urban-adapter species (e.g., the wild boar), behavioral flexibility emerges as a critical feature enabling wildlife to thrive and persist in human-dominated landscapes.

Losing fear of humans may increase diurnality in human-habituated bears?

Grignolio S.[1], Latini R.[2], Ciucci P.[3], Tosoni E.[2], Gentile D.[2], Scillitani L.[2], Bertolucci C. [1], Brivio F.[4]

[1] Dipartimento di Scienze della Vita e Biotecnologie, Università di Ferrara
[2] Parco Nazionale d'Abruzzo Lazio e Molise
[3] Dipartimento di Biologia Animale, Università La Sapienza – Roma
[4] Dipartimetno di Medicina Veterinaria, Università di Sassari

Animal responses to environmental resource availability or stressors are not homogeneous within a population but may vary individually in one or more behavioural traits. The Apennine brown bear (*Ursus arctos marsicanus*) is a critically endangered subspecies. A few human-habituated or food-conditioned bears (HHB) recurrently use areas in proximity and inside the villages, exacerbating the conflict at the local scale. The occurrence of HHBs provides the opportunity to study how losing fear towards humans may reflect changes/adaptation in other key behavioural traits. Our main goal was to ascertain whether human-habituated bears (HHBs) exhibited different activity rhythm patterns with respect to non-human-habituated bears (NHHBs), with the ultimate aim of enhancing the efficacy of management and conservation measures.

This study was conducted in an area encompassing approximately 2500 km^2, including in and surrounding the Abruzzo, Lazio, and Molise National Park (Italy). We analysed accelerometer data collected from 2009 to 2021 from collars worn by 9 bears (6 females and 3 males, 5 HHBs and 4 NHHBs). We identified environmental and anthropogenic variables influencing bear activity to control for their effects when assessing differences between HHBs and NHHBs. We also investigated whether HHBs targeted by aversive conditioning treatments modified their activity rhythms by comparing data from the 24 hours before and after such events. We restricted our analyses to the active period of the bears, avoiding the hibernating period. To maintain homogeneity in the analysis year by year and among the individuals, we fixed this period from April to October. We used Generalised Additive Models (GAMs) to investigate the effect of the explanatory variables on activity rhythms.

We observed similar activity patterns in HHBs and NHHBs throughout the April-October period, characterized by bimodal peaks around sunrise and sunset. However, HHBs exhibited higher activity during midday compared to NHHBs. Furthermore, HHBs showed more pronounced activity peaks during daylight hours, with a delayed morning peak and an advanced evening peak compared to NHHBs. Interestingly, the degree of human presence due to tourism did not appear to significantly affect bear activity, as no discernible differences were observed across days with varying levels of tourism, irrespective of bear group. Additionally, HHBs did not show a modification of activity rate on the day after a conditioning treatment.

Our findings suggest that bears inhabiting different degrees of human occurrence contexts show distinct activity patterns. Bears that have lost fear and increased their confidence towards humans further enhance their ability to exploit possibly more rewarding resources by increasing their diurnality and likely by taking advantage of vision to enhance foraging efficiency. Deterrence events did not cause a change in activity, highlighting that preventing access to anthropogenic resources is the most effective way to discourage HHBs and prevent exacerbation of the problem.

Two drones to rule them all: using drones for effective stray dog populations monitoring in urban environments in Puerto Deseado, Argentina

Padulosi E.[1,2], Scaravelli D.[2,3], De San Pedro M. E.[4,5], Pastrana S.[4,5], Diaz F.[4,6], Procopio D.E.[4,7,8]

1. BIOME Lab, Department of Biological, Geological and Environmental Sciences, Alma Mater Studiorum, University of Bologna, via Irnerio 42, 40126 Bologna, Italy
2. Museo Ornitologico Foschi, via Pedriali 12, Forlì, Italy
3. Department of Biological, Geological and Environmental Sciences, Alma Mater Studiorum University of Bologna, via Selmi 3, 40126 Bologna Italy
4. Universidad Nacional de la Patagonia Austral (UNPA), Santa Cruz, Argentina (UNPA)
5. Instituto de Tecnologías Aplicadas, Unidad Académica Caleta Olivia (UACO), Santa Cruz, Argentina
6. Programa de Sistemas y Tecnologías de Información (PAM-UACO)
7. Instituto de Ciencias del Ambiente, Sustentabilidad y Recursos Naturales (ICASUR-(UNPA-UACO))
8. Centro de Investigaciones Puerto Deseado (UNPA-UACO)

Domestic animals can have negative consequences for biodiversity and present specific challenges for conservation. Globally, dogs are among the most invasive species due to their adaptable behavior and broad ecological niche. Their interactions with wildlife are various including predation, disease transmission, competition and hybridization. In South America, especially in Argentina, where dog ownership is widespread, the impact on wildlife is significant, requiring methods for effective population monitoring to implement the right control measures. This study was conducted in Puerto Deseado, a city located in the Santa Cruz province, characterized by a rich animal biodiversity due to its coastal and estuarine ecosystems. Recently, the population of dogs has increased due to rapid urbanization in the area which has worsened the conflicts with native animal species. This study provides a methodical strategy for monitoring the number of stray dogs in the city using drones.

Between March 30 and April 18, 2023, 106 flights with a total of 16 hours of flight, were done in the city using two low-cost drones, a DJI Mavic 2 Pro a DJI Mini 2. The flights were conducted manually with an altitude of 40 meters to optimize coverage of road networks while following the local privacy regulations. Concurrent ground surveys, conducted at 5 km/h speeds using the Cybertracker application, served to validate aerial observations and enhance data accuracy.

In addition to addressing the number and condition of dogs, the methodology focuses on the effective utilization of drones in urban environments. The quality of the results primarily depends on following specific protocols. Using printed maps during a car or foot transect, a preflight evaluation is first required to identify potential obstacles (people, birds, cables, and antennae) to avoid during the flights. Secondly, choose between automated and manual flight techniques based on the obstacles found in the city. To maintain better control of the aircraft, manual flight may be quite helpful when flying over moving objects or in the presence of birds. Another step in ensuring drone operations is to secure the required permissions and examine local aviation laws in advance by visiting the appropriate sites. To guarantee the safety of flights, check the weather every day (wind speed, quantity of satellites). Important is combining aerial observations with ground-based methods to enhance overall data accuracy and reliability. Then, promoting the use of drones to local authorities, to gather support, can help with effective management strategies.

Integrating drones' view in the analysis of urban areas as in Puerto Deseado, despite challenges obstructive elements like trees and rooftops, provided insights into dog populations that, when coupled with ground-based techniques, can increase data collection efforts. This approach can promote informed decision-making and intervention strategies aimed at the coexistence between urban communities and wildlife.

POSTER

Demography of *Muscardinus avellanarius* in an alpine environment

Angotti A.[1], Bellè A.[1,2], Melcore I.[3], Bertolino S.[1]

1. Department of Life Sciences and Systems Biology (DBIOS), University of Turin, via Accademia Albertina 13, 10123 Turin, Italy
2. Institute for Alpine Environment, Eurac Research, Drususallee/Viale Druso 1, I-39100 Bolzano/Bozen, Italy
3. Department of Theoretical and Applied Sciences, University of Insubria, Via J.H. Dunant 3, 21100 Varese, Italy.

The hazel dormouse (*Muscardinus avellanarius*) is considered a lowland species, although it has been occasionally observed in mountain habitats up to 2,000 m altitude. In 2019, we started a long-term monitoring project to investigate the ecology and adaptations of the hazel dormouse in an alpine environment, employing wooden nest boxes and a capture-mark-recapture approach. Here, we present the demographic data collected during these years.

The study was conducted in Valsavarenche (S) and Val di Rhêmes (R), two valleys within the Gran Paradiso National Park in the Western Italian Alps. In 2019, six nest box grids (three for each valley) were placed along an altitudinal gradient from 1,000 m to 2,000 m a.s.l. The vegetation of the grids was quite similar between paired areas at similar altitudes in the two valleys to obtain spatial replication: mixed deciduous forest (R1200 and S1492, where the number indicates the altitude), coniferous forest (R1870 and S1870) and a heterogeneous habitat with a mix of conifers, shrubs and alpine meadow (R1990 and S1982). Each grid was built to fit the irregular shape of the sites, typical of the mountain environment, and it consisted of about 40 nest boxes spaced approximately 50 m apart. The nest boxes (size 10x18x21 cm) were placed on trees at a height of 1.5 m, with the entrance hole (3.5 cm in diameter) pointing toward the trunk to reduce use by birds. For the first three years of the project, nest boxes were checked irregularly, while during 2022 and 2023, the inspections became more frequent, with sampling sessions approximately every 15 days from May to October. Animals found in nest boxes, excluding newborns, which were only counted and not handled, were placed into plastic bags, weighted, sexed, and marked with a unique PIT tag. Morphometric and reproductive data were also collected. Subsequently, the animals were promptly returned to the nest box to minimize disturbance.

Our observations of hazel dormouse populations during the sessions revealed significant trends. In R1990, the number of hazel dormice increased from 3 at the beginning of May to a peak of 11 at the beginning of August 2022. A similar pattern was observed in 2023, with a minimum of 2 individuals in June and a peak of 12 at the beginning of September. Overall, in R1990, we observed 24 different hazel dormice in 2022 and 33 in 2023. In S1982, the number of animals in nest boxes increased from 2 individuals in late May to a peak of 5 in late August and late September 2022. In 2023, animals entered the nest boxes in May, peaking with 6 animals in June and July. Overall, in S1982, we observed 18 different hazel dormice in 2022 and 10 in 2023. These two areas were the only ones where reproductive events were recorded. In R1990, there were 3 reproductive females with a total of 13 newborns in 2022 and 2 females with 10 newborns in 2023. In comparison, in S1982, we observed only one reproductive female each year, with 2 juveniles in 2022 and 3 in 2023.

The high-altitude areas we analyzed present unique characteristics that challenge the conventional understanding of suitable habitats for hazel dormice. For instance, R1990, the area with the highest density, is located at the upper edge of forest vegetation and is characterized by sparse tree density and shrub cover interspersed with alpine meadows. This unexpected preference for areas near and over the timberline in the Alps could be attributed to the abundance of berries and lower competition with other species, such as the garden dormouse (*Eliomys quercinus*). This novel insight into the habitat preference in high-altitude areas necessitates further research to fully understand the species' ecology in these extreme alpine environments. Such understanding is pivotal for conservation efforts, as it can help mitigate potential threats to the species in the Alps.

The final count-tool: results of wolf's monitoring after the first year of Life Imagine Project

Bassi E.[1], Piazzalunga S.[1], Convito L.[2], Vercillo F.[3], Lombardi G.[2], Chirichella R.[4], Apollonio M.[1]

1. Department of Veterinary Medicine, Via Vienna 2, University of Sassari, 07100, Sassari
2. Servizio Foreste, montagna, sistemi naturalistici e Faunistica-venatoria, Via Angeloni 61, 06124, Perugia
3. WildUmbira APS, 06026, Pietralunga, Perugia
4. Department of Humanities and Social Sciences, Via Roma 151, University of Sassari, 07100, Sassari

The action C10 ("Intervention for the conservation of wolf and bear") of the LIFE IMAGINE UMBRIA (LIFE19 IPE/IT/000015) project aimed to collect data about the status of the wolf population in Umbria Region, by means of different wolf's monitoring techniques. To do so, Umbria Region was divided in 7 different macroareas, and, starting from June 2022, those 7 areas will be monitored in turn for 5 years project, in order to return a complete imagine about both wolf number and distribution, and genetic status of the population. Having wolf very wide distribution range, monitoring has to be adjusted to the local environment, and the combination of indirect methods is the key to study this predator. In this scenario, researchers conducted the monitoring by means of video-trapping, genetic methods, and passive monitoring based on data collected by a network of trained volunteers.

During the first year (June 2022-June 2023), the monitoring focused on Trasimeno and Alto Tevere macroareas. For the sampling scheme, researchers overlapped a 5x5 km cells grid to the territory of the two macroareas and randomly selected 63 cells to perform the investigation, covering 50% of the total surface. In each cell camera trap was set preferably in wolf marking spots, in order to facilitate and allow individual recognition. Genetic investigations were carried out starting from videos recorded by camera trap; when suspected individuals (i.e. individuals with anomalous phenotype) were detected, researchers looked for genetic samples of the target pack.

With the 63 camera traps placed during the first year we collected a total of 59425 videos, of which 916 recording wolves, resulting in 21 packs and 7 lonely wolves. Based on the phenotypical characteristic of individuals recorded by camera trapping in the first two macroareas, we collected a total of 15 samples, 11 of which were suitable for genetic analysis, resulting in 5 different wolves, 5 different introgressed wolves and 1 hybrid.

The result collected seemed to be consistent with similar situation, as for example, the one found in the neighbouring Tuscany, where the Sassari University group have census wolves in the past years. Moreover, the experience of the first year of monitoring underline the importance of combining different monitoring techniques, especially the very useful tool represented by passive monitoring made by trained volunteers. Indeed, including local people and stakeholders not only made them feel like an important part of the story, which translates in a good attitude toward the project itself (which also could mean reduction in theft and in damaging of camera traps), but also allow to perform better monitoring thanks to their deep knowledge of the territory, which results both in finding suitable places for monitoring and in a much bigger number of camera traps in the field.

Comparing the efficacy of nest boxes and tracking tubes for monitoring the hazel dormouse (*Muscardinus avellanarius*): an occupancy-based approach

Bellè A.[1,2], Melcore I.[3], Bertolino S.[1]

1. Department of Life Sciences and Systems Biology (DBIOS), University of Turin, Via Accademia Albertina 13, 10123 Turin, Italy
2. Institute for Alpine Environment, Eurac Research, Drususallee/Viale Druso 1, I-39100 Bolzano/Bozen, Italy
3. Department of Theoretical and Applied Sciences, University of Insubria, Via J.H. Dunant 3, 21100 Varese, Italy

The hazel dormouse, *Muscardinus avellanarius,* is an arboreal rodent protected by the EU Habitats Directive (Annex IV). Various methodologies, including nest boxes, nest tubes and tracking tubes are employed to monitor the species, as with other members of the Gliridae family. However, it remains unclear which method is most effective in detecting its presence, making this a priority in terms of conservation efforts. The aim of this study was to compare the probability of detecting *M. avellanarius* using two sampling methods: nest boxes and tracking tubes using a standardised approach.
The study was conducted in Valsavarenche (S) and Val di Rhêmes (R) within Gran Paradiso National Park. Three study sites were selected for each valley, arranged along an altitudinal gradient in comparable habitats between the two valleys, ranging from 1000 m to 2000 m a.s.l. In 2019, approximately 40 nest boxes were installed per site, positioned on trees in a grid pattern. In 2022, tracking tubes were coupled to each nest box. From May until December 2022, biweekly checks were conducted to assess the presence of animals inside the nest boxes and to inspect footprints within the tracking tubes. Occurrence data for both sampling methods were compiled into a presence/absence matrix for the fifteen sessions and analysed using occupancy models implemented in the software Presence 2.13.47. To assess the effectiveness of nest boxes and tracking tubes in detecting *M. avellanarius*, we initially compared models incorporating constant occupancy (ψ) and detectability (p) for each site. Although this constant model may not perfectly represent the data, our objective was to compare the relative efficiency of different sampling protocols for detecting the species. Utilizing parameter estimates from more complex models, which account for detectability variations over time or incorporate habitat variables, could introduce unknown biases that might complicate comparisons. However, we subsequently explored more complex models to enhance the fit of the presence data.
When comparing the probability of detection (detectability) between the two methodologies, the tracking tubes performed always better: detectability (p±se) in nest boxes in Val di Rhêmes R1200 (the letter indicates the valley and the number the altitude) p=0.07±0.037, R1870 p=0.06±0.04, R1990 p=0.26±0.042 and for the tracking tube R1200 p=0.47±0.037, R1870 p=0.52±0.03, R1990 p= 0.63±0.034; nest boxes in Valsavarenche S1492 p=0.03±0.03, S1870 p=0.05±0.04, S1982 p=0.17±0.03 and for the tracking tube S1492 P=0.312±0.03, S1870 p=0.40±0.05, S1982 p= 0.48±0.03. The naïve occupancy estimates (i.e. the percentage of occupied sampling sites) derived from the nest box models were highest at the highest sites, with estimates of naïve ψ=0.18 for S1982 and naïve ψ=0.54 for R1990, compared to lower elevations where estimates were lower (S1492 naïve ψ=0.12, R1200 naïve ψ=0.18). The occupancy estimates obtained from the tracking tube method were consistently higher and peaked also at the high-altitude sites, with estimates of naïve ψ=0.67 for S1982 and naïve ψ=0.95 for R1990. The comparison between nest boxes and tracking tubes across six study areas at varying altitudes in the Alps reveals that the probability of detecting the presence of *M. avellanarius* using tracking tubes is considerably higher than that of nest boxes. However, nest boxes offer the advantage of allowing researchers to handle animals present inside, thereby facilitating the collection of valuable biological data. This finding should be considered in studies aiming to quickly detect the presence of the species without the need to gather abundance data or other information on animals.

Mortality of mammals in irrigation channels in Friuli Venezia Giulia (NE Italy)

Bernicchi L.[1], Frangini L.[1], Barca V.[1], Franchini M.[1], Riva V.[1], Madinelli A.[1], Filacorda S.[1]

1. Department of Agricultural, Food, Environmental and Animal Sciences, University of Udine, Udine, Italy

Irrigation channels are a priority linear infrastructure for society, but nevertheless they represent a great threat for wildlife. Like other types of linear infrastructure, such as roads and highways, irrigation canals result in habitat fragmentation, act as barriers to animal movement thus hindering the gene flow and are a cause of non-natural mortality due to accidental drownings. However, irrigation channels have received less attention than other linear infrastructures and their impacts, and very little is known about the dynamics that lead to wildlife drowning.

In Friuli Venezia Giulia (NE Italy) every year dozens of animals drown in the irrigation canals that run along the lowland, making these infrastructures one of the biggest causes of non-natural mortality in the region. The goals of this study are: (*i*) to assess whether there are differences in the number of accidental drownings per species; (*ii*) whether there are differences in the number of drownings among months of the year; (*iii*) whether the number of drowned animals in a given stretch of a canal is related to the percentage of 3 different land-use classes, i.e. natural elements, agricultural fields and urban areas. We retrieved records of drown wildlife from the web application InfoFauna FVG, collecting data from 2019 to 2023. To compare the differences, and check for the statistical significance, in drowning rates between species and months of the year we adopted a chi-squared test (χ^2). To answer the question (*iii*) we used a linear regression model, by using the number of drownings in each channel portions (enclosed between two water control units) as the response variable, and by calculating the percentage of the three land-use classes within a 500 m buffer around that portion of the canal.

Between 2019 and 2023, a total of 423 mammals were found drowned along the irrigation channels of Friuli Venezia Giulia. The most affected species was the roe deer (*Capreolus capreolus*) (χ^2 = 1210.6, df = 6, p-value < 0.01), which accounted for 306 drownings over a total of 423, followed by the wild boar (n = 65) and the red deer (n = 24). The months with the highest number of drownings were May (n = 140), April and June (n = 67) (χ^2 =475.24, df = 11, p-value < 0.01). Mortality peaks during the late spring - early summer months, with lows during winter months. The fitted linear regression model did not provide a meaningful variation of the variance in the number of drownings (R^2 = 0,1182; p > 0.05). Moreover, we found no significant variations in the number of drownings in relation to the percentage of the 3 land-use classes.

Mortality in irrigation channels may affect animal populations, especially in areas of high infrastructure density and high animal wildlife abundance. The incidence of drowning mortality in irrigation canals of Friuli Venezia Giulia is relatively high, averaging about 35 drownings per month every year. Most of the drowned wildlife recorded during the study period were roe deer. However, data for this work were collected within the lowland portion of Friuli Venezia Giulia, where roe deer is one of the most abundant species, especially near agricultural areas where irrigation canals are flowing. Moreover, mortality peaks were reached during the late spring and early summer months, when roe deer births occur and individuals. In this period roe deer are more active roaming through the territory and dispersing, thus increasing the probability of falling inside irrigation canals. Considering the linear regression model, the land-use variables selected do not significantly influence the number of drownings, and the fitted model does not offer a robust framework to forecast wildlife drownings in irrigation channels. Additional factors, such as landscape connectivity around irrigation channels, should be integrated in future analyses, to gain a better understanding of the factors contributing to the number of wildlife drownings and implement mitigation measures.

Assessment of animal biocenoses before and after forest harvesting using camera traps: preliminary study and results in the Lago di Vico nature reserve

Bertagni G.[1], Puddu G.[2], Manzo E.[3]

1. Independent researcher – Via degli olivi 33, 00171, Rome (RM), Italy
2. Regione Lazio – Riserva Naturale Lago di Vico 01032 Caprarola (VT), Italy
3. Fondazione Ethoikos, Convento dell'Osservanza s.n.c., 53030 Radicondoli (SI), Italy

Woodland harvesting proposes significant challenges to biodiversity conservation, especially in protected areas.
To understand the impacts on animal biocoenoses, this study aims to analyze changes in mammal communities before and after coppicing using camera-traps.
The study is on 38 hectares formed by a mixed coppice of turkey oak and chestnut.
Camera-traps were placed before the cutting site to document the presence, activity patterns and relative abundance of animal species. Four plots were selected, 2 where coppicing took place and 2 as control areas to see differences in the composition of animal biocoenosis before and after coppicing.
A comprehensive checklist identified 12 mammal species (4 small, 5 medium and 3 large). Two relative abundance indices (RAIs) were measured, one is related to the cutting areas (RAIs= 0.115), and one is related to control areas (RAIs=0.142), to observe how the abundance of mammal populations may change over time following coppice. Additionally, activity patterns were analyzed for each species, with most of the small and medium mammals exhibiting bimodal, crepuscular and nocturnal, activity. This suggests that coppicing could benefit species that are more active during the night or, at any rate, have reduced impacts on these species.
These preliminary findings provide insights into the pre-harvesting animal biocenoses and serve as baseline data for assessing the impacts of forest harvesting on animal communities in the Lago di Vico Natural protected area. The ongoing research will track changes in mammal community composition and activity during and post-harvesting. Our data will be useful for identifying potential strategies to mitigate the effects of forest cutting on animal biocenoses in the reserve.

The presence of wolves in the Abruzzo Lazio and Molise National Park: a protocol to test for human related threats

Lagger M.[1], Latini R.[2], Ursitti J.[2], Mugnari A.[2], Tosoni E.[2], Gentile E.[2], Martinoli A.[1], Bisi F.[1]

1. Environment Analysis and Management Unit, Guido Tosi Research Group, Department of Theoretical and Applied Sciences, Università degli Studi dell'Insubria, Via J.H. Dunant, 3, 21100 Varese, Italy
2. Parco Nazionale Abruzzo Lazio e Molise, Viale Santa Lucia, 2 - 67032 Pescasseroli (AQ). Italy

In Italy, the wolf (*Canis lupus*) underwent a significant decline in the 20th century until the 1970s. Subsequently, due to social and cultural changes, as well as a better legal protection, the species experienced a notable increase. Since 2022, the wolf has moved from the Vulnerable (VU) category to the Near Threatened (NT) category, as per the Red List of Italian Vertebrates (IUCN). In this context, protected areas play a pivotal role, aiming to preserve natural environments and promote the maintenance of ecological functionalities and dynamics. This research applied a monitoring protocol to analyze the probability of wolf presence in relation to anthropogenic disturbance within the Abruzzo Lazio and Molise National Park (PNALM).

The monitoring activity coincided with the winter season between December 2022 and April 2023. The presence and distribution of wolves, along with the phenomenon of hybridization, were monitored using two sampling methodologies: camera-trapping and snow-tracking. The latter aimed to detect indirect signs of the species and collect biological samples. Within the study area, 9 sampling cells (10x10 km^2) were identified, each containing two transects, and at least two camera traps were set. Data were analyzed to explore wolf, human, and ungulate activity patterns and calculate their presence probability using occupancy modeling. Collected biological samples (mainly droppings) were analyzed by the ISPRA's laboratory for wolf DNA.

The investigation allowed the compilation of a checklist of medium and large mammals, confirming the rich biodiversity of the Park. The calculation of circadian activity rhythms enabled the evaluation of wolf habits, revealing that periods of greater activity coincide with those of its prey, while being opposite to those of humans. The probability of presence (occupancy) using data obtained from camera traps and those derived from presence signs detected along the transects indicated that the wolf occupies a large portion of the Park (Ψ=0.86 ± 0.08). The analysis of ungulate occupancy, the potential prey of the wolf, showed a high probability of presence (*Capreolus capreolus* Ψ=0.74 ± 0.11; *Cervus elaphus* Ψ=0.71± 0.11; *Sus scrofa* Ψ=0.61± 0.11). Human occupancy is also high and similar to wolves (Ψ=0.86 ± 0.08), but with a higher detection probability. The presence of domestic dogs has been lower than other species (Ψ=0.53 ± 0.13). Within the Park's borders, no genetic samples showed introgression, but two samples collected occasionally outside the Park highlighted the presence of the hybrid individuals.

Both wolves and their main prey species are present and well-distributed throughout the PNALM. Potential anthropogenic pressure, including the presence of humans and domestic dogs, appears not to affect their behavior. Regarding hybridization, even if in our limited sampling there is no evidence of it within the Park's borders, we believe that since it is listed as the main threats to the species in Italy, further investigation is needed to better explore this aspect.

Recovery of five ground-dwelling predators in Veneto Region (NE Italy) during the XXI century: common factors driving the improvement of a trophic network

Bon M.[1], Cassol M.[2], Dartora F.[3], De Nadai G.[4], Deon R.[5], Semenzato M.[6], Triches S.[7], Lapini L.[8]

1. Museo di St. Nat. G. Ligabue, S. Croce 1730 – 30135 Venezia.
2. Via Fornaci 25a - 32036 Sedico (BL).
3. Wild Life Initiative Italia ETS, Via Monte Tesoro, 21 Verona.
4. Via Piave 71 - 32035 Santa Giustina (BL).
5. Via Piave 30 - 32026 Mel di Borgo Valbelluna (BL).
6. Associazione Faunisti Veneti, Santa Croce 1730 – 30135 Venezia.
7. Vicolo Loat 11 - 32035 Meano di Santa Giustina (BL).
8. Via dei Monti 21 - 33034 Fagagna (UD).

The impressive biodiversity crisis of the XX century has led to extinction or rarefaction of various predators, with a strong simplification of the trophic networks all over the world. The reasons are principally related to the anthropic activities connected to agricultural management of the environments, to animal and plant pest-control, to the protection of both livestock farming and various fish and game-species, traditionally harvested by fishers and hunters. Various nature protection initiatives began in the 1970s, with specific laws both in Europe and in Italy, aimed to the protection of some apex species and eco-systems. Currently, despite a permanent global situation of bio-diversity crisis, the results of such protection reverberate in the impressive local recovery of various trophic networks. This very provisional work aims to outline some of these factors, all involved in the surprising recovery and expansion of five carnivore species (*Canis lupus, Canis aureus, Felis silvestris, Mustela putorius, Lutra lutra*) in Veneto Region at the beginning of the XX Century, all paradigmatic of the local improvement of trophic networks. The increase of these species is evident by comparing the distribution picture published in the last Atlas of Mammals of Veneto. The new data were obtained mainly from camera trapping, road mortality verification, genetics, biomolecular identification, and otter river and bridge surveys. The comparison shows an overall improvement of the food web of the entire Veneto Region, with an impressive expansion of all five species studied, which seems to have occurred in less than ten years of the 21st century. The reasons for these local recoveries are various. A first common factor is the natural reforestation in mountain ecosystems. A second reason concerns the general increase in local people sensitivity and the various protection laws that have driven hunting and habitat management. The repopulation of various game species has also been very important for some apex predators, as well as the contemporary better management of hunting activities. Finally, the decrease in the concentration of organochlorine pesticides and polychlorinated biphenyls was guaranteed in the 20th century by various independent European laws and throughout the EU by the Stockholm Convention (2001), while the elimination of some herbicides such as atrazine and simazine were subsequent (2004-2005). However, it is necessary to highlight that the impressive increase documented in this comparison could be partly due to a large use of camera trapping. In this overall very positive situation, it is possible to point out some emerging problems:

1-The cross-breeding with domestic relatives presents some threats to the conservation of the original genetic pool of some species (*Canis lupus*, *Canis aureus*, *Felis s. silvestris*).

2-The possible competition with some allochthonous species constitutes a putative threat for the conservation of some populations of *Mustela putorius* and *Lutra lutra*.

3-The lethal control of some allochthonous species and native predators constitutes a threat for *Lutra lutra* and *Canis aureus* due to possible mistakes in the culling operations of coypus and foxes.

4-At present the road mortality is surely one of the main threats for *Canis aureus* and *Lutra lutra*, followed by the poaching and dispersion of poisoned bait.

Further improvement and conservation of the studied trophic networks from Veneto Region will increase only thanks to the continue and positive cooperation between hunters and regional

Authorities, in the frame of the national law 157/92 and the EU Directive 92/43, driven in Italy by the DPR 357/97.

“Lo scoiattolo a Mestre”: a citizen science project for the study and the conservation of a new urban species

Bon M.[1], Nardotto A.[2], El Assil M.[3]

1. Museo di Storia Naturale G. Ligabue, Santa Croce 1730 - 30135 Venezia (VE)
2. Wildlife Services, Via Guizze 55/3 - 31020 Villorba (TV)
3. Calle de la Sbiaca 3561/A - 30170 Venezia (VE)

“Lo scoiattolo a Mestre" is a Natural History Museum G. Ligabue project, in collaboration with the Municipality of Venice. The main goals are the collection of distribution and ecological dataset on Red squirrel (*Sciurus vulgaris* Linnaeus, 1758) in the urban environment, and the monitoring of the presence of alien Sciuridae in the Venetian mainland. The project involved citizenship in the monitoring campaign on the squirrels. An information and communication campaign was started in May 2018, both through local press and using social networks. Some training meetings were organized and a dissemination postcard was distributed, inviting citizens to communicate possible squirrel observations. Seventy signs were placed in green urban areas (public gardens, parks, cemeteries, etc.), with an invitation to participate in the research. Two methods of data transmission were recommended: by email to be sent directly to the Museum of Natural History or through the iNaturalist application (www.inaturalist.org/projects/lo-scoiattolo-a-mestre).
The transmission of basic information to citizens regarding the presence of the red squirrel and the existence of a monitoring plan was facilitated by some communication activities. Public participation in the project is very positive, with the collaboration of 277 surveyors in the period May 2018 – February 2024. 428 reports were recorded: 338 of these arrived as emails sent by citizens to the Museum's email inbox, 90 through the “iNaturalist” platform. Of all the reports, 173 were accompanied by photos or videos, representing a good dataset for future studies on coloring, circadian activity, feeding habits, etc. Through images, it is possible to perform a more precise validation of the data. In addition, a case of predation by a domestic cat has been documented. The report of two alien squirrels (*Callosciurus nigrovittatus* and *Callosciurus prevostii*), not yet reported in Italy, was also received. To date, the presence of the Gray squirrel (*Sciurus carolinensis*) can be excluded.
The data collection carried out through a citizen science project has proved, in this case, a good tool to gather information on an urban species easily detectable and quite recognizable. Sending e-mail was the most efficient tool compared to using the iNaturalist application. Public participation has contributed to a considerable update of the Red squirrel data recorded in the Atlas of mammals of the Veneto region. The first data collected are encouraging; citizens are a determining factor in monitoring this species, which proves to be rather confident and visible in the city. The squirrel seems to tolerate the reduced connectivity between suitable habitats within cities and is also capable of using anthropogenic sources of food. This flexibility determines the success of squirrels in the urban environment. The experience gained in this research allows us to make some general considerations:
1) information and involvement of citizens leads to a greater awareness of the values of biodiversity and conservation of the natural heritage; alongside, the increase in knowledge must be linked to the awareness that alien species constitute a threat;
2) to consolidate the presence of the species, a better planning of public green areas is required, which provides for greater continuity between the peripheral park areas and the city park areas. Furthermore, the planting of indigenous plant species that are palatable should be encouraged;
3) currently, major risk factors in the urban environment are road investments, domestic cats predation and bait-traps used for rodent control.

Influence of the Covid-19 pandemic lockdown on the activity rhythm of wildlife in peri-urban Mediterranean area

Del Frate M.[1], Bongi P.[1], Gaimari G.[2], Scandura M.[1], Apollonio M.[1]

1 Department of Veterinary Medicine, University of Sassari, Via Vienna 2, I-07100 Sassari, Italy
2 Department of Biologu, University of Pisa, Via A.Volta 4bis, I-56126 Pisa, Italy

In 2020, the COVID-19 pandemic caused by SARS-CoV-2 led to the implementation of various forms of lockdown worldwide, aiming to ensure social distancing and limit the spread of the disease. These closures resulted in a drastic and unexpected reduction in human activity, thus creating the opportunity to study how large-scale changes of this kind impact wildlife. In Italy, a complete shutdown of non-essential economic activities and stringent restrictions on people's movement was implemented from11 March 2020, to 4 May 2020, causing a significant reduction in human presence in natural environments and in protected areas. The main goal of the study was to investigate the variations in daily activity as a consequence of anthropogenic disturbance reduction during the COVID-19 pandemic, focusing on four emblematic species - fallow deer (*Dama dama*), wild boar (*Sus scrofa*), fox (*Vulpes vulpes*), and wolf (*Canis lupus*) - inhabiting a natural protected site, commonly used as recreational area, close to a medium-sized Italian city.

The area is represented by the San Rossore Estate, a protected area of 4.650 hectares 5 km far from the city centre of Pisa (about 90.000 inhabitants), Italy. A sub-Mediterranean climate characterize the study area. Woods are dominated by mixed deciduous forest and pine forest, alternating with marshes and meadows. We collected data from January 2020 to December 2021 using 22 camera traps in video mode, operating 24 hours a day, and randomly placed in 22 different sectors, approximately 200 hectares each, spanning the entire protected area. We analysed data collected in relationship to different periods, i.e. 1) pre-lockdown; 2) during lockdown; 3) post-lockdown, considering both the frequency of videos recorded for different mammal species, and the mean number of individuals recorded per video in different periods.

In comparison to pre- and post-lockdown periods, the frequency of videos pertaining to the species under consideration rose during the. The red fox was the only species to exhibit an opposite pattern, with a significant drop in the frequency during the lockdown compared to the other times. Obviously, there was also a considerable variance in the frequency of human presence during the periods under consideration. Additionally, we observed a variation in the average number of individuals trapped by cameras throughout different times, with a higher group size during the lockdown. Finally, we observed that during the lockdown, videos recorded during daylight hours increased, for all species except the wolf.

Our findings demonstrate the impact of lockdown measures on the activity patterns of wild species. Specifically, during the period of restricted access to natural habitats, fallow deer, wild boar, and wolf increased their movements in the area, extending their diurnal activity and reinforcing their social bonds (expressed by group size). This research underscores the significant impact of anthropogenic disturbance on wildlife behaviour, even within peri-urban protected areas.

Scent marking behaviour in wolf, in relationship to pup presence

Del Frate M.[1], Gaimari G.[2], Mureddu E. [1], Bongi, P. [1], Corrente D. [3], Tursi J. [4], Scandura M.[1], Apollonio M.[1]

1. Department of Veterinary Medicine, University of Sassari, Via Vienna 2, I-07100 Sassari, Italy
2. Department of Biology, University of Pisa, Via A.Volta 4bis, I-56126 Pisa, Italy
3. Department of Sciences, Roma Tre University, Viale Guglielmo Marconi 446, I-00146 Rome, Italy
4. Department of Agriculture, Food, Environment and Forestry (DAGRI), University of Florence, Piazzale delle Cascine 18, I-50144 Firenze, Italy

Scent marking serves as the primary olfactory communication method employed by wolves, characterized by the deposition of urine or excrement containing glandular secretions. Within a family unit, increased marking activity of the dominant pair is observed during the mating period; frequent reciprocal overmarking by the alpha male and female likely contributes to the reinforcement of their pair bond. Marking also serves as a mechanism to delineate the territory of the reproductive nucleus, with marking sites strategically located in areas of high visibility and ease of scent diffusion. In this context, road intersections serve as crucial elements for maximizing the efficacy of marking behavior. Our study delves into marking behavior, specifically examining its correlation with site selection and the presence/absence of new cubs.

We walked 12 standardized transects throughout the San Rossore Estate, a protected area, spanning about 47 km^2, covered by mixed deciduous and pine wood. Transects were distributed across the entire area and measured on average 8.3 km. They were meticulously surveyed, and all identified excrements were geolocated, labeled, and placed in plastic bags for preservation at -4°C, pending future analyses. Utilizing QGis software, we generated a distribution map of the marking sites and constructed heatmaps to elucidate their concentration patterns. Additionally, we investigated the correlation between the timing of excrement deposition and the wolf's biological cycle. To assess the frequency of the obtained data, we employed the chi-square test, while the influence of cub presence on site selection was evaluated using the Student's t-test.

We collected 115 wolf excrements, between July 2017 and November 2023. Of the total excrements collected, 53.9% was discovered at crossroads, with the remaining 46.1% located at other points not corresponding to crossroads. Analysis revealed that, overall, there was no significant preference for road intersections as deposition sites ($\chi 2 = 0.704$, $P = 0.401$).

However, when considering fecal marking in relation to the year, a noticeable disparity emerged in the utilization of crossroads, particularly evident from the second half of 2021. The heatmaps revealed a shift in the spatial distribution of marking sites relative to the presence of pups. Specifically, at the rendezvous site established after the reproductive event, there was a higher concentration of excrements near the crossings compared to random sites in the estate. The selection of fecal marking sites varied with the presence of new generations, exhibiting a notable preference for sites near crossings (Student's t-test: $F = 0.104$; $t = -5.511$; $P < 0.001$).

Following the first reproductive event in the San Rossore estate, a shift in the selection of marking sites was noticed, with a notable predominance of excrements discovered at road crossings. Specifically, the utilization of road crossings notably increased during the weaning period of the pups, marking the phase when the newborns commence independent exploration within the pack's territory. During the period when a single male wolf inhabited the study area, scats were discovered in sites with similar frequencies. Conversely, a solitary individual typically exhibits no interest in advertising its presence. However, upon the formation of a reproductive nucleus, the delineation of territorial boundaries becomes imperative. As corroborated by other studies, road intersections assume a paramount role in this regard. Ultimately, selecting easily recognizable sites could aid newborns in navigating in their initial exploratory experiences within the pack's territory.

The golden jackal (Canis aureus) in Emilia-Romagna: updated results of presence and telemetry monitoring

Braghiroli S.[1], Molinari L.[2], Fior E.[3], Barbacini D.[3], Ferri M.[4], Frangini L.[5], Bernicchi L.[5], Barca V.[5], Madinelli A.[5], Filacorda S.[5]

1. Regione Emilia-Romagna, Direzione Generale Agricoltura Caccia e Pesca
2. Wolf Apennine Center, Ente Parco Nazionale dell'Appennino Tosco-Emiliano
3. Ente di Gestione per i Parchi e la Biodiversità Emilia –Occidentale
4. *Canis aureus* news
5. Università degli studi di Udine, Dipartimento di Scienze Agroalimentari, Ambientali e Animali

This contribution aims to provide an updated situation of the presence reports about golden jackal (*Canis aureus*) in Emilia-Romagna, with a further contribution resulting from the telemetry outcomes of two jackals fitted with GPS collars. The information about the presence in Emilia-Romagna was acquired through an important Citizen-science coordination action; the data collected by the experts' group are all validated and catalogued according to the specific GOJAGE protocol. In November 2023 two young golden jackals were recovered in good condition in two Wild Animal Recovery Centres (CRAS); after a short stay in the CRAS of Reggio-Emilia (Rifugio Matildico) and Rimini (Atena), where the animals were adequately cared for, the two individuals were fitted with collars with GPS and Iridium technology. The first report of a golden jackal in Emilia-Romagna, the first south of the Po River, dates back to 2016, in the municipality of Castell'Arquato, in Piacenza province; a second report was documented in Modena plain. Since then, there have been several reports in the Emilian plain while, already in 2021, the Golden Jackal was present in almost all the provinces of Emilia-Romagna, with the confirmation of the first reproductive group and the colonization of the Apennine areas as well.

Important information was acquired thanks to the data sent by the collars. The first collared jackal was recovered at the end of November in a sewage tank on a farm in the Reggio-Emilia plain; after a short stay in the CRAS the animal, a young male, was released near the recovery site. The area, although heavily anthropized, was near the rendez-vous site documented the previous year. Video trapping method was used to support GPS localizations. In the first two months after release, this made it possible to detect passages not only of golden jackals, but also of foxes and wolves. Jackal and wolf were observed an hour apart in the same site, but never at the same time. On some occasions the subject with the collar was filmed together with the family group, while many jackal observations took place at the manure heaps of the two monitored farms. In the two months of presence around the release areas, the animal, together with the family group, showed habitual behaviours: in a range of approximately 5 km2 (50% isopleth of the BBMM defined UD), the jackal moved from small portions of wooded areas during daylight hours to various farms during nocturnal for food purposes. The animal then began an important phase of dispersal towards the north-east; initially he headed towards the Po River, covering about 40 km in a few days, and then retraced his steps and remained for some time along the plain portion of the Enza river. Unfortunately, the animal died at the beginning of March 2024. The second individual was recovered in end of November 2023 from an illegal snare trap in the province of Rimini and showed also signs of being shot. The animal was treated in the CRAS and then released near the discovery site. After an initial period of presence at the release area, where the individual alternated between natural and highly anthropized environments, the jackal began the dispersal phase. Initially it moved north, traveling more than 60 km in about 10 days, arriving at the gates of Ravenna. Despite several attempts, the individual was unable to overcome an anthropic barrier and unfortunately died in early March 2024. We are currently waiting for the outcome of the necropsy tests carried out by the competent Zooprophylactic Institute for both the individuals. Thanks to the precious collaboration with many competent subjects and institutions, it was possible, through satellite technology, to confirm the exceptional ability of the Golden Jackal to adapt to resources in human dominated landscape, such as the Emilia-Romagna plains but also demonstrating the

difficulties identified in cause of the ecological barriers present, providing important elements for future conservation strategies.

Preliminary investigations on behavioural ecology and species composition of small mammal communities along the urbanisation gradient

Bressani P.C.[1], Tranquillo C.[1], Bisi F.[1], Santicchia F.[1], Wauters L.A.[1,2], Martinoli A.[1], Preatoni D.G.[1]

1. Environment Analysis and Management Unit, Guido Tosi Research Group, Department of Theoretical and Applied Sciences, Università degli Studi dell'Insubria, Via J.H. Dunant, 3, 21100 Varese, Italy
2. Evolutionary Ecology Group, Department of Biology, University of Antwerp, Campus Drie Eiken Universiteitsplein, 1, 2610 Wilrijk, Belgium

Urbanisation is a phenomenon widely recognised to have strong impacts on wildlife, inducing changes both in the species composition of animal communities and the physiology, morphology and behaviour of species that succeed in persisting within urban settings. In Italy, these mechanisms have not yet been particularly investigated for small mammal communities. However, it would be opportune to better explore this aspect, considering that small mammals provide essential ecosystem services, like seed dispersal, and that they are generally less vagile than bigger mammals making them more vulnerable to habitat fragmentation caused by urban expansion. The present study aims to investigate all these issues, focusing mainly on rodent communities and using two different approaches.

The first approach aims to assess changes in species composition along the urbanisation gradient within the Provinces of Varese and Como (Lombardy, Italy), using camera-traps provided with close-up camera filters to shorten the focusing distance. The second approach is intended to focus on mice of the genus *Apodemus* and to make behavioural comparisons between populations inhabiting natural and urban green areas. For this purpose, capture-mark-recapture sessions are planned to measure morphological parameters, as well as to perform some behavioural tests: the Emergence Test, the Open Field Test, and the Handling Bag Test, to examine personality traits like boldness, activity, and exploration.

The present study is expected to find personality differences among individuals from the two environment types. In particular, factors like noise and light pollution could affect individual personality. In addition, coexistence with black rat *Rattus rattus* has been documented in all urban populations of mice of the genus *Apodemus* identified until now. The hypothesis is that animals living in urban context could have a bolder temperament in order to cope with these challenges. Secondly, the surveys conducted using camera-traps, thanks to a detailed examination of microhabitat and macrohabitat conditions, will enable to understand which situations facilitate the occurrence of individual species of small mammals and also the co-occurrence of several species in the various contexts along the urbanisation gradient.

In conclusion, this study will help to understand which species are more prone to colonise the urban environment. Furthermore, it will be interesting to explore not only how species typically associated with less urbanised environments (e.g. *Apodemus spp.*) manage to penetrate the urban matrix, but also how typically anthropophilic species (e.g. *Rattus spp.*) disperse away from human settlements. The results will provide insights useful to design future management interventions aimed at small mammals. Furthermore, behavioural investigations of mice of the genus *Apodemus* will provide information on how they cope with urbanisation and on how other species might do the same. Indeed, mice are short-lived animals that become sexually mature when few months old and can produce large litters. These factors result in populations able to adapt to the surrounding environment faster than other animal species. Thus, mice may be an excellent model to check for microevolutionary processes and to understand what will happen to other species due to progressive urbanisation.

Intra-guild competition and ecosystem services of mammal scavengers in a new colonized wolf landscape

Brogi R.[1], Bongi P.[1], Del Frate M.[1], Sieni S.[1], Cavallera A.[2], Apollonio M.[1]

1. Department of Veterinary Medicine, University of Sassari, Italy
2. Department of Agri-food Production and Environmental Sciences (DISPAA) – Animal Science, University of Florence, Italy

Carcass utilization by scavengers is crucial for ecosystem dynamics, influencing energy transfer, nutrient cycling, and disease regulation. Through the provision of unconsumed carcasses, the return of wolves to European ecosystems can trigger complex cascading effects on scavenger communities.
Here, we investigate the scavenging dynamics of mammalian species in a prey-rich Mediterranean coastal area close to a large city where wolves have recently returned. Using camera traps, we monitored the scavenging activity on fallow deer carcasses preyed upon by wolves over a five-year period following the predator's return, and developed models to analyze the temporal patterns in the utilization of carcasses by red foxes, wild boars, and wolves themselves.
The latter exhibited a consumption of only minor portions of prey and a negligible reuse of carcasses, while foxes and wild boars competed for access to this emerging trophic niche. We revealed a notable temporal change in scavenging activity along time, with wild boars emerging as the primary scavenger and providing a substantial removal of carcass biomass.
Our findings underscore the importance of considering scavenger dynamics in the context of apex predator recolonization and highlight the potential implications for ecosystem functioning and disease regulation. Further research is warranted to elucidate the long-term effects of scavenger interactions on community structure and ecosystem services in the face of increasing wolf populations across Europe.

Reporting of wolf sightings: a window into the spatio-temporal distribution of people's concerns?

Brogi R.[1], Neirotti G.[1], Lazzaroni M.[2], Marshall-Pescini S.[2], Mattioli L.[3], Apollonio M.[1]

1. Department of Veterinary Medicine, University of Sassari, Italy
2. Domestication Lab, University of Veterinary Medicine, Vienna, Austria
3. Settore Attività Faunistico Venatoria, Pesca Dilettantistica, Pesca in mare, Regione Toscana, Italy

Following a prolonged period of human persecution that nearly drove wolves to extinction across much of their original range, wolf populations have swiftly rebounded and are now reclaiming their former range in Europe, including highly human-dominated areas. In addition to the renowned conflicts with human productive activities such as livestock breeding, wolf recovery is creating the opportunity for novel interactions between wolves and various stakeholders including common citizens, with the potential rise of new conflicts disrupting the current paradigms of large carnivore management and conservation. Citizen reporting of wolf sightings to a dedicated phoneline can reveal the spatio-temporal distribution of these emerging interactions and their relationships with wolf- and human-related factors. We hypothesized that wolf reports would be more likely to emerge where wolves returned more recently, and hence people are less used to their presence. We formulated two alternative hypotheses relating to the urbanization effect, with wolf reports being potentially more frequent either i) in areas with a higher expected density of wolves (least urbanized areas) or ii) in areas with a higher density of potential reporters (maximum urbanization). Finally, we hypothesised an effect of wolf dispersal and breeding seasonality on the temporal distribution of wolf reports.

We analysed data collected from wolf reports received by the Tuscany Region administration's wolf report phoneline service in 2022 and 2023. Employing an observed/availability design, we modelled the spatial and temporal distribution of wolf reports. We used the time since the area was recolonized by wolves (1972, 1996, 2005, 2016, or later, obtained from published papers and reports) as a spatial proxy of people habituation to wolf presence, predicting more frequent reports in areas that were more recently recolonized by wolves. We also modelled the distribution of reports along the urbanization gradient, predicting more reports either i) in least urbanized areas (higher wolf density) or ii) in more urbanized areas (higher human density). Finally, we examined the temporal distribution of wolf reports along the year, predicting an increased frequency of wolf reports in late winter and a decrease in summer.

Our analysis revealed that 41% of reports expressed fear and/or concern about the presence of wolves, 16% were neutral reports of wolf presence, and only 3% expressed a positive attitude. The reasons for reporting were unspecified in the remaining 40% of cases. Our results revealed that wolf reports were more common in recently recolonized areas, indicating limited habituation of people to wolf presence. Additionally, urbanized areas accounted for the majority of wolf reports, suggesting that human population density, rather than wolf density, was the primary predictor of reporting. Consistent with the wolf's biological cycle, wolf reports peaked during late-winter dispersal phase.

We depict a novel and complex landscape of wolf-human interactions in human-dominated areas, which may be only partially predictable through the lens of wolf biology and ecology. Our findings facilitate the identification of key regions where conflicts are more likely to occur and where ad-hoc socio-ecological management plans will be more needed in the upcoming future.

Urban wildlife, a spiky issue: first detection of Giardia duodenalis in Italian European hedgehogs (Erinaceus europaeus)

Brustenga L.[1], Rigamonti G. [1], Moretta I. [1], Morganti G. [1], Calgaro V. [1], Diaferia M. [1], Lepri E. [1], Lucentini L. [2], Veronesi F. [1]

1. Department of Veterinary Medicine, University of Perugia.
2. Department of Chemistry, Biology and Biotechnology, University of Perugia.

Giardia duodenalis is a polyflagellate protozoan and causative agent of giardiasis, a disease that can affect humans, pets and also wild animals, causing a diarrheic gastrointestinal disease. As many other enteric parasites, *G. duodenalis* has a fecal-oral transmission route, with trophozoites that inhabits the small intestines of infected hosts and cysts that are shed with feces, being viable in the environment for up to three months in appropriate conditions. Basing on the molecular analysis of several genetic markers like triosephospate isomerase, beta-giardin and the small subunit rRNA, *G. duodenalis* is furtherly classified in eight assemblages (A to H) that display different host affinity. Among them, assemblages A and B have zoonotic potential and are able to infect a broad range of hosts, including humans; whereas assemblages C and D are mostly found in canids, assemblage E in ungulates, assemblage F in cats, assemblage G in rodents and assemblage H in pinnipeds. Among the many species of wild animals that inhabit urban settlements, the European hedgehog (*Erinaceus europaeus*) is one of the few species that has adapted to live in close contact with humans, using gardens and public parks as foraging areas and sheds, garages and woodpiles as nesting grounds. Hedgehogs often meet the compliance of humans that provide them with food and water, either directly or indirectly, encouraging the use of human spaces. Therefore, a survey of potential zoonotic parasites shared from hedgehogs and humans could be of great public health concern, especially in urban areas with high hedgehog density.

Fecal flotations for coproparasitological exams are routinely carried out on hedgehogs admitted to a Wildlife Rescue Center in Central Italy. To confirm the suspect of infection with *G. duodenalis*, feces were also destined to a direct immunofluorescent assay (MERIFLUOR) and DNA extraction followed by Nested PCR amplification of a 511 bp fragment of the beta-giardin gene to be used in a RFLP protocol that allow for assemblage characterization and for further identification of sub-assemblages of assemblages A and B that have different degrees pathogenicity. Furthermore, one of the two hedgehogs that tested positive to *G. duodenalis* died due to a severe diffuse interstitial and granulomatous pneumonia; samples of the small intestine were harvested, formalin fixed, processed with routine histological techniques and stained with Hematoxylin and Eosin to search for trophozoites attached to the intestinal mucosa.

Cysts of *G. duodenalis* were detected in the fecal flotations of two hedgehogs, both the immunofluorescence assays and the PCR amplifications confirmed the presence of the parasitic cysts and DNA respectively and the RFLP protocol attributed one of the two amplified samples to the zoonotic assemblage A1. Trophozoites were also found on the histological slides made out of the collected samples confirming once more the presence of the parasite in the hedgehog small intestine.

Giardia duodenalis has been previously found in hedgehogs from Austria, France, the Netherlands and New Zeland but, until now, was never reported in Italian hedgehogs. Even though giardiasis can also affect humans, the main threat is the transmission of the parasite to pets that can share food and water bowls with hedgehogs. Therefore, is important not to leave food and water sources that can be shared among pets and wildlife preventing the spreading non just of enteric parasites like *G. duodenalis*, but also other zoonotic parasites. Furthermore, cats and dog usually harbour species- specific assemblages (F and C-D, respectively) that are not zoonotic and are not a threat for human health. The detection of a zoonotic assemblage in hedgehogs can therefore bridge the transmission of the parasite from the wild to the domestic environment using pets as intermediate proxies.

Activity patterns of bats in forest environments: insights from the LIFE SPAN project

Castiello G.[1, 2], Ferretti F.[1], Colangelo P.[3], De Cinti B.[3]

1. CREA Research Centre for Forestry and Wood, v. le Santa Margherita 80, 52100, Arezzo, Italy
2. Department of Biology and Biotechnologies "Charles Darwin", Sapienza University of Rome, Rome, Italy
3. National Council of Research (CNR), Research Institute on Terrestrial Ecosystems (IRET), Via Salaria km 29.300, Montelibretti, 00015, Rome, Italy

Despite bats' role as providers of important ecosystem services, few studies exist on their conservation in forest environments, many of these focused on individual threatened species. Understanding the activity patterns of bats and the interaction within the same functional group, particularly when related to management practices, is crucial for the conservation of these species in forest environments. The LIFE SPAN project in the Cansiglio Orientale forest (Friuli-Venezia Giulia) aims to promote forest ecosystem resilience and biodiversity conservation by mitigating the negative effects of traditional forest management. Through different silvicultural practices such as pollarding, basal slits creation, girdling, uprooting, tree cavity creation, thinning and gaps creations, is encouraged the presence of bat target species.

Passive acoustic sampling was used to assess bat activity in 8 forest areas subjected to the silvicultural practices mentioned above. Data were collected in 2022-2023 from May to July for 5 nights per month (from one hour before sunset to one hour before sunrise), placing ultrasonic microphones to record the echolocation calls of bats during their nocturnal foraging activities. The acoustic data collected were analyzed with Kaleidoscope PRO software and manually checked in order to identify the species to which the calls belonged. To assess nocturnal activity patterns, the species were divided according to functional groups related to genus and foraging behaviour. Interactions among groups were assessed by generalized linear mixed models (GLMMs), in which total bat activity (i.e., total bat passes per species) was used as the response variable. Predictors included habitat type (open or closed), forest composition and total activity of other functional group, while site and year were incorporated as random effects. Successively, species nocturnal activity patterns were investigated, to evaluate species interaction and temporal overlap of species with similar foraging behaviour. The following taxa were selected and investigated: *Barbastella* sp., *Eptesicus* spp., *Hypsugo* sp., *Miniopterus* sp., *Myotis* spp., *Nyctalus* spp., *Pipistrellus* spp., *Plecotus* spp., *Rhinolophus* spp., *Tadarida* sp., and *Vespertilio* sp.

Analysis of acoustic recordings revealed the presence of over 20 bat species from three families: Miniopteridae, Rhinolophidae, and Vespertilionidae. The results suggest that the activity of certain species is positively correlated with that of others. Forest composition appears to have no significant influence on activity patterns, while the presence of clearings exerts a more substantial influence, particularly on species that forage in open areas or forest edges, but also on narrow foragers such as the Barbastelle bat and species within the genus Rhinolophus. Analysis of nocturnal activity patterns by species reveals that for some species within the same functional group the nocturnal activity could be temporally differentiated.

The study highlights the importance of targeted management strategies to enhance bat presence and foraging opportunities in forest ecosystems. Clearings were identified as crucial for bat activity, emphasizing the significance of landscape heterogeneity in conservation efforts. Understanding interspecific competition within functional groups underscores the need for holistic conservation approaches. Initiatives like the LIFE SPAN project can significantly contribute to bat conservation and ecosystem resilience. However, more research is needed to assess the long-term effects of such interventions on bat communities and to refine conservation strategies accordingly.

Spatial bias in dietary studies about the gray wolf (*Canis lupus*) in Italy

Cerri J.[1], Musto C.[2], Bassi E.[1], Brogi R.[1], Apollonio M.[1]

1. Department of Veterinary Medicine, University of Sassari, 07100 Sassari, Italy
2. Department of Veterinary Medical Sciences, University of Bologna, 40064 Bologna, Italy

Synthesis research is fundamental to draw robust and generalizable conclusions about the ecology of animal species. Meta-analyses, which summarize existing dietary studies, are particularly useful to define the food habits of large carnivores. However, to date no study quantified the spatial distribution of dietary investigations, with respect to the spatial distribution of target species, to test for the potential occurrence of spatial bias.
In this study we collected gray literature and peer-reviewed studies about the diet of the gray wolf (*Canis lupus*) in Italy (n = 38). We compared their spatial distribution, and the environmental characteristics of their study areas, in relation to the distribution of wolves in Italy, quantified as a 10km grid used for the three reporting periods of the Habitat directive (2007-2013, 2014-2019, 2019-2024). We clusterized the cells of the grid according to prey availability, including both wild ungulates and livestock, and to landscape attributes reflecting forest cover and anthropization.
Our findings indicate that the distribution of wolves in Italy can be divided into a set of 6-7 macroareas, defined by considering prey availability and environmental characteristics. However, existing dietary studies, which predominantly report the occurrence of wild ungulates in wolf diet, focused on only a narrow subset of these areas, being concentrated in Central and North-Western Italy. Regions where wolves coexist with human activities, such as animal husbandry in Central and Southern Italy, exhibit notably poor coverage. Critical gaps also occur in those areas of new wolf expansion such as of the Po Valley, characterized by a limited availability of wild ungulates and higher landscape anthropization.
Future studies should focus on investigating the diet of wolves where ecological conditions differ from those of areas that have already been covered by dietary studies, thus providing a more holistic understanding of the gray wolf's feeding ecology to facilitate informed conservation and management strategies?

Senescence in ungulates: different approaches to evaluate the effect of aging and the potential outcome on population dynamics

Chirichella R.[1], Luccarini S.[2], Apollonio M.[2]

1. Department of Humanities and Social Sciences, Via Roma 151, University of Sassari, 07100, Sassari
2. Department of Veterinary Medicine, Via Vienna 2, University of Sassari, 07100, Sassari

Senescence is defined as a chronological decline in demographic performance with age, showing a gradual deterioration of body functions and a related decline in survival. In this framework, senescence can affect various aspects of an ungulate's life, including reproduction, locomotion, sensory perception, and overall health. Evaluating senescence in ungulates involves monitoring different parameters and employing various methods such as life history data analysis, reproductive performance, physical condition and health, behavioural observations, endocrine and biomarker analysis, longevity studies, genetic analysis, and remote sensing techniques.
To discuss the available methods in ungulates species, we conducted a general review, and we revealed advantages and disadvantages in the use of different approaches.
Moreover, through the use of linear and generalized additive mixed models, we analysed over 100,000 records of biometric data from Alpine chamois (*Rupicapra rupicapra*; Central-Eastern Alps, Italy), red deer (*Cervus elaphus*; Central-Eastern Alps and Northern Apennine, Italy), and roe deer (*Capreolus capreolus*; Central-Eastern Alps and Northern Apennine, Italy) legally culled during at least 10 consecutive hunting seasons. Available data confirmed that females experienced a later senescence than males (Alpine chamois: 15-16 *vs.* 9-10 years; red deer: 17-18 *vs.* 14-15 years; roe deer: 11-12 *vs.* 8-9 years), in accordance with a greater energy expenditure undergone by males in rut period and to the different polygyny exhibited by these species. Interestingly different environmental, climatic and population conditions influenced the decline of body functions of animals living in different areas. A pivotal role in this process seems to be played by tooth wear, which advances differently in relation to species, sex and ecological context experienced by different animals. In addition, according to deer species, we collected and analysed female reproductive tracts data, showing the importance of aging also in implantation failure and litter size, and highlighting high inter-annual variability due to important effects of female attributes and environmental factors.
As a consequence, life expectancies and population dynamics in different ungulates species over a large portion of the Alps and the Apennines depend on the starting phase and development of aging process. Improving the knowledges of the relevance of environmental, climatic and population conditions on individual biometrical characters and reproductive performances should be considered one of the priorities to improve adaptive management of hunting species.
Indeed, by combining these methods and describing the senescence process, researchers can better highlight implications in population dynamics and address conservation and management challenges, developing strategies to mitigate the effects of aging on population sustainability in wildlife species.

Unraveling environmental factors shaping the coexistence of two glirid species near to hazelnut plantations

Ciampricotti A.[1], La Morgia V.[2], Puddu G.[3], Bertolino S.[1]

1. Department of Life Sciences and Systems Biology, University of Turin, Via Accademia Albertina 13, 10123 Turin, Italy
2. ISPRA (Institute for Environmental Protection and Research), Via Ca' Fornacetta, 9, 40064 Ozzano Emilia (BO)
3. Ente Monti Cimini – Regione Lazio, S.R. Cassia Cimina km 12.00 – Caprarola (VT)

This study aims to identify environmental variables that may influence the presence of the fat dormouse (*Glis glis*) and the hazel dormouse (*Muscardinus avellanarius*) in a woodland where both species coexist. The area is near hazelnut plantations, where the fat dormouse produces significant damage. Our investigation aims to provide useful information for the management of this problem.
The presence of the target species was recorded as part of a study conducted between July 2022 and December 2023 in the "Lago di Vico" Natural Reserve (VT). Forty-four nest boxes (mean distance ± SD = 50±18m, range = 24-97 m) were positioned along four transects within a coppice forest in the eastern part of the reserve, characterized by a high prevalence of chestnut (Castanea sativa). This area is adjacent to hazelnut groves, which dominate the reserve's landscape. Throughout the study period, the nest boxes were monitored 1-2 times per month to collect data on the presence of glirids.
Additionally, environmental data were gathered from areas surrounding the trees with nest boxes. Circular plots with an area of 314 m2 (radius 10 m) were established, and measurements were taken of all stems diameters. Furthermore, an evaluation of habitat trees (evaluated with the R.A.DA.R. table), shrub and tree species, fruit production, and distances from adjacent hazelnut groves were recorded. The environmental variables were analysed using Generalized Linear Models. Nest boxes were located mainly on chestnut trees (55%) and on stems belonging to the *Quercus* genus (30%), on plants with an average diameter of 24 cm (range=13-49 cm). The probability of presence of the hazel dormouse increased with the distance from the hazelnut groves, while the presence of the fat dormouse decreased. Other environmental parameters influencing glirids presence included the number of habitat trees with cavities, the diversity of shrub and tree species, the density of trees and the presence of some plant species (such as broom, chestnut, hornbeam and manna ash). These results highlight the significant influence of these variables on the presence of the target species.
Our result support a competition between these two species, with the larger fat dormouse potentially displacing the smaller hazel dormouse. Furthermore, it is possible to observe that fat dormouse is more likely to be found near hazelnut groves unlike the hazel dormouse, and these results confirms what we know about the species. Although the study did not provide a direct answer to the starting question, some general variables seem promising for further investigation. Our results allow us to take the first steps towards a better understanding of the effects of these factors on the presence of fat dormouse and hazel dormouse in an area with massive presence of hazelnut groves, indicating which aspects to investigate in order to carry out effective management interventions and guarantee the coexistence between wildlife and anthropic activities.

Small mammal community in eastern Po plain between climate and agricultural changes

Coatti S.[1,2], Zanfei G.[2], Padulosi E.[3], Scaravelli D.[1,2]

1. Department of Biological, Geological, and Environmental Sciences, University of Bologna.
2. Museo Ornitologico di Forlì, via Pedriali 12, 47121 Forlì.
3. BIOME Lab, Department BIGEA, University of Bologna, via Irnerio 42, 40126 Bologna, Italy.

The communities of small mammals that characterize the eastern Po Valley in the last thirty years have undergone significant changes over the past thirty years, both in the distribution of species and in the number of individuals present. Numerous studies have shown the occurrence of changes in the frequencies of bioindicator species with a notable particular increase in thermophilic species and a decrease in mesophilic ones. This which suggests a correlation of these variations to environmental changes that have involved the study area.
To assess determine the composition of the small mammal community, pellets produced by Barn Owls were analysed from nesting sites located in the study area. These were then compared with a database made up of the results published or present in the DS database in the area. A total of over 10,000 prey items were thus used to determine evaluate the changes that have occurred in the area in the last decade. Diversity index and thermophilic indexes were calculated for actual and historical collections. In the study 8 different sites are compared with over 2120 prey items.
13 species of micromammals were observed, 7 Rodentia and 6 Soricomorpha. All sites identify *Microtus savii* as the most present species in the Barn Owl's diet (from 33% to 72%), followed by *Apodemus sylvaticus, Crocidura suaveolens, C. leucodon., M. arvalis, Mus domesticus* and *Suncus etruscus*. The number of individuals of the species *Sorex samniticus, Sorex antinorii, Rattus rattus* and *R. norvegicus* remains low. *Talpa europaea*, *Micromys minutus* and one *Mustela nivalis* are the species with the least number. No *Neomys milleri* or *Arvicola italicus* which are known from sampling in nearby areas, were found.
Comparisons of indices with previous local studies indicate a decline rather than the anticipated increase in these populations from the comparison of the indices with previous local studies there appears to be a decrease in them rather than the expected increase. The factors deriving from the changes underway in agricultural practices, with the further including the loss of the last hedges, trees and spaces in the banks of rivers and canals, due to the further intensification and industrialization of local agriculture, appear to be more have a significant influencing in the structure of the communities of micromammals. Consequently, in concert, there is a marked very notable decrease in the most sensitive species such as *Micromys minutus* or even the disappearance of species such as *Neomys milleri* and *Arvicola italicus*. For the latter, the signs of a strong decline have been evident for some time, but now they are increasingly notable in an area that has historically hosted important populations, but today they appear to be becoming decidedly important in an area that historically hosted important populations. It seems urgent to act for the conservation of these important elements of local fauna.

Can Epigenomics Empower Conservation? A Pilot Study on Brown Bears

Colangelo P.[1], Ciucci P.[2], Gramolini L.[1], Solano E.[1], Gentile L.[3], Guadagnini R.[4], Bonapace I.[5]

[1] National Research Council, Research Institute on Terrestrial Ecosystems, Montelibretti (RM), Italy;
[2] Department of Biology and Biotechnologies "Charles Darwin", University of Rome La Sapienza, Italy;
[3] Servizio Veterinario - Parco Nazionale d'Abruzzo Lazio e Molise, Pescasseroli (AQ), Italy;
[4] GPG WildlifeProject, Via Cavalleggeri Udine 41, 38017, Mezzolombardo (TN), Italy;
[5] Department of Biotechnology and Life Sciences, University of Insubria, Busto Arsizio (VA), Italy

Mechanisms such as methylation can influence gene expression and play an important role in the adaptation to local environmental conditions and selective pressures, introducing non-genetic variability within species. Experiments on this matter have been commonly performed in model organisms kept under laboratory conditions rather than wild populations. Examining the extent of epigenetic variation in wild animals experiencing different levels of environmental complexity and genetic structure is essential for advancing our understanding of the role of epigenetics in shaping the adaptive capacity of populations in their natural habitats. Detecting adaptive differentiation at the population level is fundamental to design appropriate conservation strategies and interventions, as these should possibly account for the smallest population segments featuring independent and unique evolutionary trajectories, i.e. Evolutionary Significant Units (ESUs, lineages that have undergone substantial reproductive isolation leading to adaptive differentiation).

In this work we focused on brown bear (*Ursus arctos*) a species genetically relatively homogenous in Europe, but showing very different phenotypic characteristics between populations. Particularly one of the most endangered groups in Europe, the Apennine brown bear, is genetically depauperated but still able to express a significant phenotypic variation of possible adaptive significance. This species can give new insight into the role of epigenetic differentiation as a potential source of phenotypic divergence and plasticity. In order to test if two closely related populations, i.e Italian Alpine and Apennine brown bear populations, present differentiated methylation profiles we extracted DNA from blood of six specimens. Successively, by using a reduced representation bisulfite sequencing approach (RRBS), we sequenced the methylome of the six specimens and used the Bismark pipeline to map them against the *U. arctos horribilis* annotate genome. Successively we assessed correlation of methylation pattern among specimens and tested for differential methylation across different regions of the genome. Finally, on the set of genes carrying differentially methylated sites (DMS), we performed a gene ontology (GO) enrichment analysis using the GO terms annotation from polar bear (*Ursus maritimus*).

The correlation analysis showed that the samples group more strongly by populations, indicating that methylation signatures are similar within the two groups. A high number of sites resulted differentially methylated in Central Apennines population compared to the Alpine (6% within the promoter regions, 40% intronic regions, 11% exons and 43% intergenic regions). Gene Ontology analysis suggested that differentially methylated sites are mostly located in genes involved in development and anatomical differentiation.

Our results show that methylation profiles of the two populations are significantly distinct. The GO enrichment analysis corroborates previous studies suggesting a role for the alteration of developmental pathways in shaping phenotypic novelties with a putative adaptive significance. These preliminary evidence underscore the importance and the effectiveness of including epigenetic approaches in wild non-model organisms. The stochastic origin of adaptive epigenetic variation holds particular significance in genetically depauperate populations, including those characterised by small size and/or inbred isolation. Hence the study of the epigenome can be particularly relevant for populations of endangered species who experienced a significant erosion of genomic diversity.

Exploring the Relevance of Citizen Science for Mammal Detection and Monitoring along the Central Adriatic Coast

Compagnone F.[1], Varricchione M. [1,2], Carranza M.L. [1,2]

1. Department of Biosciences and Territory, University of Molise, Pesche (Is), Italy;
2. National Biodiversity Future Center (NBFC), Palermo (PA), Italy.

Coastal ecosystems, which are complex transition zones between land and sea, show significant biodiversity but are globally vulnerable, especially in the Mediterranean. Effective conservation efforts require rigorous monitoring, which can be challenging due to high costs, limited accessibility to sampling sites, and difficulties in organizing targeted campaigns. The emergence of online platforms and digital technologies has expanded biodiversity data collection through *Citizen Science* (CS), providing a cost-effective and energy-efficient approach. CS involves non-professional citizens in scientific activities such as data collection and analysis and supporting conservation efforts.

In this study, we aim to investigate the potential of CS initiatives supported by the iNaturalist platform for monitoring Alien and Threatened species in the marine-coastal ecosystems of the Central Adriatic.

Data collection was implemented with the support of the "Wild Coast Adriatic" (WCA - https://www.inaturalist.org/projects/wild-coast-adriatic), iNaturalist project gathering biodiversity data registered in the years 2020- 2023. The analysed area includes the coast of Abruzzo and Molise regions, a 166 km seashore encompassing two sites of the Long Term Ecological Research Network (LTER: Foce Saccione-Bonifica Ramitelli, IT20-003-T and Foce Trigno-Marina di Petacciato, IT20-002-T - https://deims.org/6d7ffd99-40e1-4f0d-ad26-6904581dbe9b) and encompasses seven Natura 2000 sites (IT7120215 – Torre del Cerrano; IT7140107 – Lecceta Litoranea di Tornio di Sangro e Foce del Fiume Sango; IT7140108 – Punta Aderci – Punt della Penna; IT7140109 – Marina di Vasto; IT7228221 – Foce Trigno - Marina di Petacciato; IT722216 – Foce Biferno Litorale di Campomarino; IT722217 – Foce Saccine - Bonifica Ramiteli). The data collection engaged several groups as students (from primary school to university level), teachers, families, volunteers and individual citizens.

Each observation in the WCA project includes a field photo, geographic coordinates, and taxonomic identification based on iNaturalist criteria. Uploaded observations are validated by the scientific community to achieve "Research Grade" status.

WCA counted almost 3000 “Research Grade” observations of which almost 10% are mammals, covering 4 marine and 4 terrestrial species: *Tursiops truncates* (25 obs.), *Myocastor coypus* (12 obs.), *Stenella coeruleoalba* (7 obs.), *Balaenoptera physalus* (1obs.), *Grampus griseus* (1obs.), *Hystrix cristata* (1 obs.) *Sciurus vulgaris (1 obs.) and Sus scrofa* (1 obs.).

All marine species are protected by the Habitats Directive, Annex IV and II and all but *G. griseus* are listed as Vulnerables in the Red List of IUCN in the Mediterranean area. 12 over 15 obs of terrestrial mammals referred to *Myocastor coypus*, an alien species of Union Concern (sensu EU regulation 1143/2014), that was mainly recorded in the SAC IT7140107 – Lecceta Litoranea di Tornio di Sangro e Foce del Fiume Sango (n = 6).

These findings contributed to both the fifth reporting cycle 2019-2024 under Art. 17 of Habitat Directive and recommend timely actions to control the invasive coypu in the Natura 2000 site IT7140107.

Our results, which were obtained through CS campaigns with the support of iNaturalist project, WCA are valuable support for traditional monitoring methods and have the potential for the development of specific plans for the protection of endangered environments and species.

Do common bent-wing bats swarm?

Cosentino F.[1], Festa F.[1,2], Scalisi M.[3], Ancillotto L[4].

1. Department of Biology and Biotechnologies “Charles Darwin”, University of Rome “La Sapienza”, Rome, Italy
2. National Reference Centre for Rabies, Istituto Zooprofilattico Sperimentale delle Venezie, Legnaro, Italy
3. Regione Lazio, Direzione Regionale Ambiente CCTESP, Rome, Italy
4. National Research Council (CNR), Institute for the Research on Terrestrial Ecosystems (IRET), Sesto Fiorentino, Italy

Autumn swarming is one of the most understudied behaviors performed by bats worldwide. It consists of a high flight activity during which bats emit many social call emissions, chasing each other, and circling in and around the entrances of the roost, usually underground sites. It mostly occurs among Holarctic bat species at the end of the bats’ active season, albeit cases in tropical species are not excluded. Although both the function and definition of swarming are still debated, it has been suggested that the main purpose of this behavior is mating, with evidence of strong sex bias toward males showing a higher activity than females. Among European bat species, swarming has been observed on species of the genus *Myotis,* and within the Plecotinae subfamily, besides that species sharing the same ecological characteristics may show the same behavior.
Miniopterus schreibersii is an insectivorous troglophilus bat, widely distributed throughout the southern Palearctic region. During spring and summer, it forms nurseries mostly composed of females with the birth season taking place from May to July followed by mating during the early autumn. Despite the well-known phenology of the species, it is not clear yet whether *M. schreibersii* actually performs swarming, similarly to the European Vespertilionid bats which often share roost with the species. Here, we tested whether *M. schreibersii* performs typical swarming in relation to mating behavior hypothesizing a strong sex bias in the numbers of bats emerging from and entering the roost at night.
We conducted our study at two roosts in the Lazio region (central Italy) located within the Natura 2000 network. Both roosts consist of straight-lined artificial tunnels ca. 130 m long with an arched 5x3 m entrance surrounded by Mediterranean broadleaved forest. One of the sites is used by bats as a nursery, while the second is considered as a transitory roost for several species that use it only between September and December when it is abruptly abandoned.
Each year, from 2018 to 2023 (excluding 2020), we conducted a mist-netting session at the presumed swarming site by positioning a 6 x 3 m mist net at the entrance of the roost, i.e. covering ca. 90% of roost entrance, from sunset to approximately 5 hours to limit disturbance. After capturing, we immediately processed each bat, recording usual biometric data, together with the side of the net where the bat was captured as a proxy of the bat’s flight direction. Individual bats were released in situ, but away from the net, on average within 10 minutes from capture.
To analyze the presence of a sex bias in the numbers of bats, we used a chi-square test comparing the proportion of males and females emerging from and entering in the roost across all years.
In total, we captured 8 species and 407 individuals (range: 56-108; median: 81) considering all species occurred over the sampling period. The sex ratio in *M. schreibersii* was very unbalanced towards males with 152 males emerging from and 70 entering the roost, and 20 females emerging from and 48 entering the roost. However, the chi-squared test showed a statistically significant difference between males and females with more females entering the roost (p-value < 0.001).
Although more analyses are needed to take evidence of the swarming behavior (e.g., social call analysis) which may differ among species and temporal scales, our results support a signal of swarming behavior in *M. schreibersii* with an intersexual variation in strategies to maximize fitness as observed in other species with confirmed swarming behavior. Future studies may compare ecological traits of species with known swarming versus species with no evidence of it to investigate which ecological characteristics, if they are, are associated with the swarming behavior.

Movement and social behaviour of individual wild boar (*Sus scrofa*) after different management approaches

DalCanale S. [1,2,3], Pontiggia P.[3,4], De Nicola V.[1,2,3], Ossi F.[1,5], Franzetti B.[6], Garret S.[7], Cagnacci F.[1,5]

1. Fondazione Edmund Mach, San Michele all'Adige, Italy
2. Center Agriculture Food Environment, University of Trento, San Michele all'Adige, Italy
3. Field Engine Wildlife Research and Management, Connecticut, USA
4. Università degli Studi di Roma Torvergata, Roma, Italy
5. National Biodiversity Future Centre, Palermo, Italy
6. Istituto Superiore per la Protezione e la Ricerca Ambientale, Roma, Italy
7. Mississippi State University, Mississippi State, USA

The proliferation of wild boar populations has increased concerns about the transmission of African Swine Fever (ASF) from wild to domestic environments. This disease poses a serious threat to both wild and domestic pig populations, requiring extensive measures to prevent ASF contamination. In addition, the combination of intensive agricultural practices and the overabundance of these highly plastic and opportunistic animals has escalated human-wildlife conflicts with significant economic implications, including in urban contexts (e.g., car accidents, littering). Many management methods offer only partial removal of a social group (e.g., trapping, hunting). For these reasons, it is essential to develop management practices to control wild boar while understanding the effect of individual removal on the movement ecology of the remaining components of a healthy group.

Field Engine Wildlife Research and Management (FEWR) has patented a simple but effective trap, the Pig Brig®. The aim of this trap is to increase the number of individuals captured in a single trapping event (whole sounder capture), reducing the impact on them and the cost of management operations. The Pig Brig® is a passive trapping system that works like a creel, exploiting the rooting behaviour of pigs. Individuals are attracted to the feed in the centre of the trap, pass under the net, and are held in the net by a partial net floor. The use of Pig Brig® is still in its infancy and needs to be accompanied by a thorough scientific understanding of the effects of partial removal on the social behaviour and movement ecology of the target sounder groups.

We propose to study the response of individual wild boars, both in terms of movement and interactions, when different management approaches are put in place. Specifically, we are interested into the effect of partial removal of the sounder on the remaining individuals. We will study these aspects in three areas in Italy comparing the effect of the removal of the whole sounder group (by Pig Brig®) with other management actions such as the partial sounder removal or selective hunting. In each area, we will use Pig Brig® traps to capture the two closest social groups of wild boar, one of which will be the "experimental" group, while the other will act as a "control" group. In the control group, all adult females will be fitted with GPS collars and juveniles will be fitted with GPS ear tags integrated with proximity sensors to understand their movements and interactions. In the treatment groups, all adult females or few of them (according to the management strategy to be tested) will be removed from the sounder, while juveniles will be monitored in a similar way to the control group. We will monitor this case-control study in time, too, by looking at reproduction rates and dispersal events.

Eurasian otter diet reflects prey distribution along three Italian rivers

De Sanctis C.[1,2], Mirone E.[1,2], Giovacchini S.[1,2], D'Aloise S.[1], Di Febbraro M.[1], Loy A.[1,2,3]

1. Envix Lab, University of Molise, 86090, Pesche (IS), Italy
2. CNR-IRET, 00015 Montelibretti (RM), Italy
3. IUCN SSC Otter Specialist Group, Gland, Switzerland

The Eurasian otter (*Lutra lutra*) suffered a significant contraction of its historical European range, caused by several anthropic threats. In Italy, it survived only in the southern part of the Italian peninsula, from where it is gradually recovering in its former range and is now classified as Vulnerable on the national Red List. As other predators, increasing the knowledge about the feeding ecology of the otter is a key step in developing effective conservation strategies and foster its expansion.
We compared fish remains in otters scats along 30 km of three Italian rivers, i. e. Bussento (Campania, from upstream to the mouth), Biferno (Molise, from Liscione Lake to upstream), and Sangro (Abruzzo, from Barrea Lake to upstream). From 2018 to 2021 we collected 704 otter spraints at 21 mfrequent marking sites. Undigested prey remains were identified through morphological analyses and included mainly fish, followed by amphibians, crustaceans, reptiles, insects, birds and mammals. Remains of fish were identified at the family level. To compare the frequencies of fish families along the rivers, marking sites were pooled in three 10 km river sectors for each river. Frequencies of fish families were compared among river sectors through generalized linear mixed models (GLMMs), setting the sampling site as a random effect nested within river sectors. Model goodness-of-fit was assessed through conditional R2, while predictive performance was quantified through a five-fold cross-validation approach, calculating the area under the receiver operating characteristic curve (AUC). GLMMs showed a good robustness (R2 conditional = 0.94), confirming a significant difference in fish family frequencies among river sectors. By looking at fish family composition in the river sectors, a higher proportion of cyprinids, percids and eels was observed in lentic waters and in the middle and lower sectors of the rivers Biferno and Bussento, whereas salmonids were poorly represented and decreased from the upper to the lowers sectors. Conversely, in Sangro river, prey remains were always dominated by salmonids in all sectors, with cyprinids and percids mostly appearing in the lower sector. These results suggest that the composition of fish prey found in scats reflects the local composition of fish community, informing on otter predatory behaviour and ecology.

Recovery capacity of a damaged bat patagium

Dondini G. [1], Catani F. [2], Consolo M. [1], Giacolini C. [3], Vergari Sim. [1], Vergari Seb. [1]

1. Museo Naturalistico Archeologico Appennino Pistoiese Via Orange, 51028 Gavinana (PT)
2. Fondazione ParSeC- Centro di Scienze Naturali Via di Galceti, 74, 59100 Prato (PO)
3. Bat World Italia Via Bosco dell'Arneret 17, 33080 Fiume Veneto (PN)

The recovery capacity of a damaged bat *patagium* will vary depending on the extent of the damage and the overall health of the bat. In general, bats have a remarkable ability to heal and regenerate tissue, so they may be able to recover from minor damage to their *patagium* relatively quickly.
This work presents data on the recovery capacity and healing speed of lesions on the *patagium* in *Pipistrellus nathusii*, *Hypsugo savii*, *Nyctalus noctula*, *Tadarida teniotis* and *Vespertilio murinus*. Overall, 9 lesions of the patagium were examined, divided among the following species: 1 of *Pipistrellus nathusii*, 5 of *Hypsugo savii*, 1 of *Nyctalus noctula*, 1 of *Tadarida teniotis* and 1 of *Vespertilio murinus*.
The patagium has great regeneration capabilities without the application of stitches or surgical glue, which in fact can irreparably damage the tissue, stimulating the subject to bite the damaged part. A case of this type of incorrect intervention will be showed in *Pipistrellus kuhlii*.
It is highlighted that the speed of recovery of the wound depends on the season: faster in summer and slower in autumn-winter.

The density of meso and macro mammals in a Marsican bear corridor of the Central Apennines

Dragonetti C.[1], Ceci N.[1], Von Kempis S.[1], Trei J.[3], Visconti P.[2], Cipollone M.[3], Di Marco M.[1]

1. Department of Biology and Biotechnologies “Charles Darwin”, Sapienza University of Rome, Italy
2. International Institute for Applied Systems Analysis (IIASA), Laxenburg, Austria
3. Rewilding Apennines, Gioia dei Marsi (AQ), Italy

Ecological corridors are crucial for the conservation of meso- and macro- mammals as they connect suitable habitat patches across the protected areas. Five corridors have been identified in the Central Apennines for the conservation of the endangered Marsican bear (*Ursus arctos marsicanus*). In our study, we evaluated the effectiveness of two of these corridors to support the populations of other mammal species. We focused on the corridor connecting Sirente-Velino Regional Park with Abruzzo, Lazio and Molise National Park (ALMNP) and the corridor connecting the Southern part of ALMNP with the Matese Regional Park. Using camera traps, we applied a Random Encounter Model (REM) to estimate the density of eight mammal species.

Data were collected through 34 camera traps, placed according to a random stratified sampling in the study area, from June 2023 to September 2023. We entities of 8 meso- and macro-mammals species: roe deer (*Capreolus capreolus*), red deer (*Cervus elaphus*), red fox (*Vulpes vulpes*), wild boar (*Sus scrofa*), Apennine wolf (*Canis lupus italicus*), European badger (*Meles meles*), European hare (*Lepus europaeus*) and porcupine (*Hystrix cristata*).

REM is a model that operates with unmarked animals to estimates their population density in a given area, treating animals like ideal gas particles. The densities are estimated based on different parameters: trapping rates (number of independent encounters per unit time), animal day ranges, and the camera traps’ effective detection.

Densities ranged from 0.21 ind./km^2 (SE = 0.08) for the Apennine wolf in Corridor 2 to 4.51 ind./km^2 (SE = 1.93) for the European badger in Corridor 1. Densities in Corridor 1 resulted to be generally higher than corridor 2. This could be explained by the different features of the landscape and by the different degree of anthropization. Our results revealed high densities for most of the analysed species, comparable to the ones estimated in nearby PAs, and even higher in some cases.

This work, being the first population assessment for the species in the areas, represents an important contribution for conservation planning. By confronting our density estimates with the ones in other nearby PAs, we can confirm that corridors intended for the Marsican bear can support other mammal species, and so to determine the potential “umbrella” role of the Marsican bear.

Camera trap monitoring and application of occupancy modelling in the 5 Terre National Park

Duradoni D.[1], Perrone M.[2], Oneto F.[1], Ottonello D.[3]

1 Centro Studi Bionaturalistici Srl, Via San Vincenzo, 2 16121 Genova (Ge)
2 Parco Nazionale delle 5 Terre, Via Discovolo snc c/o Stazione Manarola 19017 Riomaggiore (Sp)
3Arpal Agenzia Regionale per la Protezione dell'Ambiente Ligure, Via Bombrini, 8 16149 Genova (Ge)

Within the 5 Terre National Park (SP) no studies are available that have exhaustively described the presence and distribution of mammal species, with the exception of some data contained within the Ligurian Observatory of Biodiversity (Li.Bi.Oss.). Therefore, in 2022 the Park decided to start monitoring with the use of phototraps: phototrapping is in fact a survey methodology that allows to obtain a large amount of information on medium and large mammals, making it possible to also detect elusive species that particularly frequent wooded areas such as those characterising the study area.
The main objective of the monitoring project is to increase faunistic knowledge of the species present within the Park's territory, in order to identify the areas of greatest specific richness (hot spots) and the environmental factors that characterise them. As a whole, the aim of the study is to estimate the probability of detection of a species and to obtain an estimate of the probability of presence, i.e. the proportion of occupied sites, unaffected by false absences occurring during sampling. The design makes it possible to identify possible differences in occupancy by the target species in the different areas studied and possible intraspecific differences depending on the season considered and environmental conditions.
The study area was divided into a 1x1 km grid within which 10 homogeneously distributed sampling sites were identified. The surveys were carried out between June and November 2022 and 2023, respectively, for a total of 3200 trap nights.
A total of 2014 photograms were collected during the two monitoring seasons, divided among 9 species other than Martes sp. for which the diagnostic characters for specific attribution are not evident. The most common species proved to be wild boar (*Sus scrofa*) and roe deer (*Capreolus capreolus*), together accounting for 83% of the records collected. In second order were the red fox (*Vulpes vulpes*), eurasian badger (*Meles meles*), crested porcupine (*Hystrix cristata*) and red squirrel (*Sciurus vulgaris*). More rare, with frequencies of less than 1%, are the grey wolf (*Canis lupus*), beech marten (*Martes foina)* and edible dormouse (*Glis glis*).

A modern sight of past hearing: taxonomic identification of bat fossil petrosals from Zoolithen cave (Germany) via µCT 3D reconstruction

Eccel N.[1], Schultz J.[1], Martin T.[1]

1. Institut für Geowissenschaften, Abteilung Paläontologie, Universität Bonn, Germany

Unambiguous morphological determination of fossil bat material is usually based exclusively on mandibles, maxillae, isolated teeth, and distal epiphysis of the humerus. However, even the bony parts of the ear region often allow accurate species identification. Petrosals (temporal bone) are commonly preserved in deposits due to their high bone density and unique shape. Even though these highly valuable remains are poorly studied and rarely used for fossil fauna evaluation, scientific interest in the inner ear increased in recent years. Here we investigate the inner ear of fossil bats with the aid of µCT reconstructions.

We focused on samples from Zoolithen cave (Burggailenreuth, Franconia, Germany), where the findings cover a period from the late Pleistocene until recent. This study aimed to describe and identify the species by comparing 3D models of petrosal bones, inner ear cavities, innervations, and main vasculature reconstructed from high-resolution µCT scans. Moreover, three-dimensional measurements on the reconstructed models were carried out for multivariate principal component analyses, to test whether the bony labyrinth proportions are a good proxy for identification.

Among the three different identified species (*Myotis* cf. *mystacinus*, *Myotis* cf. *brandtii*, *Myotis exilis*/*daubentonii*), the bony labyrinth and innervation patterns of the endocasts have species-specific morphology, while the vascular system showed a more inconsistent pattern with wide intraspecific variation. Furthermore, the species composition we detected differed from the thermophilous faunal composition previously reported in the cave (i.e., *M. bechsteinii* as the most common species). Morphology and size also hint at an older age (Lower to Middle Pleistocene) than previously assessed in the bonebeds (Upper Pleistocene).

Overall, µCT scanning and 3D reconstructions aid in identification, which could be limited by the preservational state (e.g., damaged semicircular canals). The greater detail compared to bare stereomicroscope observation allows precise measurements, more efficient and immediate manipulation, and thorough visualization of small and internal anatomical parts. Moreover, two cryptic species (*M. mystacinus* and *M. brandtii*) could be readily distinguished and the age estimated from morphology and size is compatible with a speculated and controversial older age of the cave's bonebeds. Thus, this work shows the potential of bat petrosals for future biostratigraphical and palaeoecological studies while offering a basis for possible phylogenetic, functional, or systematic analyses.

First data on ecology and biology of *Dryomys aspromontis* in Aspromonte National Park (Calabria, Italy)

Fava E.[1], Provenzano M.[1], Siclari A.[2], Aloise G.[3]

1. Associazione Ge.Co., Largo S. Antonio 12- 88046 Lamezia Terme (CZ)
2. Città Metropolitana di Reggio Calabria, Piazza Italia - 89100 Reggio Calabria
3. Museo di Storia Naturale e Orto Botanico Università della Calabria, via Savinio, Edif. Polifunzionale-87036, Rende (CS)

The aims of this research are to show the first data in Southern Italy on biology and ecology of Calabrian forest dormouse *Dryomys aspromontis*. The research was conducted between 2018 and 2020 to study Calabrian forest dormouse in the Aspromonte National Park. 400 nest boxes were placed on trees in 20 monitoring sites located in 5 different habitat types by stratified sampling method (beech forests, coniferus forests, chestnuts forests, oak forests, mediterranean evergreen shrubs) and were monitored monthly. During nest box surveys were signed occurrence of Calabrian forest dormice, nests, signs of presence, physiological status and if possible, recorded biological data of individuals. The presence of *D. aspromontis* in Aspromonte National Park was recorded in 6 monitoring sites located in 2 habitat type (beech dominated forests and mixed forests with high conifer presence) in an altitude range of 1200-1850 m asl. First signs of presence in the monitoring sites were observed from a minimum of 2 to a maximum of 14 month after nest boxes placement. Most of nests were mainly made with musk and lichen. Sometimes, forest dormice used nest boxes previously occupied by birds or other dormice. Nest box was defined as “active” when it contained 1 or more dormice, new nests, nests with evident signs of recent presence (fresh pellets and food remains). Nest-boxes were active from May to October. No forest dormice in hibernation phase was observed in nest boxes. No dormice or new sign of presence were observed in nest boxes from November to April suggesting that a hibernation phase occurred probably in this period.
Calabrian forest dormice used nest boxes for breeding in 2020 (6 nest boxes in 5 monitoring sites). Probably, breeding period was between May and July. First pups were observed at the end of June (min 1 – max 3 pups with furs and open eyes, but very small size). Last litter, comprised of 3 almost independent juveniles, was found at the end of September. Mean litter size was 2 individuals (ds: ± 1,09; min 1-max 3 individuals). It would seem that the female remains with puppies until one month after birth. Presence of several individuals in the same nest, would seem to be linked to the reproduction period (min 2-max 4 individuals).

Bats of the caves of Monte Soratte (Lazio, Rome)

Ferri V.[1], Bernabei T.[2], Bernabei M.[3], Marini F.[4], Battisti C.[4]

1. Centro Studi Naturalistici Arcadia, via Valverde 4, Tarquinia (VT)
2. Associazione Geografica La Venta
3. Gruppo Speleologico Sabino "P. Cometti"
4. Città Metropolitana di Roma Capitale, Servizio Aree protette , viale Giorgio Ribotta n 41-43 Roma

There are not many Italian protected areas that can boast a continuity of investigations and monitoring of present bats over such a long period of time: starting from 2006 with first data on the presence of these mammals in the large tunnels of the Monte Soratte Bunker, to the research by Ferri and collaborators began in 2010 and continued almost annually, until 2021 both to support VIncA with respect to the interventions and projects to be carried out in the "Soratte Bunker" and to expand scientific knowledge throughout the accessible "external" area of the Reserve Natural and to raise awareness among citizens and visitors to the area about bats.

During 2023, a research was activated (on behalf of the Metropolitan City of Rome Capital - Protected Areas and protection of biodiversity - DPT0303) aimed at verifying which and how many taxa of Bats frequent them permanently or only for the winter, the largest known natural underground cavities of Monte Soratte (Natural Reserve and Special Conservation Area IT6030014). In this first year the monitoring was only bioacoustic, with positioning - coordinated with speleologists - of Ultramic 384BLE Dodotronic bat detectors, from April to September.

Within the 10 studied cavities, 11 species/taxa of Chiroptera were found: 3 Rhinolophidae (*Rhinolophus ferrumequinum, R. hipposideros, R. euryale*), 6 Vespertilionidae (*Pipistrellus pipistrellus, P. kuhlii, Hypsugo savii, Eptesicus serotinus*, two different *Myotis* n.d., 1 Miniopteridae (*Miniopterus schreibersii*) and 1 Molossidae (*Tadarida teniotis*). Species recognition of *Myotis* is currently being studied.

Rhinolophus hipposideros was found to be present in all cavities and this confirms the good situation of this species in the monitored areas of Lazio, with at least stable populations. The confirmation of *Rhinolophus euryale* also in the reproductive period in 3 cavities is important. The large Santa Lucia Cave proved to be a fundamental site for the bat fauna of this protected area and all taxa reported with this study frequented the cavity. The research also made it possible to verify the safety of the accesses with respect to human attendance and to provide for a suitable closure of the most dangerous hypogea.

Proposals to reduce the impact of second generation Anticoagulant Rodenticides on non-target fauna

Ferri V.[1], Aldi D.[2]

1. Centro Studi Naturalistici Arcadia, via Valverde 4, Tarquinia (VT).
2. Centro Recupero Animali Selvatici Parcobaleno, via L. Guerra 4/b, Mantova (MN).

Intoxication by second generation anticoagulant rodenticides (SGAR), together with pesticides and other toxic substances, causes more than 11% of the mortality of European Strigiformes. Small portions of prey poisoned by Brodifacoum and Difethialone (among the most used molecules in the composition of the most used products in urban and agricultural areas in the control plans of *Rattus* sp. and *Mus* spp.), are lethal for an adult *Tyto alba* and *Strix aluco*, the most affected species. Unfortunately, the free trade of these products even to private citizens, with therefore indiscriminate use and in every environment, is also having notable consequences on other micromammals' predators.

As recent work proves, the use of SGAR is having harmful consequences on numerous animal species, both wild and domestic, both through the direct consumption of bait and through secondary poisoning. In a study carried out between 2006 and 2016, it was ascertained that 91% of birds of prey found dead or hospitalized at a Recovery Center in Massachusetts (USA) tested positive for two or more different types of rodenticides containing in addition to Brodifacoum and Difethialone also Bromadiolone. A Danish study on the diffusion of the latter molecule in small non-target mammals demonstrated intoxication in 12.6% of small rodents (*Apodemus flavicollis*, *Myodes glareolus*, *Microtus agrestis* and *Micromys minutus*) and insectivores (*Sorex araneus*) caught in the ray of approximately 20 meters from the box containing the treated bait, with individuals found poisoned more than 80 meters away.

The work we present here aims to take stock of the regulatory and commercial situation of these products and ask for maximum attention and collaboration in order to achieve at least an exclusively professional use of products containing SGAR and, above all in extra-urban and agricultural areas, the obligation to evaluate the environmental sustainability of "disinfestation" interventions to avoid indiscriminately affecting other non-target species. The promotion and activation of high-tech eco-friendly alternative routes, which are already significantly widespread and with more than positive results, is also fundamental.

Factors affecting habitat use of brown hyena *Parahyaena brunnea* in the Fish River Canyon, Namibia

Ramello V.[1], Augugliaro C.[2], le Roux L.[3], Bormioli M.[4], Franchini M.[5]

1. Department of Research and Conservation, Wildlife Initiative Italia, Via Monte Tesoro 21, 37132, Verona (VR), Italy.
2. Wildlife Initiative, Bayangol, 6th Khoroo Micro District 10, 210349, Ulaanbaatar, Mongolia.
3. Canyon Nature Trust, P O Box, 90311, Windhoek, Namibia.
4. Large Cat Conservation Trust, 5 Groot Tiras Street Eros, 90311, Windhoek, Namibia.
5. Department of Agrifood, Environmental and Animal Sciences, University of Udine, Via delle Scienze 206, 33100, Udine (UD), Italy.

The brown hyena *Parahyaena brunnea* has experienced a significant contraction of its historical distribution range, primarily due to anthropogenic factors such as negative human–wildlife interactions, poaching, habitat loss/fragmentation, and vehicle collisions. Namibia hosts nearly one–third of the global brown hyena population. The species' spatial ecology remains poorly understood likely due to its nocturnal behaviour, making it challenging to study. The purpose of this study was to realize the first assessment of the main environmental and biological/anthropogenic factors affecting the habitat use by the brown hyena in the Fish River Canyon, Namibia. Investigating the habitat use by this species assumes paramount importance, particularly considering its crucial role in the ecosystem.
From May to October 2023, 54 camera–traps were arrayed in 52 stations, with a minimum distance of two km between them, distributed across the Canyon Nature Park (17°35' E; 27°26' N), Namibia.
Overall, the study area covered 349 km^2 (Minimum Convex Polygon – MCP). Cameras were placed along trails, narrow passages, and near marking points or water sources. The habitat use was explored using single–season single–species occupancy models. Elevation (m), Topographic Position Index (TPI), Topographic Wetness Index (TWI), and Topographic Ruggedness Index (TRI) were selected as environmental covariates. The relative abundance index (RAI) of the common leopard *Panthera pardus*, springbok *Antidorcas marsupialis*, klipspringer *Oreotragus oreotragus*, Cape hare L*epus capensis*, and red rock hare *Pronolagus* sp. were selected as biological covariates, while the RAI of humans (on foot and by car) as anthropogenic covariate.
As for the environmental covariates, the findings obtained from the best model showed that the brown hyena's habitat use was significantly and positively affected by the elevation ($\beta = 1.26 \pm 0.63$ SE, $z = 2.0$, $p = 0.04$) while significantly and negatively affected by the TPI ($\beta = -2.61 \pm 1.22$ SE, $z = -2.14$, $p = 0.03$). Conversely, as for the biological and anthropogenic covariates, the results obtained from the best models revealed no significant effect of the covariates 'RAI springbok' ($\beta = 2.35 \pm 1.87$ SE, $z = 1.25$, $p = 0.21$) and 'RAI humans by car' ($\beta = -19.70 \pm 51.30$ SE, $z = -0.38$, $p = 0.70$), respectively.
The findings from this study suggested that topography has the strongest influence on brown hyena habitat use. The lack of significant effects from the considered biological covariates may indicate (i) no preference for certain prey, potentially favoured by the species' generalist/opportunistic feeding behaviour, and (ii) reduced competition or facilitation due to low common leopard abundance in the area. The absence of a significant effect from human presence may be explained by the low density of humans in the area, as well as by the brown hyena's ecological plasticity.

Wolf activity patterns in the Foreste Casentinesi National Park

Franco A.[1], Dissegna A.[2], Mencucci M.[3], Cappai N.[4]

1. Università degli Studi di Milano, La Statale, Milano (MI), Italy
2. Università di Padova – Dipartimento di Biomedicina Comparata e Alimentazione, Padova, Italy
3. Reparto Carabinieri Parco "Foreste Casentinesi", Pratovecchio Stia (AR), Italy
4. Parco Nazionale delle Foreste Casentinesi, Monte Falterona e Campigna, Pratovecchio Stia (AR), Italy

Different studies have investigated the ecology and the behaviour of the Apennine wolf (*Canis lupus italicus*) in Italy since its protection in the '70s. Elusive and highly adaptable, wolf populations had shown many different strategies in order to increase and expand still avoiding human presence, such as a mainly nocturnal activity. In the Foreste Casentinesi National Park, wolves began to recover since the '80s and exceeded the number of 10 packs present. Despite many studies about genetics, packs composition and distribution, activity patterns in this area were never been explored. For the first time, we focused on temporal data collected in a 3 winters period (2019/2020, 2021/2022, 2022/2023) through camera trapping, aiming to find the average activity pattern of this species in the protected area and to verify if there are variations among packs and solitary individuals.

We used a 5x5 km sampling grid composed by 30 cells and placed at least one camera trap per cell, from December 1st to March 31st of each winter. We considered as camera stations marking points or wolf paths, in order to maximize captures. Camera traps were set to work 24h/7 and to take 30-60 s videos. Each camera trap was inspected every 14 days and moved to another position in case it was not detecting wolves. Wolf videos have been independently analysed by two trained operators, reporting time, number of wolves and behaviour. We considered as packs only groups of three or more individuals. Pack identifications were based on pack composition, camera traps positions and especially on peculiar ("focal") individuals. We obtained activity patterns based on kernel density, finding the maximum and minimum peak during the day and comparing them among different sampling years. We also analysed the differences among packs and solitary individuals, focusing on neighbour wolves' comparison. Furthermore, when identification was possible, we estimated the pattern followed by the same pack through the years.

We obtained a total number of 3378 wolf videos in three years. Global activity patterns showed an higher peak at 7:30 pm, a lower peak at 01:30 pm and a second maximum peak around 01:00 am, with no significant changes through the years. We identified: 12 packs, 3 couples and 9 solitary individuals in 2019/20; 14 packs, 4 couples and 6 solitary individuals in 2021/22; 15 packs, 4 couples and 5 solitary individuals in 2022/23. We compared the three years overall activity with the activity from each year, showing a high index of overlap (about 97% each year). Furthermore, we compared the overall activity with each pack, couple and solitary individual. We mostly found differences analysing solitary individuals, while only few packs showed some significant differences with the overall activity. Index of overlap between the overall packs' activity and the overall solitary individuals' activity was 68%, considered as a significant difference ($p<0.05$), while comparison among packs and solitary individuals sharing part of their home range showed indexes of overlap ranging from 40% to 80%, with 9 out of 11 indexes calculated below the 70%, showing a significant difference.

Wolves' global activity patterns in the Foreste Casentinesi National Park resulted comparable to other studies. We found variability in packs and solitary individuals activity patterns, with what seems a common temporal avoidance behavior in solitary individuals in packs home ranges. This study shows how important could be for future management and research projects to better understand wolf adaptive behaviour in areas with both human presence and high packs density.

Exploring the ecology of the European polecat (*Mustela putorius*): a collaborative initiative in Italy

Fusillo R.[1], Carrea C.[2], Crispino F.[3], Ferrante G.[4], Gervasio G.[3], Giovacchini S.[5,14], Greco I.[6], Malavasi S.[7], Manzo E.[8], Marcelli M.[1], Marini S.[9], Massolo A.[10], Mori E.[11], Palombi A.[12], Pastorino A.[2], Petroni L.[10], Rovero F.[6], Sforzi A.[13], Spada A.[7], Trei J.N.[14], Viviano A.[11]

[1] Lutria sas *WRC*, via S. Oberto 69, 00173 Roma, Italy; [2] Il Piviere srl, via Cavalieri di Vittorio Veneto 23, 15066 Gavi (AL), Italy; [3] Greenwood s.c. via Pozzillo 21, 87045 Dipignano (CS), Italy; [4] Dip. Biologia Ambientale, Università La Sapienza, p.le Aldo Moro 5, 00185 Roma, Italy; [5] University of Molise, contrada Fonte Lappone, Pesche (IS), Italy; [6] Dip. Biologia, Università di Firenze, Via Madonna del Piano 6, 50019 Sesto Fiorentino (FI), Italy; [7] Dip. Scienze Ambientali, Informatica e Statistica, Università Ca' Foscari, Via Torino 155, 30172 Venezia Mestre, Italy; [8] Fondazione Ethoikos, Convento dell'Osservanza, 53030 Radicondoli (SI), Italy; [9] Via Morelli 7, Norcia (PG), Italy; [10] Ethology Unit, Department of Biology, University of Pisa, Pisa, Italy; [11] Consiglio Nazionale delle Ricerche IRET, Via Madonna del Piano n. 10, 50019 Sesto Fiorentino (FI), Italy; [12] Riserva Naturale Regionale Monte Rufeno, piazza Santa Maria 1, 01021 Acquapendente (VT), Italy; [13] Museo di Storia Naturale della Maremma**,** Strada Corsini n. 5, 58100 Grosseto, Italy; [14] Rewilding Apennines, via san Giorgio, 5, Gioia dei Marsi (AQ), Italy

The European or Western polecat (*Mustela putorius*) is a medium-sized carnivore native to the Western Palearctic, belonging to the Mustelid family. Its wide distribution and supposedly large populations justified the inclusion among mammals of Least Concern at global and national level. However, the paucity of updated population and distribution data prevents high-confidence assessment of its conservation status. In addition, as a solitary carnivore, the polecat usually occurs at low densities and there is evidence of populations decline in some European countries. For these reasons, the polecat remains a protected species under European (Habitats Directive, Annex V) and national laws (L. 157/1992), and is subjected to periodical assessment obligations. This mostly nocturnal and elusive mesocarnivore can be considered under several aspects a poorly studied mammal. Nowadays, camera-trapping is among the most promising field techniques for studying *M. putorius*; however, an evaluation of the efficacy and relevance of this technique for polecats is lacking.

During 2022, the Mesocarnivore Research Group of the Italian Mammal Society launched a nationwide initiative aimed at improving the ecological knowledge and distribution data of two neglected mustelids: the polecat (*M. putorius*) and the weasel (*M. nivalis*). As part of this initiative, the group explored, among some Italian theriologists, the availability of camera-trapping data of polecats, and the willingness to commonly analyze them. The main objective was to evaluate ecological factors and sampling conditions associated with polecat detections. A further goal of the project was to gather hints and suggestions to improve the application of camera-trapping for future polecat studies.

Eleven research groups joined the collaborative study. Polecat images and videos were collected, during systematic camera-trapping surveys, at 759 sampling sites in 10 regions of the Italian peninsula (Liguria, Veneto, Toscana, Emilia-Romagna, Umbria, Marche, Abruzzo, Lazio, Campania, Calabria). Sixty-four percent of camera-trapping sites are located in protected areas. The common dataset includes data collected during last fifteen years, mostly (93%) after 2014. The total camera-trapping effort exceeds 100.000 trap-nights. Sampling covers all seasons. One or more polecat events (i.e. photographic captures) occurred at 14.5% of sampling sites.

The collaborative group is currently considering the selection of appropriate response variable and modeling approaches supported by available data. Specifically, we aim to evaluate the influence of season, elevation, distance to freshwater habitats, and general habitat on polecat occurrence probability, while considering factors affecting polecat detectability, such as camera-trap features and sampling protocols.

Recolonizing otters (*Lutra lutra*) in southernmost Italy fail to occupy small rivers in urban areas

Marcelli M. [1], Luzzi G.[2], Fusillo R.[1]

1. Lutria sas Wildlife Research and Consulting, via S. Oberto 69, 00173 Rome, Italy
2. Appennino Lucano Val d'Agri - Lagonegrese National Park, via Manzoni 1, 85052 Marsico Nuovo, Italy

Accurate assessment of patterns and drivers of changes in species distribution is key to conserving biodiversity. Understanding how human land use constrains species distribution can be used to prioritize conservation actions. A reduction in impacts of human land use on habitats may be one of the factors involved in the recolonization of past ranges by native species. The signature of this process could be detected as a temporal reduction of land use effects on species occupancy, or as residual effects that act only in habitats more sensitive to anthropogenic stressors. We explored these hypotheses for Eurasian otter (*Lutra lutra*) in Italy, a nationally vulnerable species with a restricted but expanding range. Human land use is likely to affect otters due to their association with riparian and aquatic habitats.

We used three independent survey datasets collected in 2003, 2009 and 2019 at the southern range periphery, and unpaired-site occupancy models to account for imperfect detection. To assess how land use affects recolonization by otters we tested three main predictions: (1) Occupancy increased over years, (2) Effects of agricultural and urban land cover on occupancy decreased over years, (3) Effects of land use did not change with time but varied with stream size and elevation.

We found evidence of a large occupancy increase, with predicted mean occupancy of 0.27 in 2003 and 0.65 in 2019. An interaction effect of urban land use with stream size was the strongest predictor of otter occupancy. Namely, higher proportion of urban land cover around streams was predicted to reduce the probability of occupancy at smaller streams, but did not influence occupancy at larger streams. In spite of a large increase in occupancy, otters at the southern periphery of the Italian range were unable to colonize small rivers in urbanized areas.

The pattern we found agrees with our expectation that human land use can affect recolonizing species at sensitive habitats, considering the intrinsic vulnerability of small stream ecosystems to anthropogenic stressors. Restoring small streams crossing urban areas can be a valuable conservation action to increase habitat connectivity and encourage recolonization of otters.

The presence of wolves in the Terra delle Gravine Regional Natural Park

Gaudiano L.[1], Pinto R.[1], Cascella A.[1], Pucciarelli L.[1], L'Erario P.[1], Chiatante G.[2]

1. Systema Naturae Via G. Salvemini 19, 70056 Molfetta (BA), Italy
2. Department of Ecological and Biological Sciences, University of Tuscia Largo dell'Università s/n, 01100 Viterbo (VT), Italy

This work fits into the context of the wolves' expansion in southern Italy, contributing to the understanding of ecology and management of this new phase of colonization. The data were obtained from two different project activities. The first, from 2016 to 2018, falls within the scope of the project 'UPPark! Network strategies for the Terra delle Gravine Park'. The second, conducted from 2019 to 2020, as part of project "Action 8 - Actions for the conservation of the Apennine wolf *Canis lupus*", as part of a broader project axis "Actions for the conservation of flora and fauna of conservation interest in the SAC/SPA Area delle Gravine - IT9130007". For both projects, the objectives we set focused on obtaining informations about the presence and the spatial arrangement of breeding packs of wolves in the Terra delle Gravine Regional Natural Park (about 25.000 ha, included within the SAC/SPA Area delle Gravine and SAC Murgia di Sud-Est IT9130005). Such information would be of particular conservation and management relevance due to a series of peculiarities of the territory under investigation. In the first instance, the protected area extends over a series of canyons characterized by steep rocky walls, rich biodiversity and of significant ecological relevance, surrounded by an agricultural agroecosystem. Furthermore, this territory boasts an ancient pastoral tradition with the breeding of indigenous breeds of conservation significance. In order to achieve the objectives, the applied methods were camera trapping (from 2016 to 2021) and wolf howling (2019-2020). Camera trapping was conducted using an opportunistic method, uniformly investigating the areas of greatest relevance within the park territory. The average number of sites investigated was 14.6 (min2019=5; max2016=20). The sampling period coincided with the reproductive season and the territorial phase of the species (March-September). From the analysis of camera trapping data, a relative abundance index (trap rate) and the presence of reproductive nuclei were obtained. Wolf howling was conducted during the summer period, from July to September. The survey stations were set based on a study of suitability related to the possibility of the presence of rendezvous sites. The number of stations investigated in the two years of the study was 55 (272019 and 282020). The results from the camera trapping activity show a widespread and ubiquitous presence within the territory of the Park; the trap rate values seem to vary over the years of the investigation (K-W H-test $p<0.05$), with a prevalence in the central (Sant'Antuono Wood and Mount Sant'Elia) and western (Laterza Canyon and Ginosa Canyon) sectors. In these two areas, through the study period, and in accordance with the data obtained from wolf howling, we have always contacted at least two reproductive packs.
In order to understanding the ecological preferences and spatial dynamics of wolf populations, we recorded land use data for each rendezvous location, categorizing them into various land use classes based on the Corine Land Cover categorization and the official Land Use data of the Environmental Department of Regione Puglia. We organized the database to be readable in R, assigning numeric codes to different land use classes, and the statistical analyses were performed using the R 'stats' package. We performed t-test analyses to assess whether there were differences in land use between positive and negative rendezvous sites. Finding no significant disparities (p values > 0.05), we subsequently conducted PCA to delve deeper into the various land use classes characterizing the rendezvous, with the aim of identifying the most relevant ones. The first three PCA dimensions described 38.73% of the variation, revealing distinct ecological patterns influencing wolf rendezvous site, highlighting natural habitats being negative correlated to human settlements. Moreover, the results showed positive correlation among grasslands, coniferous forests, and agricultural areas, underscoring the importance of natural habitats for wolf ecology and the coexistence with human environmental features, even though further studies are needed to explore social and behavioral factors influencing rendezvous site selection. Our study provides valuable insights into the ecological drivers shaping wolf habitat utilization, offering a guide to conservation efforts and management strategies for this peculiar territory, promoting coexistence between wolves and human communities.

Predation by feral cats on breeding colonies of Scopoli's Shearwater *Calonectris diomedea* and Yelkouan shearwater *Puffinus yelkouan* on Tremiti Islands, Mediterranean Sea

Gaudiano L.[1,2], Luce G.[2], Biondo C.[3], Dell'Agnello F.[3], Magarielli L.[2], Pucciarelli L.[1,2], Sposimo P.[3], Corriero G.[2]

1. Department of Biology, Biotecnology and Environment, University of Bari, Via Orabona 4, 70125 Bari BA, Italy
3. Systema Naturae Via G. Salvemini 19, 70056 Molfetta, BA Italy
4. Nature and Environment Management Operators Srl, Viale Giuseppe Mazzini, 26, 50132 Firenze FI Italy

The impact of the introduction of domestic cats (*Felis catus*) to offshore and islands world-wide have had deleterious impacts on endemic land vertebrates and bird populations. Feral cats are known to have driven numerous extinctions of endemic species on islands and have contributed to at least 14% of all 238 vertebrate extinctions recorded globally by the IUCN. In addition, predation by feral cats currently threatens 8% of the 464 species listed as critically endangered. Feral cats feed on a wide variety of prey and they are considered opportunistic and generalist carnivores. Seabirds, particularly petrels and shearwaters, are often negatively affected by introduced cats due to their lack of defence against terrestrial predators and because their population dynamics are sensitive to high adult mortality. For these reasons, feral cats are considered to be one of the 100 worst invasive species in the world. In Italy, the national law 281/91, concerning the management of pets and the control of feral cats, has introduced a no-kill policy for this species. Thus, "trap-neuter-release" (TNR) programmes have been carried out to control the increase of populations of feral cats. This study, which aims to examine the cats' impact on seabird population, was carried out on Tremiti Islands (Protected Marine Area EUAP0168), a small archipelago belonging to the Adriatic Sea (Italy), entirely included in the SACIT9110011 "Isole Tremiti" and in the Important Bird and Biodiversity Areas (IBA222 "Medio Adriatico"). The islands host the only adriatic Italian colony of Scopoli's shearwater *Calonectris diomedea* (Least Concern in the Red List of Threatened Species of the International Union for Conservation of Nature IUCN) with 300-400 cp and Yelkouan shearwater *Puffinus yelkouan* (Near Threatened and declining in the IUCN red list) with 100-150 cp. Within the project LIFE Diomedee - LIFE18 NAT/IT/000920, with the aim to protect species and habitats in Tremiti (Diomedee) Islands and other Apulian SCI's through actions against IAS, monitoring activities were carried out in order to identify Yelkouan and Scopoli's shearwater nest cavities, thus to asses breeding success. In 2023 linear transects were walked three times on San Domino Island along the coast line for a total of 5,1 km. The total number of nests sites investigated amounted to 42.

Each cavity was investigated by means of head torches and a telescopic probe. In the surveyed area a total of 14 carcasses of shearwaters (4 *P. yelkouan* and 10 *C. diomedea*) potentially preyed on by cats were found. All the carcasses were found in the nest sites in the southeast of the island, near the village. In other occasions, signs of cat presence were recorded on sandy ground of shearwater breeding sites, suggesting a continuous inspection of the cavities in search of shearwaters.

Furthermore, camera traps (totally: 230 night) were placed in three shearwater nests, in order to understand the presence of cats on nest sites. In a particularly rough multi-nest cavity, we verified the attendance of 3 different cats on 40% of the nights investigated, directly confirming two predation events on Scopoli's Shearwater adult while laying egg. Therefore, we have confirmed the predatory habit (and consumption of prey) of feral cats on a nest of a stretch of coast close to the village. The impact of cat predation supports the urgent need to manage feral cats from this major Shearwater breeding site: such action is considered a priority for the conservation of seabird colonies.

The return of the otter *Lutra lutra* in the Latium region. Is environmental DNA as a reliable monitoring tool?

Giovacchini S. [1,2], Mirone E. [1], Bruno A. [3], Ramazzotti F. [3], Caprotti L. [3], Krupa H. [1,2], Monaco P. [1], Jamwal P.S. [1,2], Canu A. [4], Galaverni M. [4], Di Febbraro M. [1], Galimberti A. [3], Loy A. [1,2,5]

[1] University of Molise, contrada Fonte Lappone, Pesche (IS), Italy
[2] IUCN SSC Otter Specialist Group, Gland, Switzerland
[3] University of Milano-Bicocca, piazza della Scienza 2, Milano, Italy
[4] WWF Italia, via Po 25/c, Roma, Italy
[5] CNR-IRET, 00015 Montelibretti (RM), Italy

Once widespread throughout Italy, the Eurasian otter (*Lutra lutra*) suffered a drastic decline in the last century. At the end of the 1990s its range was limited to a few river basins in southern Italy and the species was classified as Critically Endangered in the national Red List. Rigorous protection and banding of harmful pollutants allowed a slow but constant recovery since the beginning of this century. As the species is listed in Annex II and IV of the Habitat Directive 92/43/EEC, it is mandatory to guarantee a proper surveillance of its conservation status over time. Environmental DNA (eDNA) represents a cost-effective novel technique that could support traditional species survey and monitoring.

We tested eDNA efficiency in detecting the otter in freshwater bodies and compared it with a traditional standard field monitoring technique. The study was run at the boundary of the current otter range to i) assess new colonization events, ii) comprehend if eDNA is a profitable monitoring tool to detect the species in new areas of occurrence.

A systematic field survey recommended by IUCN SSC Otter Specialist Group, was run in 6 river basins (Liri, Amaseno, Mignone, Marta, Fiora, Paglia) of the Latium region by searching for otter tracks along 600 m of riverbank at 208 sites. Water samples (3 liters) were collected at 17 sampling sites along the same rivers with two replicates (2021 and 2022).

Water samples were prefiltered employing cellulose mixed esters 8 μm filters and then filtered with 0.22 μm filters using a vacuum pump. DNA was extracted from filters using Power Soil extraction kits, and then amplified using Eurasian otter species-specific primers through quantitative PCR. Detections from eDNA and field standard survey were compared at the scale of i) sampling site, ii) 5 km radius upstream, iii) 10 km radius upstream.

Environmental DNA allowed to detect otters at 8 over 17 sampling sites, seven located in the southern catchments of Liri river and Pontine Marshes, and one in a tributary of the river Tiber at the regional boundary with Tuscany (river Paglia). Standard surveys confirmed otter occurrence in the Liri river basin, where otter signs were found at 23 sites. In contrast, no otter signs were found in the river Paglia, nor in the rivers of northern Latium where a remnant otter population occurred until 2000. Compared to traditional field survey, eDNA showed a higher detection rate (0.41) compared to standard survey, analysed at both sampling site (0.06), 5 km radius (0.23) or 10 km radius (0.35). By excluding true absences (i.e. sites that were negative to both eDNA and field samplings), detection values just readjusted but eDNA detection remained higher (0.8 vs 0.1, 0.4, and 0.6). Fisher's Exact Tests showed statistically significance in the difference among eDNA and standard surveys at sampling site scale only.

These results proved eDNA to be a more sensitive method in revealing otter presence, as already evidenced by our team in Himalaya.

Spatial distribution and niche comparison of weasels in northwestern Italy

Granata M.[1], Belfiore A.M.[2], Di Paolo, F.[1], Di Febbraro, M.[2], Bertolino S.[1]

1. Department of Life Sciences and Systems Biology, University of Turin, Turin, Italy
2. EnviXLab, Department of Biosciences and Territory, University of Molise, Pesche (IS), Italy

Over the last decade, Ecological Niche Models (ENMs) have emerged as valuable tools for investigating spatial distribution and comparing species' ecological niches. Currently, northwestern Italy hosts three weasel species: least weasel *Mustela nivalis*, stoat *Mustela erminea*, and western polecat *Mustela putorius*. While the stoat is commonly reported in the Alps and the western polecat in the lowlands, the least weasel is believed to be more widely distributed throughout the region. However, because of their high elusiveness, little is known about their current distribution and ecological niche characteristics. Therefore, after collecting weasels' data and environmental predictors, we fitted ENMs to investigate their distribution and compare their ecological niches.
Through a collaboration network of regions, parks, and museums, and by downloading data from open-source databases, we collected 337, 149, and 129 recent records (2000-2023) of *M. erminea*, *M. nivalis*, and *M. putorius*, respectively. However, after dropping imprecise and clustered data, we retained 149, 109, and 80 final occurrences. Based on the ecology of weasels and after checking their collinearity, we selected 2 topographic, 7 bioclimatic, and 11 land-use variables. We opted for an ensemble forecasting approach with 3 algorithms (Maxent, Random Forest, and Generalized Boosted Models) to calibrate ENMs. For each species, we generated 10,000 background points that were geographically located in the study area according to the density of species occurrences. We projected the ENMs on selected predictors, binarized them to obtain range maps, and calculated the importance of variables for each species. Then, we compared the ecological niches, calculating the Schoener's D index for each species pair and assessing their significant niche similarity/dissimilarity through randomization tests. Lastly, we implemented Random Forest classification models to identify the most important environmental conditions that differentiate non-overlapping niche parts.
Overall, ENMs achieved fair–to–good predictive performances: *M. erminea* (AUC ± SD = 0.873 ± 0.022); *M. nivalis* (0.743 ± 0.023); *M. putorius* 0.742 ± 0.03). Stoat habitat suitability was shaped mainly by slope and distance from forests. For the least weasel, distance from vineyards and fruit trees had the most important effect, along with distance from rice fields and heterogeneous agricultural areas. Habitat suitability for western polecats was molded by rice fields, coniferous forests, and mean temperature in the wettest quarter. Niche overlap analyses reported a significant niche similarity between least weasels and western polecats (Schoener's D = 0.37). As for the environments differentiating species niches, the stoat differed the most from the others, particularly showing higher values of precipitation seasonality, mean diurnal air temperature range, mixed forests, and shrubs, and lower values of isothermality and distance from intensive agricultural areas and deciduous forests. The least weasel niche diverged from the other species niches in terms of high values of the mean temperature of the driest season and low distances from shrubs and heterogeneous agricultural areas.
The low number of records suggests that none of these species can be considered common in our study area. The strict association of stoats with the Alpine environment and the broader distribution of the other two species, particularly in the lowlands, underscore the importance of understanding their ecological niches. The significant niche overlap between least weasels and polecats suggests the presence of other factors that mitigate their competition. Importantly, all three ENMs reveal potential threats to the species, with climate change posing a significant risk to stoats due to their Alpine link, and land-use change, specifically intensive agriculture, threatening least weasels and western polecats. We plan to expand our research to model the current and future distribution of weasel species across the entire Alpine Arch. This will allow us to assess their extinction risk under various climate and land-use change scenarios.

Mammals in the Biodiversity Assessment of Makgadikgadi Pans in Botswana

Guerra M.[1], Franchi F.[2], Cavalazzi B.[1], Scaravelli D.[1]

1. Department of Biological, Geological, and Environmental Sciences, University of Bologna.
2. Dipartimento di Scienze della Terra e Geoambientali, Università di Bari.

Deserts and drylands constitute the 30% of Earth's land surface. Their extreme environments generated amazing adaptations and unique biodiversity but are becoming increasingly threatened by anthropogenic impacts. In this context, the assessment and monitoring of biodiversity in these environments result a priority. In Sub-Saharan Africa, Botswana is one of the driest countries, with nearly the 100% of its surface being dryland. The Makgadikgadi Pans are a complex of salt pans which constitute the second largest desert in the country, after Kalahari. Biodiversity there is poorly documented and the target of the research was to determine rapidly the mammal diversity.

Five sampling points were chosen based on literature data and satellite images. Four were chosen inside the Makgadikgadi, 2 in the savanna (one in shrub and one in grassland savanna) and 2 in the desert. The external comparison point, more humid and forested, was chosen near the Nata River. Monitoring include: plots to characterize vegetation structure (species and abundance of shrub and trees, cover of herbaceous vegetation); linear transects and camera traps to assess the presence of vertebrates; ultrasound recording to detect the presence of bats. Biodiversity was assessed correlating the presence of species of mammals to the vegetation type. To count and recognize bat sounds the software BatSounds was used.

For each ecosystems, the most frequently encountered mammals were: in the bush savanna *Genetta genetta*, *Tragelaphus strepsiceros*, *Lepus capensis*; in grassland savanna *Mastomys natalensis, Lepus capensis, Raphicerus campestris*, *Aepyceros melampus* and *Lupulella mesomelas*; in the desert one point showed absence of mammals, while in the other there were rodents (not identified species) and bats of one species in Vespertilionidae and one in Molossidae families; in the riparian woodland *Sylvicapra grimmia*, *Chlorocebus pygerythrus, Galago moholi* and the same previously cited bat species. In the riverine point livestock were strongly present with cows, goats, horses, donkeys and dogs.

Inside the desert, mammals are represented only by small rodents ad bats, while larger mammals are mostly seasonal migrants, as reported by literature. Carnivora, with 2 species of meso predators, are represented only in savanna. Primates were found only in riparian woodland where also the domestic animals exert strong competitive and disruptive pressure. This aspect constitutes the major conservation problem, especially considering the fundamental supporting role as source areas for the different populations generated by the riparian ecosystems.

Assessment of the impact of mouflon on the vegetation of Giglio Island

La Russa L.1, Rosso C.1, Sammuri G.2, Giannini F.2, Nicoloso S.1

1. D.R.E.Am Italia, Via Enrico Bindi 14, 51100 Pistoia (PT) Italy
2. Parco Nazionale Arcipelago Toscano, Loc. Enfola n 16, 57037 Portoferraio (LI) Italy

The mouflon (Ovis aries) is counted among the most impactful species in the environments in which it is released, if not the most damaging allochthonous ungulate, exerting significant pressures on native flora and fauna. This is even more dramatic in island settings, which are rich in endemism and more fragile to the impacts of allochthonous species, the biocoenoses present having evolved in the absence of large predators and herbivores. The main impacts caused by mouflon are mainly overgrazing, variation in plant communities in grazed areas, a decrease in the development and growth of shrub species, loss of herbaceous cover, and increased soil erosion. The impacts that a species exerts on anthropogenic activities are easily estimated, unlike damage to the natural component. Despite the size of the island and the time that has elapsed since the first releases 70 years ago, the population has predominantly occupied the areas adjacent to the release site, a closed bottom at the "Il Franco" locality. The high philopatry, the tendency to live at high densities, the small size of the occupied area, the type of poorly productive Mediterranean environments, and the mismatch between ideal trophic conditions and those present on the island suggest a significant impact of the population on the ecosystems of the island, particularly on shrub and forest regeneration.
The purpose of the study was to assess the impact on the plant component in terms of biomass, caused by the population present on Giglio Island. With the data collected as part of the LIFE LETSGO Giglio eradication project, it was possible to reconstruct the population size and demographics. All mouflons removed from the island were characterized by age and sex, geo-referenced, and, where possible, key biometric measurements were taken. To identify the area permanently occupied by the mouflon population on the island, the home ranges of the specimens on which the radio collar was placed (“judas” animals) were calculated by a Brownian bridge model. This made it possible to identify the population home range, a fairly accurate result considering that 76% of the removed animals were within this area. Therefore, the population within the area was reconstructed, and biomass plant intake requirements were calculated.
The “Judas”" home range area, was found to be 303 hectares with an ascertained presence of 81 individuals distributed as follows at the time of capture: 9 Adult males, 17 Subadult males, 7 yearling males, 4 juvenile males, 34 adult females, 6 yearling females, 3 juvenile females and 1 indeterminate.
The resulting density within the population home range is 26.7 heads/100 ha. From the weight recorded on a sample of 68 animals, an estimated live biomass of 2,210.8 kg is derived. The dry matter requirement of the species turns out to be about 2.5 percent of live body weight, which corresponds to 56.1 kg per day (93.5 - 160.4 kg of fresh matter), net of the increased requirements for adult females in the reproductive stages. Considering these resulted in a dry matter requirement of ~21 tons per year, for a fresh matter value of 35-60 tons. From these values, a lost carbon sequestration of ca. 29 tons of CO2 per year is estimated.
The major trophic resource for the Mouflon population on Giglio Island was represented by forest regeneration, which has been practically zero until now, and shrubs, which constitute one of the key stages in the transition abandoned agricultural fields to natural environments. In light of the results, it is appropriate to consider that the considerable and continuous removal of vegetation mass on the above components would have had considerable effects in the long run, preventing the renewal of the previous formations, which were already advanced in some areas. The preservation of tons of annual plant biomass, mainly composed of forest renewal and shrubs, in such a restricted area will allow the natural evolution of stands to the most advanced stages depending on the edaphic and climatic context.

The sound of silence: ultrasound communication in *Crocidura suaveolens*

Lagrotteria A.[1], Vergari Seb.[2], Vergari Sim.[2], Dondini G.[2], Ancillotto L.[3,4], Mori E.[3,4], Viviano A.[3], Gordigiani L.[5], SchianiniV. [6]

1. Department of Life Sciences and Systems Biology, University of Turin, Via Accademia Albertina 13, Turin 10123, Italy
2. MuNAP - Museo Naturalistico Archeologico Appennino Pistoiese, via Orange, 51028 Gavinana, Pistoia, Italy
3. Consiglio Nazionale delle Ricerche, Istituto di Ricerca sugli Ecosistemi Terrestri, Sesto Fiorentino (Firenze), Italy
4. National Biodiversity Future Center (NBFC), Palermo, Italy.
5. Avvistiamo APS, Palermo, Italy
6. Department of Biology, University of Pisa, Pisa, Italy.

Assessing the vocal repertoires of species is pivotal to understand their communication strategies and, in turn, their ecological roles. In this context, shrews (Eulypotyphla), despite exhibiting considerable vocalization variability, lack comprehensive scientific data of their vocal repertoires. In this study, conducted during spring 2022, we collected recordings of four juvenile *Crocidura suaveolens* within a fauna box, using an external microphone.

Overall, the duration of diurnal and nocturnal records was 2.5 months collecting 738 records equal total time of 2 hours (mean = 00:00:10). Initial spectrogram analysis revealed significant vocalization variability, encompassing both tonal (whistle, twitter) and non-tonal (click-like, screech, short screech) vocalizations.

Our research represents the first acoustic characterization of *Crocidura suaveolens*, and the first assessment in any juvenile shrew, to delineate the constituent sounds and frequencies comprising their vocal repertoire and ascertain any potential echolocation functions in addition to communication.

Urbanization does not influence red foxes' interest in anthropogenic food, but makes them more cautious

Lazzaroni M.[1*], Brogi R.[2], Napolitano V.[2], Apollonio M.[2], Range F.[1], Marshall-Pescini S.[1].

[1] Domestication Lab, Konrad Lorenz Institute of Ethology, University of Veterinary Medicine, Vienna, Austria

[2] Department of Veterinary Medicine, University of Sassari, via Vienna 2, I-07100 Sassari, Italy

Human presence and activities have profoundly altered animals' habitats, exposing them to greater risks but also providing new opportunities and resources. The animals' capacity to effectively navigate and strike a balance between risks and benefits is crucial for their survival in the Anthropocene era. Red foxes (*Vulpes vulpes*), adept urban dwellers, exhibit behavioral plasticity in human-altered environments. We investigated variations in detection frequency on trail cameras and the behavioral responses (explorative, bold and fearful) of wild red foxes living along an urbanization gradient when exposed to a metal bin initially presented clean and then filled with anthropogenic food. All fox populations displayed an increased interest and similar explorative behavioral responses towards the anthropogenic food source, irrespective of the urbanization gradient. Despite no impact on explorative behaviors, foxes in more urbanized areas initially showed heightened fear towards the empty bin, indicating increased apprehension toward novel objects. However, this fear diminished over time, and in the presence of food, urban foxes displayed slightly reduced fear compared to their less urban counterparts. Our results highlight foxes' potential for adaptability to human landscapes, additionally underscoring the nuanced interplay of fear and explorative behavioral response of populations living along the urbanization gradient.

Coexistence of three alpine ungulates (*Cervus elaphus*, *Rupicapra rupicapra* and *Capreolus capreolus*) in an alpine mammal community with anthropogenic disturbance

Limonciello L.[1,2,3], Vanderlocht C.[4,5], Squillaci N.[6], Dal Farra S.[4], Ossi F.[4], Corlatti L., Pedrotti L., Ciucci P.[7], Cagnacci F[4]

1. Department of Earth and Sea Sciences, Via Archirafi 22 90123 Palermo, Italy
2. NBFC, Piazza Marina 61 90133 Palermo, Italy
3. Department of Biosciences and Territory, University of Molise, Pesche (Is), Italy
4. Fondazione Edmund Mach, San Michele all'Adige, Italy
5. Center Agriculture Food Environment, University of Trento, San Michele all'Adige, Italy
6. Department of National Park Monitoring and Animal Management, Bavarian Forest National Park, Grafenau, Germany
7. Sapienza Università di Roma, Rome, Italy

The Italian Alps are characterised by high spatial heterogeneity and seasonal fluctuations of resources, along with spatial and temporal pulses of anthropogenic pressure. This variability is likely to affect the animal community residing in this environment. In this work, we analysed how a set of environmental and anthropogenic factors shapes the assemblage of alpine terrestrial mammals, and the possible differentiation of their influence according to a combination of species-specific ecological traits, with a particular focus on the ungulate species present in the study area, i. e. the roe deer, red deer and chamois.

Data were collected through camera trapping at 77 random sites within a systematic grid distributed along an altitudinal and environmental gradient with diverse anthropogenic pressures, from May through October 2022 in Trentino and Alto-Adige Autonomous Provinces. Association between species occurrence and environmental and anthropogenic variables was analysed by means of Redundancy Detrended Analysis (RDA). RDAs were ran separately over three periods to account for seasonality, based on trends of vegetation primary productivity (NDVI).

Results proved that both environmental and anthropogenic factors contribute to distribute the occurrence of alpine ungulates. Variations mostly reside in a differential response of the species to forage maturation, human infrastructures, and outdoor activities, likely linked to species traits, including body size, feeding behaviour and generalist/specialist strategy. The two larger ungulates, i. e. red deer and chamois, tend to dissociate from any form of anthropogenic pressure more than roe deer, although this tendency diminishes in fall. Moreover, red deer and chamois are tightly associated with each other, suggesting a spatial overlap between the two, whereas roe deer seems to be rather dissociated from the two and is more linked to vegetation productivity and forested habitats throughout the whole monitoring period.

These association patterns among ungulates might indicate potential forms of competition between red deer and chamois, with seasonal variations mirroring their altitudinal migratory patterns between summer to winter ranges. Further investigation on the ecological processes underlying these associations is ongoing, especially in light of the expansion of red deer across the Alpine range and of the increasing human disturbance, to provide information supporting appropriate management interventions.

Assessing the threat of free-ranging domestic cats in the “Lago di Vico” Natural Reserve

Luzi G.[1], Bertagni G.[2], Sabatini G.[1], Puddu G.[3], Manzo E.[4]

1. Cooperativa Trifolium - Via del Paradiso 3, 01100 Viterbo (VT)
2. Indipendent reseacher – Via degli olivi 33, 00171 Roma (RM)
3. Regione Lazio – Riserva Naturale Lago di Vico, 01032 Caprarola (VT)
4. Fondazione Ethoikos – Convento dell’Osservanza snc, 53030 Radicondoli (SI)

Domestic cats pose a significant threat to wildlife globally, particularly in sensitive ecosystems like natural reserves. This study investigates, the presence of free-ranging domestic cats within the Lago di Vico Natural Reserve and its potential impact on wild mammal populations.

We deployed camera trap surveys across three sampling seasons to establish the presence and distribution of free-ranging domestic cats within the reserve. The study area was divided into a 1 km square grid, and in each season, camera traps locations were modified within the same study area. The first season was divided into three consecutive surveys with a total of 3780 camera-trapping days (survey 1=897 trap days; survey 2=1386 trap days; survey 3=1497 trap days) between July 2018 and June 2019. The second season was divided into two consecutive surveys with a total of 2103 trapping days (survey 1=1000 trap days; survey 2=1103 trap days) between November 2020 and February 2021. A total of 57 km² were monitored in the first season, and 46 km² were monitored in the second season. In the first season, our focus was primarily on the territory of the Lago di Vico Natural Reserve and its adjacent areas. During three different surveys, we captured 122 images or videos of domestic cats, occupying 26 different cells (1st survey: 7 cells with 27 detections; 2nd survey: 9 cells with 20 detections; 3rd survey: 10 cells with 75 detections). In the second season, the study area included both the Lago di Vico Natural Reserve and the Special Areas of Conservation known as “Monte Cimino”. During two surveys, we captured a total of 28 detections of domestic cat detections across 12 locations (1st survey: 7 locations with 16 detections; 2nd survey: 5 locations with 12 detections). Results from our camera trap surveys indicate a widespread presence of free-ranging domestic cats throughout the Lago di Vico Natural Reserve.

The presence of free-ranging domestic cats within the Lago di Vico Natural Reserve raises concerns about their potential predation pressure on wild mammal populations. Further investigation is required to determine the extent of this impact. Our findings underscore the need for stricter regulations on free-ranging domestic cats near protected areas.

Eyes on the elusive: participatory mapping of weasel and polecat in italy with mustelawatch.it

Manzo E.[1], Di Stefano C.[2], Fusillo R.[3], Palombi A.[4], Spada A.[5], Sforzi A[6]

1. Fondazione Ethoikos, Convento dell'Osservanza, 53030 Radicondoli-Siena
2. ISPRA - Istituto Superiore per la Protezione e la Ricerca Ambientale
3. Lutria sas *Wildlife Research and Consulting*, Roma
4. Riserva Naturale Monte Rufeno, Acquapendente
5. Università Ca' Foscari, Venezia
6. Museo di Storia Naturale della Maremma, Grosseto

Weasels *Mustela nivalis* and polecats *M. putorius* are thought to be common mustelids in Italy, but data on their distribution and abundance remain scarce, due to the difficulties of gathering data on these elusive species. Citizen science offers a valuable tool to bridge this knowledge gap.
We introduce MustelaWatch.it, a new web platform, developed in collaboration between the Mesocarnivore Research group of the Italian Mammal Society and Natural History Museum in Grosseto, specifically designed to collect and verify presence data of weasels and polecats from the community across Italy. The user-friendly interface allows submission of sightings with mandatory location data and media uploads (photos or videos) of the observed animal. A team of experts verifies submissions to ensure data quality before incorporating them into an interactive distribution map. The website also provides educational resources about these species.
MustelaWatch.it takes advantage of the power of citizen science to enhance our understanding of weasel and polecat distribution across Italy. Moreover, by engaging the community in data collection and by providing information on the ecology and identification of the two species, MustelaWatch.it empowers everyone to enhance his/her personal scientific knowledge on weasel and polecat. This in turn potentially allows a better understanding of their conservation needs and facilitates further data collection for researchers and conservation organizations, directly supporting data-driven conservation efforts.

The return of the wolf (*Canis lupus*) in the central Po Plain, preliminary investigation on the ecology of the species in the province of Mantua

Meggiorini D.[1,6,7], Frignani E.[1,7], Giachello S.[2,3], Cevenini D.[4,5], Avanzi G.[11], Balasini L.[1,7], Bonatti M.[10], Castagna A.[8], Cecere F.[7], Fratta D.[12], Lupi G.[1], Maffezzoli L.[6], Pavesi A.[1], Rossetti L.[6], Salandini C.[9]

1. G.N.M. - Gruppo Naturalistico Mantovano (MN).
2. Department of Environmental Science and Policy - Università degli studi di Milano, Via Celoria 10, Milano (MI)
3. University School for Advanced Studies IUSS Pavia, Piazza della Vittoria 15, Pavia (PV)
4. Università degli studi di Padova - Dipartimento di Biologia (DiBio), Via U. Bassi 58, Padova (PD)
5. Area per l'Avifauna Migratrice (BIO-AVM) - Istituto Superiore per la Protezione e la Ricerca Ambientale (ISPRA), Via Cà Fornacetta 9I, Ozzano Emilia (BO)
6. Parco Regionale Oglio Sud, Piazza Donatori del Sangue 2, Calvatone (CR)
7. Associazione WWF Mantovano, Via XI Febbraio 7, Suzzara (MN)
8. Via R. Vantini 7, Castiglione delle Stiviere (MN)
9. Via Monte Grappa 39, Carpenedolo (BS)
10. Via Domenico Fetti 45, Marsiletti (MN)
11. Via Don L. Sturzo 12, Campitello (MN)
12. Via dei Boschi 11, Volta Mantovana (MN)

In recent years, the wolf (*Canis lupus*) population in the Po Valley has recovered naturally. The expansion is made feasible by the species' great adaptability and the now-consistent availability of suitable prey such as ungulates in the Po Valley area. The first confirmed wolf sighting in Mantua occurred in the summer of 2020, about two centuries after its disappearance. From 2021 to the present, an inquiry has been conducted to monitor the occurrence of wolves in the province of Mantua, aiming to analyse aspects of their ecology to better understand their behaviour in an area significantly impacted by human activities in the central Po Valley.

The study was carried out in the province of Mantua via systematic and opportunistic camera trapping through video-photo traps (VPT), along with the collection of documented sightings. Additionally, between winter 2023 and spring 2024, the Life Wolfalps EU project, the Forestale Carabinieri Group, and the Provincial Police Command of Mantua supplemented the information gathered through transects and genetic sampling. The data were used to create a species distribution model (SDM) to determine which environmental factors influence the likelihood of wolf colonization in the province. Furthermore, utilizing data acquired through VPT, a yearly activity model for the species was created, as well as a comparison with seasonal activity. Finally, preliminary information on the wolf diet in the Po Valley was investigated via VPT and firsthand accounts of predation events.

Between 2021 and December 2023, two stable pairs were confirmed in the province of Mantua, one of which is actively breeding and now consists of two adult individuals and four cubs. The female and four cubs have a rusty tan phenotype, which could be a result of hybridization with domestic dogs. Genetic analysis is currently underway. The SDM model's results reveal that the availability of protected areas (Natura 2000 Network) and distance from linear infrastructures are the most important variables connected to wolf occurrence. The annual activity rhythm model shows increased activity during the twilight and overnight hours, peaking at about 06:00, declining till noon, and practically disappearing in the afternoon. There are no significant differences between warm and cold seasons, and the overlap index is high (Δ_4=0.87, 95% CI=0.85-0.89). In terms of diet, the majority consists of wild prey (mesomammals and birds), with a considerably smaller percentage of anthropogenic food sources (unguarded poultry, sheep, and cow carcasses). The coypu (*Myocastor coypus*) is one of the most preyed-upon wild species.

The data collected indicate a considerable and consistent increase in wolf presence in the province of Mantua over the last few years, and it appears that this trend is ongoing. Given the complexities of the issue in such a fragmented and human-modified ecosystem, the goal of this study is to be a useful tool

in informing local management and conservation strategies, as well as a pilot project for future wolf research investigations.

Assessing hazel dormouse distribution and abundance in Emilia-Romagna Region: insights for conservation planning and long-term monitoring

Melcore I.[1], Viviani S.[2], Rota M. [1], Gili F. [1], De Curtis O.[3], Messori S.[4], Palazzini M. [4], Martinoli A. [1], Bertolino S. [2], Grignetti A.[5], La Morgia V.[2,5]

1. Unità di Analisi e Gestione delle Risorse Ambientali, Gruppo di Ricerca Guido Tori, Dipartimento di Scienze Teoriche e Applicate, Università dell'Insubria, Via J.H. Dunant, 3, 21100 Varese, Italy
2. Dipartimento di Scienze della Vita e Biologia dei Sistemi, Università degli Studi di Torino, via dell'Accademia Albertina 13, Torino, 10123, Italia
3. Museo di Paleontologia e Preistoria P. Leonardi, Università degli Studi di Ferrara, Corso Ercole I d'Este, 32 - 44121 Ferrara
4. Settore Aree Protette, Foreste e Sviluppo Zone Montane, Regione Emilia-Romagna, Viale Aldo Moro, 52 40127, Bologna, Italia
5. ISPRA, Istituto Superiore per la Protezione e la Ricerca Ambientale, sede centrale Via Vitaliano Brancati, 48 - 00144 Roma, e sede di via Ca' Fornacetta 9, Ozzano Emilia (BO), 40064, Italia

Knowledge on the distribution or abundance of species represents the basic information necessary to establish any conservation or management strategy. The COMBI project (Knowing and Monitoring Biodiversity) undertaken in the Emilia-Romagna region aligns with this imperative. Its primary objective was to update the knowledge concerning target species and to establish a comprehensive long-term Regional Monitoring Plan (PRM) for species listed in the Habitats Directive (92/43/EEC). Among these, the hazel dormouse (*Muscardinus avellanarius*), a rodent species protected under the Annex IV of the Habitats Directive, was the focal species of the presented study.

The acquisition of presence-absence and abundance data of the species was carried out along transects of tracking tubes deployed within 42 sample cells of 1x1 km, distributed across the region. Each transect consisted of 10 tracking tubes, spaced approximately 100 m apart and left active for around 30 days. Additionally, various environmental and habitat variables such as forest type, altitude, potential pressures on the species, and shrub richness and diversity were collected. Data were analysed to estimate the total area occupied by the species in the region, and to investigate occupancy patterns via different modelling approaches.

During the first field survey, a total of 65 hazel dormouse presences were recorded within the 340 tracking tubes deployed throughout the Emilia-Romagna region, accounting for approximately 19% of the total footprint tunnels. Given the 100-meter spatial separation between tracking tubes, presence data were considered independent of neighbouring tubes. Consequently, the count of footprint tunnels with detected footprints (65) represents the minimum number of individuals present within the surveyed area. Analysis of the collected data revealed an effect of altitude on the distribution of the species, that predominantly occupies areas distant from population centres and with extensive forest cover. The absence of the specie in certain transects could primarily be attributed to the small size of the woodland areas (< 100 ha), insufficient to support viable populations, as well as habitat diversity. An additional significant finding was the presence of the species in tree corridors surrounded by cultivated fields, underscoring the importance of such features as connectivity elements in the landscape. These hedges facilitate dormouse dispersion and enable the survival of small population.

This study highlighted the efficacy of tracking tubes as a method for detecting arboreal rodents, allowing for rapid species identification. The wider spatial separation of the tubes (100 m compared to the usual 50 m) ensured the independence of each tube, providing initial insights into the minimum number of individuals within the surveyed area. To refine more accurate estimates of dormice distribution and abundance regional scale, long-term field survey is recommended, including the placement of tracking tubes alongside nest boxes to enhance presence data collection and processing.

Environmental DNA for large scale monitoring on the elusive Western polecat (*Mustela putorius*)

Mirone E.[1], Giovacchini S.[1], Bruno A.[2], Caprotti L.[2], Di Febbraro M.[1], Jamwal P.S.[1], Krupa H.[1], Monaco P.[1], Ramazzotti F.[2], Galimberti A.[2], Loy A.[1,3]

1. University of Molise, contrada Fonte Lappone, Pesche (IS), Italy
2. University of Milano-Bicocca, piazza della Scienza 2, Milano, Italy
3. CNR-IRET, viale Marconi 2, Porano (TR), Italy

The western polecat (*Mustela putorius*) is an elusive mesocarnivore associated to riparian habitats and freshwater ecosystems. This mammal is usually solitary and lives at low density. Presence occurrences are rare to the point that polecat distribution is mostly surveyed with a passive monitoring relying on mortality data obtained from roadkill carcasses. Despite the scarcity of a coordinated effort to monitor the polecat at large scale, the species is listed in the Annex V of the European Habitat Directive 92/43/EEC. EU State Members, i.e. every six years are obliged to accurately report its distribution and conservation status.

We assessed the effectiveness of environmental DNA (eDNA) as a promising method for the detection of *M. putorius*. An amplicon of 130 base pairs (a couple of species-specific primers and a probe) was developed for the first time from CytB (mtDNA) and validated through three steps (*in silico, in vitro,* and *in situ*). The assay was tested at 31 freshwater sampling sites across Central Italy. Sampling was replicated in 2021 and 2022. At each site 3 l of water were collected and prefiltered through cellulose mixed esters 8 μm membranes and then filtered on 0.22 μm membranes. DNA was extracted from the filters using Power Soil extraction kits (Qiagen), and then amplified through quantitative PCR (qPCR).

eDNA of European polecat was detected at 6.5% of the sampled sites (n=2), corresponding to new locations for the species. Results proved eDNA as a sensitive method to detect this elusive species at wide scales. Nevertheless, the eDNA detection rate is less than for other semiaquatic mammals like the otter that spend more time into the water, thus likely releasing higher concentrations of DNA in the water. However, the quantification of Limit Of Detection and extensive field testing allowed our primers to reach almost the top-quality level of eDNA assays according to standardized classifications, i.e. 4 out of 5 level. Despite further improvements are recommended to increase detection probability (replicates, season, environmental factors), our qPCR assay designed for *M. putorius* is ready and available for eDNA routine species monitoring at large scale.

Identification of variables associated with lethal wolf-dog interactions: a literature review on wolf attacks to domestic dogs

Mugnari A.[1,2], Álvares F.[2], Salvatori V.[1]

1. Istituto di Ecologia Applicata, Via C. Colombo 456, 00145 Rome, Italy
2. BIOPOLIS - CIBIO/InBIO, Centro de Investigação em Biodiversidade e Recursos Genéticos, Universidade do Porto, Campus de Vairão, 4485-661 Vairão, Portugal

The incidence of wolf attacks on domestic dogs has become a subject of growing concern worldwide and is one of the main tasks to addressed in project LIFE Wild Wolf. These attacks may result from wolves perceiving dogs as competitors or alternative prey, but their incidence and dynamics are poorly documented in the scientific literature. As wolves occur into increasingly human-dominated landscapes establishing territories in areas with various human activities, the likelihood of wolf-dog encounters and interactions (either positive or negative) rises, especially in cases of poor dog management. When such interactions result in wolf attacks on privately owned dogs the phenomenon can have strong emotional impacts and eventually lead to high levels of conflict. Understanding the drivers behind these incidents, thus become essential to promote coexistence, particularly considering the significant role of the dog-human relationship in our culture. Therefore, the aim of this study is to identify patterns and variables potentially associated with the occurrence of wolf attacks on domestic dogs based on a review of available literature.

The literature review was conducted by search on Google Scholar and other academic sources using keywords such as *'wolf'*, *'attacks'*, *'predation'*, *'interactions'*, and *'dog'*, and focusing on studies identifying causes of wolf attacks, excluding those on diet analysis in which dogs were found in wolf scats. In total, were selected 32 studies (including 21 scientific papers and 11 grey literature) published between 1989 and 2023 and covering 13 European countries and USA.

Documented drivers that influence wolf attacks on dogs were categorized as: i) Wolf-related drivers, including wolf abundance, pack size, presence of a single disabled wolf, presence of a pack specialised in dog predation and presence of wolf pups, which were all positively related with wolf attacks on dogs, while distance from pack core area had a negative effect; ii) Dog-related drivers, where certain types (hunting, pet and livestock guarding dogs), specific breeds of hunting dogs and small/medium-sized dogs were more vulnerable to wolf attacks, especially when engaged in hunting or training activities, while short distance from owner and control by leash were related to lower risk of attacks compared to freely roaming or chained dogs, particularly in backyards; iii) Hunting-related drivers, with hunter experience and team hunting showing a negative effect on wolf attacks, while number of hunting days and hunt of specific game species (e.g. moose) increase the risk of wolf attacks; iv) Temporal and spatial drivers, with no evident effect from season and hour, but altitude and distance from human settlements having a negative effect on wolf attacks while forest cover a positive one; v) Other drivers, such as scarcity of wild prey and lower livestock farm density also increase the risk of wolf attacks on domestic dogs.

This study highlights the complex interplay of ecological, behavioural and anthropogenic factors that shape the dynamics of wolf-dog interactions. The main identified patterns involve dogs roaming freely in remote areas (e.g. hunting dogs), dogs left loose in backyards, sometimes chained to a building, and livestock guarding dogs during wolf attacks on livestock. Some attacks are probably the result of chance encounters between dog and wolf, while in other situations there may be an active search by the wolf. Such incidents can exacerbate negative attitudes towards wolves, particularly in peri-urban areas. Therefore, our findings are valuable to support adequate management of domestic dogs as well as to develop awareness to reduce the risks associated with lethal wolf-dog interactions.

Monitoring plan for feral goats on Alicudi Island

Colotti S.[1], Nocentini F. [1], Nicoloso S. [1]

1. DREAm Italia, via Enrico Bindi 14 51100 Pistoia

The most reliable hypothesis on the origin of goats in our peninsula dates back to the first introduction of goats on Montecristo island concurrent with the initial stages of the animal domestication process. From a nutritional point of view, the goat is capable of adapting to different environments and very diversified diets with a good potential for storing reserves. These features makes the goat one of the species with the greatest impact in nature, especially in the most delicate environments in terms of biodiversity such as islands. The monitoring took place in the Aeolian Islands archipelago in Sicily, on Alicudi Island largely within the territory of the "Riserva Naturale Orientata Isola di Alicudi" – ZSC ITA030023 "ISOLA DI ALICUDI". Starting from the phenotypic observations carried out in the monitoring sessions, the Alicudi goats can be traced back to multiple breeds of domestic goats, which subsequently became feral, and by interbreeding over the years, resulted in individuals with different characteristics.

The main purpose was to quantify and to frame the population of feral goats (*Capra hircus L.*) within the island scenario with a focus on their socio-environmental impacts on the island. The monitoring identified the best strategies to prepare operational plans suitable for their future removal from the Island. The techniques used to quantify the population were Distance Sampling, observation with direct counting and by using a drone. In order to evaluate the impacts caused by goats to dry stone walls, UNESCO heritage infrastructures, sampling was carried out to verify the actual material damage reported by the ungulates to the walls. In each sector investigated, the damaged portions of the wall were measured, according to a specific standard developed for this work. In order to investigate the impact on the vegetation caused by goats and other feral animals on Alicudi Island, vegetation test areas were analysed, sampling morphological data of the land, concentration of vegetation present, signs of the presence of wild or feral fauna and any damage caused to vegetation by them. The test areas were chosen using GIS techniques for the identification of a random sample distributed proportionally according to the representativeness of each type of stand and intensifying the sampling in the areas of the geolocations of the rare plants endemic to the island.

A critical analysis of the data suggests that the goat population on Alicudi Island could range approximately from 600 to 700 units, considering an average underestimation factor. The analysis of dry stone walls revealed damage amounting to 24% over a length of 1.300 meters of walls analysed. Vegetation surveys verified that goats are responsible for damage in 85% of the areas surveyed. In most cases the damage caused to the plants is included in a percentage class ranging from 5 to 25% damage, but in some extreme situations there is also total damage to the plant (100%) resulting in its death.

From the analysis of the data obtained by the monitoring it is clear that the environmental impact of the goats on Alicudi Island is capable of compromising the biodiversity that characterizes some typical biotopes of the Aeolian Islands with irreversible damage also to various endemisms. Furthermore, with their winter irruptions in the inhabited areas, goats unleash a strong social impact especially among the residents who, despite the multiple difficulties they faced, keep alive an island governed by fragile balances.

Squirrel melting pot: new insights on the distribution of Sciuridae from Campania – southern Italy

Notomista T.[1], Ancillotto L.[2], Bigu B.[1], Errico D.[1], Mori E.[2], Papaleo L.[1,3], Russo L.F.[1,4], Senese A.[1], Russo V.G.[1]

1. Kayla Nature s.r.l.s., Naples, Italy
2. Consiglio Nazionale delle Ricerche, Istituto di Ricerca sugli Ecosistemi Terrestri (CNR -IRET), via Madonna del Piano 100, 50019 Sesto Fiorentino (Firenze), Italy
3. Envix Lab, Department of Biosciences and Territory, University of Molise, 86090 Pesche, Isernia, Italy
4. Department of Biology and Biotechnologies "Charles Darwin", Sapienza University of Rome, Rome 00185, Italy

Understanding the distribution of species is of primary importance for biodiversity conservation and habitat management, thereby contributing to ecosystem protection and maintaining ecological balance especially when in presence of invasive species that co-occur with indigenous ones with a similar niche.

Furthermore, forests are experiencing expansion in Europe, thanks to land and agricultural abandonment, besides also environmental protection and active restoration. As such, forest-associated species seem to be increasing their spatial spread, so that detailed field campaigns targeting these species are key to provide an updated picture of their distributions. Italy is a biodiversity hotspot, hosting high numbers of endemic taxa, besides being one of the richest European countries also in terms of introduced and invasive species. Tree squirrels are prominent amongst introduced mammals in terms of their frequency and invasiveness of alien populations across Europe, including Italy, where four introduced species are well established. Besides, two tree squirrel species are also native to Italy, one being endemic from the southernmost regions of the Peninsula (*Sciurus meridionalis*). Campania, amongst southern Italian regions, is poorly known in terms of mammal distributions.

Here, we conducted a thorough review of tree squirrel records from Campania, also adding targeted field surveys, in order to clarify and update tree squirrel distributions. The data presented in our study come from grey and scientific literature, citizen science, and amateur photographers.

Regarding field techniques, the following methodologies were followed: Visual Surveys, Hair tube surveys, Nest count, and Camera Trapping.

Overall, we collected 234 observations belonging to six species of tree squirrels. Namely, we support the occurrence of the native *S. vulgaris* in the region (16 observations), besides confirming the occurrence and dramatic range expansion of the introduced *Callosciurus finlaysonii* (212 observations). Also, we add the observations of two further alien species from the genus *Callosciurus* (*C. erythraeus*, N=3; *C. prevosti*, N=1), and of the Siberian chipmunk (*Eutamias sibiricus,* N=3). Moreover, we report on the likely occurrence of the endemic *S. meridionalis* with one observation at the border with the Basilicata region.

We discuss the potential ecological and conservation implications derived from our updated distributional assessment of this taxonomic group. Particularly concerning is the rapid expansion observed in recent years by *C. finlaysonii* spreading westward and northward , to which are added observations of 3 other alien species (*C. erythraeus, C. prevosti* and *E. sibiricus*). Regarding indigenous species, our study provides new observations of *S. vulgaris* in the northern part of the region, while simultaneously offering entirely new records of *S. meridionalis* presence in the region. Based on these results, further investigations are needed to deepen the knowledge about both autoctonous and introduced species, as well as their possible interactions.

Temporal behaviour of predators and prey in two protected areas of the central Apennine ridge (Central Italy)

Palombi A.[1], Ancillotto L.[2,3], Blasi M.C.[4], Maggioni M.[3,5,6], Piazzai M.[1], Lazzeri L.[7], Spilinga C.[8], Montioni F.[8], Viviano A.[2], Bombara G.[9], Mori E.[2,3]

1. Riserva Naturale Monte Rufeno, Piazza Santa Maria 1, 01021 Acquapendente (VT), Italia
2. Consiglio Nazionale Delle Ricerche, Istituto Di Ricerca Sugli Ecosistemi Terrestri, Via Madonna del Piano 10, 50019 Sesto Fiorentino, Florence, Italy.
3. National Biodiversity Future Center, 90133, Palermo, Italy.
4. Dipartimento di Agraria, Università degli Studi di Firenze, Firenze, Italy.
5. Dipartimento di Scienze della Terra e del Mare, Università di Palermo, Via Archirafi 22, 90123 Palermo, Italy.
6. Dipartimento di Biologia, Università degli Studi di Firenze, Via Madonna del Piano 6, 50019 Sesto Fiorentino (Firenze), Italy.
7. Dipartimento di Scienze della Vita, Università degli Studi di Siena, Via P.A. Mattioli 4, 53100 Siena, Italy.
8. Studio Naturalistico Hyla Srl, Tuoro sul Trasimeno, Perugia, Italy
9. Marturanum Regional Nature Park, Barbarano Romano (Rome), Italy

Assessing temporal activity patterns of carnivores and prey, and their overlaps provides key insights into behavioural adaptations for mitigating competition. Camera-trapping has improved our potential to conduct systematic studies of activity patterns and temporal niche overlap on mammalian guilds and, particularly, to monitor the presence and the spatiotemporal behaviour of species of conservation concern. In this study, we used 30 fixed camera traps, separated from one another by at least 1 km, to investigate temporal partitioning among carnivores and their common prey in two Central Italy wooded protected areas (Monte Rufeno Nature Reserve and Marturanum Regional Nature Park).

We obtained 10,043 independent videos in six months of monitoring, including several species of conservation concern according to the Habitats Directive: the grey wolf *Canis lupus*, the pine marten *Martes martes*, the wildcat *Felis silvestris*, the crested porcupine *Hystrix cristata*, as well as the Italian endemic Apennine hare *Lepus corsicanus*.

Our findings showed that all the species showed a crepuscular/nocturnal habit. In many species evolution has shaped nocturnality, and plus, in human-dominated landscapes, like the European ones, adopting nocturnal behaviour has become paramount to avoid people.

A high-moderate temporal overlap was detected between the wolf and other focal species (74–92% overlap). The highest temporal overlaps were reported between the wolf and the red fox *Vulpes vulpes* (92%), that were also supported by previous outcomes found in other areas, most likely suggesting a dietary facilitation of foxes by wolves released carrions. For wolf-ungulate pairs, the highest temporal overlap (90%) was reported with the wild boar *Sus scrofa*, the main prey in many places of south Europe. We detected a moderate–to-high (75-85%) interspecific overlap between the red fox and its potential prey species (hares, small rodents). Considering all the other species pairs (including hares, ungulates and medium-sized carnivores), temporal overlap was substantial (70–95%).

Assessing the temporal overlap among species within a community is crucial for understanding the mechanisms that regulate coexistence. Our study revealed that our focal species displayed a considerable overlap, indicating a lack of clear temporal avoidance on the scale examined. This observation suggests the potential presence of additional factors influencing their coexistence, particularly in terms of spatial and trophic interactions.

Analysis of ungulates presence in Campo dei Fiori Regional Park

Panebianco M. [1,2], Cremonesi G. [1], Preatoni D.G.[1], Martinoli A.[1], Bisi F.[1]

1. Environment Analysis and Management Unit, Guido Tosi Research Group, Department of Theoretical and Applied Sciences, Università degli Studi dell'Insubria, Via J.H. Dunant, 3, 21100 Varese, Italy
2. Campo dei Fiori Regional Park, Via Trieste, 40 - 21030 Brinzio (Varese), Italy

The populations of wild ungulates in Italy, especially in the Alpine and Apennine areas, are growing exponentially both in terms of distribution and size. For these reasons it is fundamental to monitor these species in order to obtain detailed and updated knowledge. From this perspective, this thesis project, conducted from December 2021 to September 2022 for a total of ten months of fieldwork, was carried out with the aim of monitoring, through a data collection campaign using camera traps, the three species of ungulates present in the territory of the Campo dei Fiori Regional Park: wild boar (*Sus scrofa*), roe deer (*Capreolus capreolus*) and red deer (*Cervus elaphus*).
The entire area of the park (63 km^2) was divided into 21 square cells measuring 2 km on each side.
Inside these cells a camera trap was positioned for each of the three seasons in which the monitoring took place, i.e. winter, spring and summer. In total we applied 63 camera-traps days effort and recorded 5977 videos. 2837 of that belonged to ungulates.
Occupancy modelling has been applied to test probability of presence in relation to seasons and to environmental and human related variables. The activity patterns of the three species differed. Wild boar shows mainly evening and nocturnal habits; red deer shows peaks of activity in the twilight hours both in the morning and in the evening, with a limited activity during the day-light and, roe deer shows diurnal habits during winter, but it is mainly crepuscular in spring and summer.
Data highlights that, considering average occupancy values for the three seasons, the species with the highest values is wild boar (Ψ=0.85), followed by roe deer (Ψ=0.82) and, finally, by red deer (Ψ=0.58). At a seasonal level, all three species show higher occupancy values during spring and summer, and lower in winter. From the analysis of covariates, it emerged that 5 covariates appear to have an intense impact, more or less strong, on the presence of the species. Human presence, the human fabrics and the slope negatively affect all three species occupancy. Furthermore, the distance from secondary roads network and elevation have a positive influence on the wild boar and roe deer probability of presence.
Considering the great expansion of these species, it is important to apply standardized monitoring protocols to collect information that are constantly updated and useful to plan proper management strategies base on scientific evidence.

New data about distribution of coypu (*Myocastor coypus*) in Cilento, Vallo di Diano and Alburni National Park and suggestions for transect-based monitoring

Papaleo L.[1,2], Russo L.F.[1,3], Senese A.[1], Chiacchio M.[1], Notomista T.[1], De Riso L.[4], Russo V.G.[1]

1. Kayla Nature s.r.l.s., via G.B. Ruoppolo, 80128, Napoli, Italy
2. Envix Lab, Department of Biosciences and Territory, University of Molise, 86090 Pesche, Isernia, Italy
3. Department of Biology and Biotechnologies "Charles Darwin", Sapienza University of Rome, Rome 00185, Italy
4. Ente Parco Nazionale del Cilento, Vallo di Diano e Alburni, Vallo della Lucania, Salerno, Italy

Invasive alien species (IAS) are one of the five major causes of biodiversity loss. They can also cause significant adverse impacts on the economy as well as human health. The IAS Regulation (Regulation (EU) 1143/2014) establishes the list of IAS of Union concern (Union List). The species included in it are subject to restrictions and measures from the Member States, such as early detection, eradication, management. Coypu (*Myocastor coypus*) is a semi-aquatic rodent species naturally present in South America, but it's been introduced during last century in Europe, North America, Asia and Africa. Coypu is included in the Union List for both ecological and economical damages it causes in colonized environments. While it's largely widespread in North Italy, its distribution in the southern regions appears more fragmented. After recent occasional reports of occurrence of the species in the North-Western area of Cilento, Vallo di Diano and Alburni National Park (CVDANP) and in contiguous areas, during 2022 we investigated coypu distribution in this macro-area. To understand where to focus field efforts, we developed a species distribution model (SDM) using the *forecast approach* as implemented in Biomod2 platform within R, using 302 occurrence data of Coypu in Italy obtained from iNaturalist and considering like environmental variables nine bioclimatic variables obtained from wordclim.com, altitude and slope. The resulting distribution map was binarized according to maximize TSS threshold. 30 random points were generated within the favourable areas for the species' presence in the study area, where to potentially define transects. We defined 25 transects (about 1 km each) and walked them looking for signs of presence of the species in 3 different seasons (winter-spring-summer), to eventually verify differences for the detectability of signs of presence. Additionally, we set 2 camera traps along two of the transects for a total of 58 trap-nights and launched a Citizen Science campaign to obtain additional data. We collected in total 28 records of the coypu through the various techniques, which can be summarized in 12 points of presence of the species for the study area. In some of them, presence of coypu was already known, while other ones represent new distribution data. Walking the transects we collected 14 signs of presence data (3 droppings, 11 footprints/tracks): 10 in the winter session, 3 in the spring session and 1 in the summer session. Additionally, we obtained 13 records from camera trapping and 3 records from Citizen Science campaign. This study allowed to update the distribution of coypu in CVDANP and in Campania, confirming its presence in Solofrone, Testene and Calore rivers (where the species has been reported in the last years), in Capodifiume river (geographically near to the previous ones) and in Alento river, from the mouth to the "Piana della Rocca" artificial lake. This last river is quite far from the other ones and with no evident ecological corridor linking with them, and it represents the southern limit of the study area. These results highlight a quite alarming southward expansion of the species and the consequent necessity to understand pathways of expansion and distribution south from Alento river. Nevertheless, we hypothesize a low density for the population in the study area, because of the few records obtained compared to the sampling effort. A further indication for this hypothesis could be the lack of perception of the species' presence from the local human population (unlike areas with high-density coypu population). The difference among the 3 sessions in the amount of signs of presence data collected, although just descriptive, suggests that the best season to use the technique of the transects to detect coypu presence is winter. This is probably due to the substrates being more

humid and adapt to collect footprints, as to the lack of a dense vegetation on the banks of the river, that consistently decreases visibility during spring and summer.

Ungulate intoxication by *Aconitum lycoctonum* L. (Ranuncolaceae) in Southern Italy

Viviano A.[1], Peluso M.[2], Cordon R.[3], Grattacaso M.[1], Gallo O.[2]

1. CNR-IRET Sesto Fiorentino, Sesto Fiorentino (Firenze), Italy
2. Università di Roma "La Sapienza", Roma, Italy
3. Università degli Studi di Pisa, Pisa, Italy

Secondary compounds of wild plants may be used by a wide range of organisms for a multitude of purposes. In particular, we focused on Aconitum lycoctonum L., 1753 consumption by wildlife and livestock. Free-ranging ungulates are susceptible to potential intoxication from poisonous plants such as aconite, thereby reducing the quality of green forage.
Our study was conducted in a small area of the Alburni, Vallo di Diano and Cilento National Park (Southern Italy, Campania region). To collect signs of ungulates feeding on aconitum, we opportunistically monitored four growing sites of this plant using infrared camera-traps. We equipped each site with one camera-trap set on video of 20 seconds-length with the shortest trigging time between consecutive events. Camera-traps remained on-site for the entire flowering period of the plant (August-September 2023), covering 46 days of activity.
We collected 74 videos with animal presence (wild and domestic ungulates, and birds), but at only two of the monitored sites. Among mammals (N = 72), wild ungulates were the predominant category (54.2%), followed by domestic ungulates (44.4%), and other mammals (1.4%: *Vulpes vulpes*). Roe deer *Capreolus capreolus* was the most detected (41.0%) wild ungulate, followed by wild boar *Sus scrofa* (35.9%) and red deer *Cervus elaphus* (23.1%). Cattle largely predominated (84.4%) domestic ungulates, followed by horses (15.6%).
We observed signs of feeding behaviour on aconitum in 22 videos, with cattle and roe deer being the only two species using the plant. Although referring to the same event (same date and temporally consecutives videos), cattle was the species feeding the most on the aconitum (N = 19, cumulative time = 19 minutes). On the other side, roe deer showed a feeding behaviour on three occasions at two sites,but referring to only one cumulative minute of feeding. Although this was a preliminary study, the evidence of use by both cattle and wild ungulates (i.e., roe deer) makes it necessary to conduct in-depth studies on the toxicity of the plant and the relationship between it and potentially harmful effects following ingestion.

Box traps or snares? Comparing the efficiency of two capture methods of the Alpine marmot *Marmota marmota* in the Central Alps

Perardi A.[1], Sooth F.[1], Nicoloso S.[1]

1. D.R.E.Am. Italia, via Enrico Bindi 14, 51100 Pistoia Italy

Burrowing by marmots can modify the physical and chemical properties of soils, potentially causing cascading effects on plant communities, species interactions and ecosystem functioning. In addition, the fossorial activities of marmots may negatively affect human land use, creating a human-wildlife conflict that needs to be mitigated successfully to ensure the conservation of marmots in the affected areas. In 2020 the Municipality of Livigno commissioned D.R.E.Am. Italia to draft a management plan for the Alpine marmot *Marmota marmota* aimed at reducing the species' impact on pastures, as well as on agricultural machinery and human infrastructures (e.g., huts, ski-lifts).
The main management technique employed was the capture of marmots in the identified core problem areas followed by their translocation. Capture operations with box traps and snares were conducted during the months of May and June of three consecutive years, from 2021 to 2023. Box traps baited with dandelion flowers Taraxacum officinalis were placed at the entrances to the most used burrows or along connecting paths. Flexible steel wire snares were installed in burrow entrances and tethered to a coloured flag serving as an alarm signal when the mechanism was tripped. Over a total of 52 working days, we captured 524 marmots (364 by box traps and 160 by snares), of which 494 were translocated. Each individual was categorized by sex and age, with sex determined by inspection of the ano-genital morphology and age determined by biometric measurements (length, body mass). Prior to translocation marmots were housed in wooden boxes with hay-covered ground. All individuals captured in the same area and/or belonging to the same family group were assigned to a specific box. During the time span between capture and release, two mortality events were recorded, both occurring during the housing period. The first event was attributable to intraspecific aggression, while the second event was caused by secondary effects resulting from the capture process (e.g., stress).
Translocations occurred within and outside the Province of Sondrio. Within Sondrio, 257 marmots were released in sites with low marmot density and where impact on human activities was not likely to occur. Outside of Sondrio, 237 marmots served as founders for two population reinforcement programs: one in the forest "Gardesana Occidentale" and the other in the Adamello Natural Park.
We compared the efficiency of box traps and snares in terms of capture frequency and trapping effort. Moreover, we analysed the mean body weight across sex and age classes over the three-year data collection period.
Our results indicate that box traps were consistently more efficient than snares each year, with variations likely influenced by food availability affecting trap attractiveness. Surprisingly, we observed a decline in mean body weight across all sex and age classes from 2021 to 2023.
This study offers insights into the short-to-medium-term effects of capture operations,
recommending the use of box traps before the onset of vegetation green-up to maximise capture rates and minimise capture time. Box traps prove to be a safe and time efficient method for capturing Alpine marmots. Our recommendations offer guidance for researchers and wildlife managers involved in conservation and management programmes which require the capture and manipulation of animals. Further studies are warranted to investigate long-term effects of capture on marmots and potential implications on wildlife welfare and research.

Were you invited to the buffet? Dynamics of use of artificial feeding sites by wildlife

Pellegrini C. [1], Salvatori M. [1,2] Ferraro E. [3], Brugnoli A.[3,4], Roner L.[1], Ossi F.[5,6], Cagnacci F.[5,6], Pedrini P.[1], Bombieri G.[1]

1. MUSE - Museo delle Scienze, Ufficio Ricerca e Collezioni, Ambito Biologia della Conservazione, Trento, Italy.
2. Dipartimento di Biologia, Università di Firenze, Sesto Fiorentino, Italy.
3. ACT - Associazione Cacciatori Trentini - APS, Trento, Italy.
4. Servizio Faunistico, Provincia Autonoma di Trento, Trento, Italy.
5. FEM – Fondazione Edmund Mach, Trento, Italy.
6. National Biodiversity Future Centre, Palermo, Italy

Supplementary feeding of wildlife is a widespread management practice used for different aims and target species, and includes feeding of ungulates for hunting purposes. However, such practice has been found to have negative effects on both target and non-target species.
We investigated use of ungulate feeding sites by the whole wildlife community in an area of the eastern Italian Alps with a high density of feeding sites, which also hosts four species of ungulates, and stable wolf packs. The area is also intensively exploited by humans for outdoor activities and tourism and some feeding sites are located very close or even within highly frequented areas. In such scenario, gaining insights on wildlife frequentation of feeding sites and their surroundings is fundamental not only to understand the efficacy of the practice to its goal and its impact on target and non-target species, but also to inform management policy in areas where ungulates, large predators and humans closely coexist.
The study was conducted in two phases between 2022 and 2023. The first phase aimed at identifying wildlife species using feeding sites and investigating spatiotemporal patterns of use by ungulates in particular. The second phase aimed at broadening the perspective focussing on prey-predator relationships and on how these may be influenced by feeding sites. In both phases, wildlife data were collected by camera trapping. Specifically, we 1) identified the species visiting feeding stations and quantified intensity of use both in time and space; 2) focused on ungulate species by analysing spatiotemporal patterns of use as well as temporal avoidance or overlap between species; 3) analysed the spatial behaviour of ungulates and wolves, in relation to both feeding sites and human presence.
We detected a total of 11 wild species and 1 domestic species visiting the sites. High variation was detected in the number of species across sites, which ranged from 1 to 8 species per site. Intensity of site use highly differed among species both in time and space: red deer was the species that used feeding sites most intensively, followed by roe deer, mouflon and the other species recorded. The red fox was the species visiting the highest number of sites, followed by roe deer, mouflon and red deer. Roe deer became more diurnal and crepuscular where red deer visitation rate was higher, showing an activity peak at dusk that was absent at sites with low red deer presence, suggesting inter-specific competition for supplemental resources. We also recorded wolf presence signs around 6 of the 14 sites, with a total of 20 signs detected including tracks, scats and depredated wild ungulates. Space use by ungulates was influenced by the distance to the closest feeding site and this might affect wolf movements and potentially influence predator-prey dynamics. Our work contributes to a deeper understanding of the complex ecosystem-level dynamics triggered by the presence of concentrated artificial resources in a landscape were humans and wild mammals live in proximity.

Assessing poaching acts on golden jackal (*Canis aureus*) in Friuli Venezia Giulia through the monitoring and surveillance regional network InfoFaunaFVG

Perlin I.[1], Baggio A.[1], Tomè P.[1], Beraldo P.[1], Orioles M.[1], Bregoli M.[2], Dorigo L.[3], Cadamuro A.[4], Benfatto M.[4], Pesaro S.[1]

1. Università degli Studi di Udine
2. Istituto Zooprofilattico delle Venezie
3. Museo Friulano di Storia Naturale
4. Regione Friuli Venezia Giulia

Poaching represents one of the major critical issues for biodiversity conservation and species protection, including the golden jackal (*Canis aureus*), listed in Annex V of the Habitats Directive 92/43/EEC. Between 2019 and 2023, 177 golden jackals (8 alive, 169 deceased) were found in the Friuli Venezia Giulia region by the Regional Forestry Service's Wildlife Recovery Service and other relevant entities. Detailed information about these animals, such as their sex, age, origin, reason for intervention, clinical signs, and *post-mortem* findings, were recorded in the InfoFaunaFVG progressive web app. 103 carcasses underwent thorough *post-mortem* assessments for health surveillance within the laboratories of the University of Udine, in conjunction with the Istituto Zooprofilattico delle Venezie, to ascertain the cause of death and any associated injuries. Among these, 69 underwent radiographic assessment to detect metallic foreign bodies. In cases suggestive of poisoning, toxicological analyses were performed on samples of stomach contents and liver tissue. As a result of these investigations, 7 cases were attributed to poaching acts: 5 to poisoning, and 2 to firearm shots. Notably, all instances of poisoning occurred within the same location and timeframe. Furthermore, one of the jackals that tested positive in toxicological analysis, led to the discovery of other three poisoned animals. Timely interventions by the Regional Forestry Service resulted in the detection and removal of poisoned baits from the carcass recovery sites, thus eliminating the potential lethal threat towards both wildlife and domestic animals in the surrounding area. In the Friuli Venezia Giulia region, poaching via poisoning appears to be localized, yet potentially underestimated, given the challenge of identifying all deceased animals. The collaborative integration of data in the InfoFaunaFVG data repository system has facilitated the detection and analysis of potential poaching incidents, providing an effective tool for wildlife conservation research. In conclusion, *post-mortem* evaluation (necropsy and radiography) is needed to detect possible poaching acts and to intervene in time to prevent further illegal killing. The collaboration between entities is of vital importance to reduce the threats to conservation for this species.

Roe deer habitat selection under hunting risk in human dominated landscapes across the Alps

Ruco V[1].,Simon R. N.[3], Pagon N.[4], Garel M.[3], Loison A.[2], Černe R.[4], Marucco F.[1]

1. University of Turin - Department of Life Sciences and Systems Biology, University of Turin, Via Accademia Albertina 13, 10123 Turin, Italy
2. Laboratoire d'Ecologie Alpine, Université de Savoie Mont Blanc
3. Office Français de la Biodiversité, Service Anthropisation et Fonctionnement des Ecosystèmes Terrestres, 38610 Gières, France
4. Slovenia Forest Service, Večna pot 2, 1000 Ljubljana, Slovenia

Intensification of anthropogenic activities has increasingly encroached on wildlife, altering their habitat selection and distribution. Animals are exposed to the risk of predation or other source of disturbance and must find a trade-off between food acquisition and risk to maximize their fitness. Several studies have confirmed that humans are perceived as predators and can induce spatial-temporal responses in both large carnivores and ungulates. Multiple anthropogenic factors may simultaneously affect wildlife, potentially in contrasting ways.. However, despite mounting evidence of the widespread impact of humans on animal behavior, our understanding of how human activities and the related lethal risk influence habitat selection is still limited and challenging, particularly in environments where the 'landscape of fear' is further shaped by the presence of natural predators for whom presence is by nature less predictable than for humans.

We analyzed the habitat selection of roe deer in three sites across the Alps: Les Bauges National Wildlife and Hunting Reserve (45°40′N, 6°13′E) in France, Pesio Valley in the Maritime Alps of Italy (44°19'N 7°40'E) and Jelovika plateau in Slovenia (46°09'N 14°07'E). These sites differed in terms of presence of a natural predators, human harvesting, and anthropogenic and environmental features. We analyzed GPS data of 45 adult roe deer (23 in France, 12 in Slovenia and 10 in Italy) during the hunting season (September to December) using resource selection functions and spatially fine-scale harvest data accounting for differences in human hunting mode (drive vs. approach/wait hunt).

Our results confirm the primacy of anthropogenic drivers on habitat selection by roe deer: animals exhibited strong avoidance both for areas with relatively high light pollution (an index of human urbanization) and a high risk of harvest by humans. Roe deer were also selected for proximity to human buildings, when hunting risk was relatively high, supporting the human shield hypothesis. Our results provide insights into the mechanisms that shape the habitat selection of a large ungulate in human-dominated landscapes, a key consideration for guiding effective management and human-wildlife coexistence.

Environmental factors driving bat migration through the Alps

Pini E.[1], Panzeri M. [1], Tattoni C. [1], Preatoni D. [1], Martinoli A. [1], Spada M. [1]

1. Dipartimento di Scienze Teoriche e Applicate, Unità di Analisi e Gestione delle Risorse Ambientali, Guido Tosi Research Group, Università degli Studi dell'Insubria, Varese (Italy)

Migration is the natural movement of animal species responding to seasonal or cyclical environmental changes, aiming to reach more favorable areas for survival. This phenomenon is extensively discussed in literature, particularly focusing on birds, which possess adaptations for long-distance travel. However, certain bat species also exhibit the ability to migrate: despite this, there is still limited knowledge on bat migration phenology and the environmental factors affecting species movements. In addition, data on bat migration across the Alps are very scant. The recent availability of bat detectors able to record automatically for long periods and the development of software for bioacoustics analysis of large amounts of data, has led to the possibility of new studies on bat migrations.
We thus carried out an acoustic survey during the autumn migration in the Passo di Spino area, a Lombardy pass in the Central Alps located in Toscolano Maderno (BS).
Data collection took place continuously from August 26 to November 13, 2022, using one SM4 bat detector. Recordings were analyzed using Kaleidoscope software, and then validated by an expert. To focus solely on migratory or potentially migratory species with an adequate number of records, we took into account only contacts classified as *Pipistrellus nathusii*, *P. pygmaeus, Nyctalus leisleri* and *Tadarida teniotis*. These records were correlated with weather, season and lunar variables to determine which factors affect the passage and activity of these species. Data about lunar phases were collected by a public repository and weather variables by the nearest weather station, located at the same altitude. For each species, we ran several generalized linear models correlating the number of contacts with the chosen environmental factors.
The most significant variables were: moon visibility and phase, precipitation, temperature and sunset time. For *P. nathusii*, the breeding period also played an important role, resulting in a higher number of contacts between August and the first half of October. Overall, greater activity was observed at dark, either during low moon phases or when the moon was set (and thus not visible), except for *P. pygmaeus*, which is significantly influenced by night brightness. Precipitation negatively affected all species. Higher temperatures correlated with increased contact rates for *T. teniotis* and *P. pygmaeus*, and had the opposite effect on *N. leisleri*. Wind didn't show a significant effect, primarily due to its low variability during the survey. Activity periods varied among species: *P. pygmaeus* resulted more active early in the night, *P. nathusii* at later hours, and *T. teniotis* showed two activity peaks during the night.
The possibility to collect and analyse big amount of data has opened new ways in understanding bat phenology. Our results shed light on how various environmental factors affect migratory bat species, revealing patterns on both daily and circannual scales. The use of automatic bat detectors in other Alpine passes would provide an insight on bat migratory routes and on how to preserve migrating bats from potential threats (e.g. wind farms).

Estimating red deer population using artificial foraging site

Provenzale E.[1], Bianchi M.[2], Santalmasi G.[2], Viara E.[1], Fossati P.[1], Bongi P.[3], Mori E.[4], Grignolio S.[5], Zaccaroni M.[6]

1. Department of Agriculture, Food, Environment and Forestry (DAGRI), University of Florence, Piazzale delle Cascine 18, I-50144 Firenze, Italy
2. Dynamo Oasi, Agricultural society s.r.l., Via private San Vito 1, I-51028 San Marcello Piteglio, Pistoia, Italy
3. Hunting office, ATCMS13, largo Bonfigli 3/5, Aulla I-54011, Massa-Carrara, Italy
4. CNR-IRET, Via Madonna del Piano 10, 50019 Sesto Fiorentino, Florence, Italy
5. Department of Life Science and Biotechnology, University of Ferrara, via Borsari 46, Ferrara, 44121, Italy
6. Department of Biology, University of Florence, Via Madonna del Piano 6, Sesto Fiorentino, 50019Florence, Italy

The preparation of wild ungulate management plans requires precise and accurate estimations of population size. These estimations are more difficult in forest environments, where visibility is poor and, consequently, the detectability of animals is difficult. Several methods are used to estimate red deer (*Cervus elaphus*) density: vantage point counts, distance sampling, counting of roaring males, spotlight counts, and camera trapping. However, no method performs well in all environmental conditions and is easy to implement also for volunteers (for instance, by hunters). A recent study provided interesting results by using baiting sites with direct observation to estimate red deer density in open areas in northern Europe. We tested an integrated approach using artificial foraging sites monitored with camera trapping to estimate the deer population in the Apennine environment characterised by a large percentage of the forest environment.

The study was carried out in Dynamo Oasi, a protected area of about 1,000 hectares, in Pistoia province, Italy. Altitude in the area ranged from 610 to 1180 m a.s.l., and the main tree species are chestnut, Turkey oak, beech, and pine black. The ungulate community is represented by mouflon (*Ovis aries*), wild boar (*Sus scrofa*), roe deer (*Capreolus capreolus*), fallow deer (*Dama dama*), and red deer. A wolf (*Canis lupus*) pack is permanently present in the area. From February 13th to March 15th, we monitored red deer activity at artificial foraging sites with a camera trapping approach. We used 10 artificial foraging sites, where we placed alfalfa pellets (1 quintal for each site) every week. At each artificial point, we deployed a camera trap on a tree 50 cm from the ground and about 5 meters from the foraging site. The cameras were left active in the field for the whole study period, in infrared mode to minimize disturbance to animals.

We observed that only deer and mouflon feed at artificial foraging sites. The other ungulate species did not use these sites to forage. Even in light of the low density of mouflon in our study area, we recorded few interactions with deer and they did not seem to affect deer use of these areas. All foraging sites were used by deer, although sites located in forest areas seem to be more attractive. Deer began using the sites from the first day of bait placement and continued on subsequent days. They used the sites with an hourly periodicity that seems to remain constant throughout data collection: close to the sunset we recorded the maximum use of baiting sites by deer. Animals used these areas also in the morning and at night, although at less predictable times. The peak of records was during the 3rd foraging event, after that red deer showed a less decrease in terms of frequency at foraging sites.

Our findings showed that red deer were attracted by alfalfa and a program with artificial foraging sites could permit them to count red deer in a good way. A camera trapping approach is preferable to direct observations because it is thus possible to obtain data even during the night hours and in forest areas.

What's your choice? Comparative analysis of nest composition in sympatric Glirid species

Ciampricotti A.[1], La Morgia V.[2], Puddu G.[3], Argenio A.[3], Bertolino S.[1]

1. Department of Life Sciences and Systems Biology, University of Turin, Via Accademia Albertina 13, 10123 Turin, Italy
2. ISPRA (Institute for Environmental Protection and Research), Via Ca' Fornacetta, 9 – 40064 Ozzano Emilia (BO)
3. Ente Monti Cimini – Regione Lazio, S.R. Cassia Cimina km 12.00 – Caprarola (VT)

This study aims to analyze the composition of the nests built in artificial shelters by the fat dormouse (*Glis glis*) and the hazel dormouse (*Muscardinus avellanarius*), cohabiting in a coppice forest in Central Italy. The analysis investigated the species – specific selection of nest construction materials and other characteristics. The goal is to provide valuable insight for management purposes, particularly by delving into the nest-building behavior of the fat dormouse, for which limited information is available, and comparing it with the nest-building behavior of the hazel dormouse.
Data on nest composition was collected as part of a study conducted from July 2022 to December 2023 in the "Lago di Vico" Natural Reserve (VT). A total of 44 nest boxes were installed (mean distance ± SD = 50±18m, range = 24-97 m) and distributed across four transects. These nest boxes were periodically checked (approximately 15-30 days). During the 20 surveys, the percentage of volume occupied by nests in each nest box was measured and categorize into five filling classes: 0, 0.1-0.25, 0.26-0.50, 0.51-0.75, 0.76-1. Additionally, the type of material used in nest construction was classified into general categories (leaves, moss, splinters, etc.), with plant species indicated where possible. At the end of the season, nests found in nest boxes that were no longer occupied by animals were collected for a more detailed analysis of selection of specific types of materials. This analysis was evaluated using two indices: the Jacob's D index and a second index called Effort (calculated as: proportion of used material in the nest x distance from the nearest material source). Additionally, distances between the nest boxes and the nearest material source were measured, along with the dry weights of the construction materials. Both variables were tested using a Krukall-Wallis Anova.
Moreover, the nests were classified into categories: grassy, foliar, layered, mixed. Data pertaining to the nests were analyzed in accordance with the Central Place Foraging Theory (CPFT).
Nest found in nest boxes inhabited by the fat dormouse were classified in the first three filling classes with a peak corresponding to the 0.1-0.25 class. Conversely, those inhabited by the hazel dormouse classified in the last three classes, with a peak at 0.51-0.75 filling class. A total of 27 nests were retrieved from the nest boxes, primarily containing leaves of ivy, chestnut, and hazel, along with bark filaments, indicating selection of some construction materials. A significant difference was observed in the weight between the bark filaments and the ivy leaves (Krukall-Wallis Anova p-value = 6.426e- 13; Dunn's post hoc test p-value = 0.016). These were the two most frequently used materials, found respectively in 21 (77.78%) and 8 (29.63%) nests respectively. However, they are used in clearly different proportions, with the average weight of ivy (0.64±0.73 g) much lower than that of bark filaments (7.49±6.28 g). All materials found in the nests were readily available close to the boxes from which they were retrieved. Most nests found in boxes occupied by the fat dormouse were classifiable as foliar, while the majority of those inhabited by hazel dormouse were classifiable as mixed.
From the results, it can be inferred that the two species likely do not make a selection for specific plant species but rather construct their nest based on the materials readily available in the area. Additionally, it appears that fat dormice tend to fill the boxes nearly completely, which may be attributed to their larger body size compared to hazel dormice. Finally, our findings highlight the different needs of the two species. The hazel dormouse occupies the boxes even during winter, suggesting a year-round presence, while there is no evidence of hibernation in artificial shelters for the fat dormouse, which appears to prefer natural cavities for this purpose.

Functional connectivity for the golden jackal (*Canis aureus*) in the Northeast of Italy (Friuli Venezia Giulia Region)

Riva V.[1], Frangini L. [1], Franchini M. [1], Madinelli A. [1], Pesaro S. [1], Ferfolja S. [1], Filacorda S. [1]

1. Department of Agri-Food, Environmental and Animal Sciences – University of Udine

Due to the rapid urban expansion and the exploitation of territories and resources, animal species find themselves having to face a continuous reduction in their habitat and its fragmentation, which prevents their movement and dispersion. It follows that it becomes essential to identify those areas that still guarantee a certain degree of connectivity so as to be able to implement adequate conservation projects. The golden jackal has a good dispersal capacity, with broad typologies of territory that it can occupy, making it vulnerable to anthropogenic mortality. Because of the importance of preserving a favourable conservation status in the Italian territory and for the future possibilities of a potential dispersion, it was chosen as the object of the study.
The method consists in the creation of a suitability map starting from a database of satellite locations obtained from 7 radio-collared individuals from 2019 to 2022 (4 males and 3 females with a total of 4396 fixes with an average of 4 fixes per day). The study area is composed of the whole Friuli-Venezia Giulia region plus a portion of the Slovenian territory to include all the telemetry locations. This area is populated by the most northwestern part of the Balkan-Dalmatian population of jackal, which is comprised of a few hundred individuals. To investigate habitat selection, five potentially significant variables have been selected according to the environmental needs of the golden jackal which will be used as covariates: altitude, slope, land cover, distance from water and distance from the streets. To understand how these covariates influence the presence of the jackal it has been used the Resource Selection Function (RSF), and a GLMM.
Based on the results obtained, it has then been predicted the environmental suitability along the entire study area. The resistance map was subsequently created, on which to run the connectivity model based on circuit theory (via the CircuitScape software). This shows a better representation of the jackal's use of space, also confirmed by other studies that show how similar species, that is dispersing mesocarnivores, are better represented by this theory.
The model obtained shows, as expected, a jackal preference for areas of prairie and shrubland, bare soils and medium-low altitudes. Higher connectivity for the southern plain areas and the beds of the main rivers and lower connectivity both for the areas at higher altitudes and for those closer to the main urban centres. The results of the RSF are all highly significant, but if observed more specifically one by one, it is possible to notice how some are likely influenced by the small sample size. The elevation shows a preference for lower altitudes. This is, however, highly affected by the presence points due to having only one of the jackals living at higher altitudes. The distance from water displays a great individual variability. The jackal's tendency to exploit the resources available near roads and smaller villages was also noted. This highlights how such behaviour of approaching them poses a great risk of death due to investments. Two of the four jackals that showed shorter distance from roads died indeed from investment.
To conclude, this study confirmed the adaptive and dispersal capabilities of the jackal, and its tendency to approach anthropogenic structures. These results show that although this species can adapt to the presence of human beings, it still requires more targeted protection and safeguarding. This would then allow it to maintain the transit areas it prefers and thus reduce the high mortality rate due to road investments. To create more precise and reliable models it would therefore be desirable to expand the data set to reduce the influence of the individual. The telemetry dataset in fact has shown it can provide a great source of information on the behaviour and the decisional processes of animals.

Reducing the impact caused by feral goats on Asinara island: investigation for suitable permanent capture techniques

Rosso C.[1], Nocentini F. [1], Colotti S. [1], Bonechi E. [1], Ceoldo F. [1], Pontiggia P. [1], Nicoloso S. [1]

1. D.R.E.Am. Italia, via Enrico Bindi 14, 51100 Pistoia Italy

Islands can be described as biodiversity hotspots, but high levels of endemism and simplified trophic webs, often due to the lack of a predator, make island communities susceptible to invasive species. Feral goats (*Capra hircus*), are one of the most damaging species to island ecosystems with direct and indirect effects mainly due to overgrazing, which often results in ecosystem degradation and loss of biodiversity. The widespread distribution of feral goats on Asinara Island can be attributed back to the time of the cessation of prison activity, in 1998, when the penitential livestock farm goats were abandoned, and the population, in the absence of predators, soon colonised the entire territory. Since 2006, the Park Authority has promoted capture operations of the species in order to contain the damage: traditional capture techniques, conveyance to fences already established on the island, were not sufficient to achieve the eradication aim set by the Park Plan, nor to mitigate the impact caused by the species. On average, over the last five years, 1047.6 goats have been caught per year (median = 881, sd = 308.5).

This research provided an assessment of the most effective trapping strategies and techniques in containing population expansion. The trapping systems introduced on the island in the summer of 2023 were two, both based on a system of remote control activation: the first, guillotine gates remotely controlled by operators, was a technological evolution to the trapping systems already present in the island; the second, Up-net ascending nets, represented the innovative and versatile key element, which, installed in strategic locations on the island, succeeded in capturing more than 40% of the animals captured. Captured animals were submitted to health monitoring, provided with a ruminal bolus and registered to the national database in order to be sent to Sardinian farms.

The project took a total of 52 consecutive working days, during which 409 goats were captured and removed from the Asinara Island. The efficiency of the results can be verified both by the number of animals captured in a relatively short period, and by the number of operators involved in the capture operations, which in this study averaged four, as opposed to the 10-15 used historically. The average daily capture efficiency was 2.4 goats/operator/day, with highs peaking at 7 on many days. Remote control systems not only resulted in successful captures efficiency but also ensured high selectivity for the target animals and minimised the disturbance to the animals during all capture operations.

This work definitely acknowledges two key points: firstly, it recognizes the presence of more efficient methods and strategies in containing such and impacting population as feral goats; secondly, it emphasizes the importance of capturing a higher number of animals annually, particularly during the pre-breeding season, to have a meaningful effect on the population. Although it was not feasible to conduct a statistical comparison with historical datasets since they were collected in different ways and at different times, the results of this study highlight the efficacy of the new approach. This emphasizes the urgent need to implement advanced capture strategies to mitigate the impact of invasive species and ensure the preservation of the island ecosystem.

Coping with Fragmented Forests: Assessing Mammalian Diversity in Emilia-Romagna

Rota M. [1], Melcore I. [1], Gili F. [1], Preatoni D.G. [1], Martinoli A. [1], Bisi F. [1], La Morgia V. [2]

1.Environment Analysis and Management Unit, Guido Tosi Research Group, Department of Theoretical and Applied Sciences, University of Insubria, Via J.H. Dunant, 3, 21100 Varese, Italy
2. ISPRA Institute for Environmental Protection and Research, via Ca' Fornacetta, 9, 40064 Ozzano Emilia (BO), Italy

Habitat fragmentation is a widespread phenomenon that can have significant consequences on biodiversity and the ecology of forest habitats. Fragmentation is often the direct result of anthropogenic expansion, leading to the conversion of forested areas into agricultural land, urban settlements or infrastructure. These changes can drastically affect the structure and functions of forest ecosystems, reducing habitat availability and hindering wildlife movements. In Emilia-Romagna, the effects of habitat fragmentation are evident, mainly at lower elevation with potentially significant impacts on local biodiversity. However, the precise consequences of this fragmentation on local terrestrial mammal fauna remain unclear. Understanding how fragmentation influences the presence and abundance of terrestrial mammals over such large extent is essential for developing sustainable conservation and management strategies. To address this knowledge gap, the present study aims to assess whether there are variations in the presence of medium-large mammals in Emilia-Romagna also due to habitat fragmentation.

From a grid of 1x1 km cells applied to the whole territory of the region, 60 cells were randomly extracted according to a randomisation procedure guided by habitat suitability maps. A total of 20 camera traps were deployed in turns of 30 days each to ensure a representative coverage of forest habitats in the region. Each camera trap was strategically placed within the cells, taking into account local environmental characteristics and potential wildlife movement corridors. To assess habitat fragmentation, we analysed Corine Land Cover data, providing detailed information on land cover distribution and structure. The 1x1 km cells were thus classified based on forest cover and fragmentation.

As a result, with a survey effort of more than 1700 camera-days, over 4000 videos of terrestrial mammals (including 500 of domestic animals) were collected. The study has allowed for the monitoring of several species of terrestrial mammals included in the Habitats Directive 92/43/EEC, such as *Canis lupus*, *Histrix cristata* and *Felis silvestris*.

Data analysis revealed changes in the composition and abundance of wildlife in response to habitat fragmentation within the Emilia-Romagna region. Cells characterized lo possiamo anticipare secondo me by broader forest cover and less fragmentation exhibited greater species richness and abundance of terrestrial mammal species compared to areas subjected to more pronounced fragmentation.

Find the intruder. Preliminary results on the distribution of *Myocastor coypus* in the Molise region

Ruggiero R.[1], Papaleo L.[1], Giovacchini S.[1], Mirone E.[1], Loy A.[1,2]

1. Department of Biosciences and Territory, University of Molise, Pesche (IS), Italy
2. Research Institute on Terrestrial Ecosystems, National Research Council, Montelibretti (RM), Italy

Myocastor coypus (Molina, 1782), commonly known as coypu, is widely considered as one of the most troublesome invasive alien species worldwide. Its expansion across various parts of the world can be attributed to deliberate and accidental releases into natural habitats. Due to its significant negative impact on freshwater ecosystems and human infrastructure, the European Union Regulation No. 1143/2014 mandates active measures by member states for monitoring, and consequently, eradicate, or control populations. Although the coypu has been detected in Molise since 2012, its effective distribution has been never investigated. In compliance with the Union Regulation mandate, we run a regional survey of the species, to identify to identify priority areas to implement effective management strategies to limit its spread and mitigate ecological damage.

To pinpoint priority areas for field investigations, we preliminary collected all available occurrence records from scientific literature, citizen science platforms (such as iNaturalist.org), social media, and regional databases. Field surveys were primarily conducted in areas where coypu sightings were reported or in areas where it was likely to occur, i.e. high suitability areas in proximity to areas of confirmed presence. Field survey was then run at 44 sites located in the areas of current or potential coypu presence covering the Volturno and Sangro river basins. Survey was run by means of Visual Encounter Surveys (VES), search for presence signs (footprints, scats etc.) along transects, camera trapping, and animal track detection platforms.

Out of the 44 sites surveyed, 11 were found positive for the presence of coypu, which the totality of them, represent new records for the Molise region. Notably, coypu was exclusively found in the Volturno river and in its tributaries.

These preliminary results suggest that after 12 years since the first records, the coypu is still confined in approximately 20 km of river stretches at the south-western border between Campania and Molise. We hypothesize that key limiting factors are preventing coypu expansion in Molise. Niche and species distribution models are on course to detect other potential areas of occurrence and identify environmental constraints affecting its current distribution in the region.

Skull Shape Variation Among Subspecies of the Eurasian Otter

Russo L.F[1,2], Lanzetti A.[3], Meloro C.[4], Goswami A.[3], Loy A.[2]

1. Department of Biology and Biotechnologies "Charles Darwin", Sapienza University of Rome, Rome 00185, Italy
2. EnvixLab, Department of Biosciences and Territory, Università degli Studi del Molise, Pesche, Italy
3. Department of Life Sciences, Natural History Museum, Cromwell Road, Kensington, London SW75BD, UK
4. Research Centre in Evolutionary Anthropology and Palaeoecology, Liverpool John Moores university, Liverpool, United Kingdom

The Eurasian otter (*Lutra lutra*) has the widest range among Lutrinae, spanning Eurasia and North Africa with 11 extant and one extinct recognized subspecies. Recent geometric morphometric studies have highlighted differences in skull shape among populations in Great Britain and Scandinavia, indicating potential geographic and adaptive variation beyond previous assumptions.

To explore intraspecific variability in skull size and shape among Eurasian otter subspecies, we employed a 3D geometric morphometric approach. Specifically, we aimed to identify variations in skull morphology across subspecies. We analyzed 235 adult otter skulls, representing 10 of the 12 recognized subspecies. Utilizing photogrammetry techniques and surface scanners, we reconstructed 3D models of each skull. Principal Component Analysis (PCA) was conducted to explore shape variation among subspecies, and ANOVA on CS and Procrustes ANOVA on shape variables were run to test the effect of subspecies on size and shape respectively.

Our results indicate significant differences in both size and shape among subspecies. The nominal subspecies *L. l. lutra* differed from the other taxa except the mountainous *L. l. kutab*. The Asian subspecies *L l. chinensis*, *L. l. barang* and *L. l. nair* were more closely related to each other and showed distinct traits concerning both the nominal subspecies and the North African *L. l. angustifrons*. Our findings suggest that similar selective pressures may drive skull morphology variations across different regions of the Eurasian otter's range, possibly linked to dietary adaptations.

Furthermore, our study suggests the existence of at least one highly divergent taxon, *L. l. nair*, which may warrant consideration as an Evolutionarily Significant Unit. However, genetic studies on Eurasian otters from Sri Lanka and broader investigations into Asian populations are lacking, highlighting an urgent need for further research, particularly given the significant threats faced by Asian biodiversity.

The Italian wolf (*Canis lupus italicus*) in Cilento, Vallo di Diano and Alburni National Park: Insights from a recovering population

Russo V.G.[1], Papaleo L.[1,2], Chiacchio M.[1], Senese A.[1], Russo L.F.[1,3], De Riso L.[4], Notomista T.[1]

1. Kayla Nature s.r.l.s., Via G.B. Ruoppolo, 80128 Napoli, Italy
2. Envix Lab, Department of Biosciences and Territory, University of Molise, 86090 Pesche (IS), Italy
3. Department of Biology and Biotechnologies "Charles Darwin", Sapienza University of Rome, 00185
4. Ente Parco Nazionale del Cilento, Vallo di Diano e Alburni, Via F. Palumbo 18, 84078 Vallo della Lucania (SA), Italy

In recent decades, the Italian wolf (*Canis lupus italicus*) has experienced a process of recolonization of its historical range. This phenomenon was facilitated by effective conservation measures, the increasing abandonment of cultivated areas, and the surge in ungulate density. In the 1970s, when the species was on the brink of extinction, the Cilento, Vallo di Diano, and Alburni National Park (CVDANP) represented one of the strongholds for the species, with a population of approximately 10 individuals. Until 2017, when the last population estimate was conducted, the local population was estimated to be of about only 20 individuals.

In the current study, we present the findings of two monitoring projects developed within the protected area. The first project occurred between October 2020 and April 2021 and was conducted as part of the national monitoring scheme for the species. It primarily utilized linear transects (90 transects) and camera trapping (54 photographic points), spread across 13 quadrants of 10 x 10 km (38% of the total protected area). The second project, spanning from July 2022 to August 2023, was implemented within the "WOLFNExT" initiative and stands as one of the most comprehensive studies undertaken in a national protected area for this species. It encompassed the entire territory of CVDANP (34 quadrants) and included 43 transects (average length of 4.5 km), for a total of 193.5 km traversing the diverse habitats of CVDANP, and 62 camera traps. Additionally, this project also incorporated wolf howling surveys. Both projects benefited from the inclusion of certified observations collected through citizen science.

During the first project, a total of 381 signs of presence was collected, confirming the species' presence in all quadrants surveyed, while visual sightings obtained from camera traps suggested the presence of at least two couples and four packs (3 to 7 individuals). The following WOLFNExT project resulted in additional 496 signs of presence, proving the species' presence in 91.2% of the investigated quadrants, and showing the existence of at least six pairs and nine packs.

In contrast to previous studies that highlighted how the species was mainly limited to mountain areas, it was observed regardless of altitudinal limits, occurring as low as the sea level. In conclusion, the species appears to have an extensive distribution within the territory of CVDANP, occupying both areas highly compatible with the species' ecology and areas previously considered to have low to moderate environmental suitability.

Distribution of *Pipistrellus* group along an altitudinal gradient in the Western Alps

Sacco A.[1], Bellè A.[1,2], Bertolino S.[1]

1. Department of Life Sciences and Systems Biology (DBIOS), University of Turin, via Accademia Albertina 13, 10123 Turin, Italy
2. [2]nstitute for Alpine Environment, Eurac Research, Drususallee/Viale Druso 1, I-39100 Bolzano/Bozen, Italy

The distribution of Chiroptera species in mountain environments is poorly studied, despite being the second most speciose mammalian order. While studies on other mountain chains exist, information on species richness and turnover along the altitudinal gradient is lacking in the Alps, particularly regarding the use of passive bio-acoustic sampling. Furthermore, limited research investigated the factors influencing bat activity in the mountain regions. In this study, we investigated which environmental variables could influence the activity and feeding activity behavior of species within the *Pipistrellus* group along an altitudinal gradient. Additionally, we aimed to determine the altitudinal peak of activity.

Study sites were selected in two side valleys of the Orco Valley within the Gran Paradiso National Park. Bat recordings were acquired using Wildlife Acoustics Song Meter Mini Bat detectors, which were positioned every 300 m in altitude from 700 m up to 3100 m. Sampling was carried out for two nights per month from March to November 2023. During the field sessions, habitat characterization data were acquired. Temperature was measured each time the bat detector was installed using a temperature logger (iButton Thermochron), while the vegetation structure was evaluated as the sum of vegetation cover at different heights surrounding the sampling point (0-24). Habitats were defined in macro categories: deciduous forest, mixed forest, rocky and alpine grassland. After the captures, bat sequences were manually identified at the species level, when possible, and feeding buzz sequences were also counted. Species activity was quantified as the number of sequences of a species or group per night at each sampling point. A GLMM model with negative binomial distribution was run for each species, with the sampling point and sampling session treated as random effect. Covariates included temperature, altitude, exposure, vegetation structure and the habitat type. GLMMs were also employed for feeding buzz analysis by incorporating the aforementioned along with species identification.

In total, 282 nights of recordings were acquired yielding 33,069 records of *P. pipistrellus*, 2,369 of *H. savii* and 396 of *P. kuhlii/P. nathusii.* The altitudinal peak in activity was observed at 1600 m for *P. pipistrellus*, *H. savii* as well as for feeding activity, while it was found at 700 m for *P. kuhlii/P. nathusii*. Regarding temperature, the peak in activity occurred at 13.7°C for *P. pipistrellus* and *P. kuhlii/P. nathusii*, but at 17.9°C for *H. savii*. Additionally, the peak of activity in the sampling season was observed in September for *P. pipistrellus*, in July for *H. savii* and in March and August for *P. kuhlii/P. nathusii*. Models show a significant relationship with temperature, grassland and rocky habitat for *P. pipistrellus*, a significant positive relationship with vegetation structure for *P. kuhlii/P. nathusii* and a significant positive relationship with temperature, vegetation structure, grassland and rocky habitat for *H. savii*. Considering the feeding buzz models, there was a significant positive relationship only with vegetation structure.

This study shows how the activity of these bat species along an altitudinal gradient is not solely related to altitude, but is primarily influenced by temperature, vegetation structure and the habitat type. While these factors play crucial roles, it's worth noting that the availability of water may also be a significant determinant of bat activity. Previous studies have recognized water availability as a key factor in the altitudinal distribution of bat species richness. The activity peaks observed at intermediate altitudes (1600m) could be attributed to a greater availability of water at mid-altitudes, particularly in dry mountain regions. This increased water availability, coupled with temperature fluctuations associated with elevation, likely contributes to a greater abundance of trophic resources and consequently leads to heightened feeding activity among bat populations.

Management methods of invasive alien species - the case of the Pallas's squirrel in Varese Province

Panebianco M.[1], Tortini A.[1], Santicchia F.[1], Preatoni D.G.[1], Martinoli A.[1], Bisi F.[1]

1. Environment Analysis and Management Unit, Guido Tosi Research Group, Department of Theoretical and Applied Sciences, University of Insubria, Via J.H. Dunant, 3, 21100 Varese, Italy

The Pallas's squirrel (*Callosciurus erythraeus*) is a tree squirrel native of South-East Asia, which has been introduced in several countries around the globe. In Europe, since 2016, the species has been included in the list of invasive alien species (IAS) of Union concern (EU regulation 1143/2014). In Italy, the species occurs since 2007, in the northern part of Varese province, where a viable population established. The Pallas's squirrel is known to damage commercial and forest trees, electric wires and parts of buildings and its presence, in co-occurrence with the native red squirrel (*Sciurus vulgaris*), affects local viability of native sciurid populations, through the influence on adult survival. In its native range, it occurs in a wide range of habitats: tropical evergreen forests, subtropical evergreen broadleaf forests, secondary forest of warm-temperate trees near sea level, subalpine conifer forests and degraded scrub landscapes, monsoonal semideciduous or deciduous broadleaf forests. Moreover, the Pallas's squirrel prefers the high tree density and canopy cover of unlogged areas, using different vertical layers of the forest canopy, such as trunks, lower lianas or higher branches of the trees. Once introduced, in the absence of control measures, the species is able to spread into new areas within a very short period of time. Indeed, tree squirrels are known to be good invaders due to their high reproductive rate, high dispersal capacity, high foraging plasticity and high adaptability in urbanised contexts.

In the north of Lombardy region, in Varese province, close to the Swiss border, occurs the only population of Pallas's squirrels present in Italy, which has been controlled since 2011, when a removal program started with a European Life Project (LIFE09 NAT/IT/00095 EC-SQUARE). Afterwards, different removal methods have been implemented, following the entry into force of the European regulation on exotic species of union concern (EU regulation 1143/2014) and the transposition with the Italian Regulation D.L. 230/2017, which contain provisions for the prevention and control of the introduction and spread of invasive alien species and the Pallas's squirrel national management plan.

The objective of the research is to test different removal methods to prevent the species to colonise new areas. Live trapping has been used to remove individuals from areas at the border of the known distribution of the population. Live capture is one of the most effective methods of removal in anthropised areas, due to its selectivity, efficiency, reduced disturbance and adapability to usage in different environmental contexts. Pallas's squirrels have been captured using trap-cages and subsequently euthanised in accordance with the animal welfare requirements of CE Regulation 1099/2009. The sex, weight and reproductive status of each individual caught were recorded.

Secondly, shooting has been used by provincial rangers and authorised control operators, at stationary points or along transects. The culled animals have been recovered and their sex recorded.

We compared both methods of removal in order to investigate their efficacy in terms of number of removed animals. We also explored variation in sexes of culled animals, for both removal techniques.

Our findings highlighted that choosing the proper method in planning control campaigns is fundamental, especially considering environmental characteristics, in order to reach the target objectives of a management plan. Control of IAS is paramount to prevent further expansion of the species and facilitate recolonisation by native ones.

Stress in the city: differential physiological response of native red and invasive grey squirrels

Santicchia F.[1], Tranquillo C. [1], Wauters L.A. [1,2], Palme R. [3], Panzeri M. [1], Preatoni D. [1], Bisi F.[1], Martinoli A. [1]

1. Environment Analysis and Management Unit, Guido Tosi Research Group, Department of Theoretical and Applied Sciences, Università degli Studi dell'Insubria, via J. H. Dunant 3, 21100 Varese, Italy
2. Evolutionary Ecology Group, Department of Biology, University of Antwerp, Campus Drie Eiken Universiteitsplein 1, 2610 Wilrijk, Belgium
3. Unit of Physiology, Pathophysiology and Experimental Endocrinology, Department of Biomedical Sciences, University of Veterinary Medicine Vienna, Veterinärplatz 1, 210 Vienna, Austria

The spatial extent of urban landscapes, the presence of humans, and consequently their impacts on ecosystems, are increasing worldwide. Human-induced changes can alter native habitats through variation of vegetation characteristics, food resources, as well as landscape structure. To cope with such novel pressures, wild species may show behavioural and physiological responses (e.g. shifts in circadian rhythms, variation in physiological stress levels) as well as changes in population dynamics resulted from human-derived resource availability or reduced presence of natural predators and competitors. Therefore, populations inhabiting urbanised landscapes may differs from those occurring in rural areas. Specifically, in vertebrate species, the activation of the hypothalamic-pituitary-adrenal (HPA) axis and subsequent release of glucocorticoids (GCs) mediates responses to environmental perturbations, such as anthropogenic disturbance. Preadaptation to face those challenges has been suggested to favour settlement and spread of invasive alien species in urbanised areas which, consequently, might respond differently than ecologically similar native species to stressors posed by urbanisation. Thus, investigating the GC response of native and invasive species to analogous stressors, is paramount to determine conservation strategies and management programs.

Using a parallel, within species, study system, we explored differences in faecal glucocorticoidn metabolite (FGM) concentrations, an integrated measure of both baseline and stress-induced GC levels (stress hormones), of the Eurasian red squirrel (Sciurus vulgaris), a native sciurid, and the Eastern grey squirrel (Sciurus carolinensis), an invasive alien congener. GC levels variation was explored in rural, suburban and urban areas and in relation to conspecific density.

We found no association between population density and FGMs and no changes in FGMs with urban type in the invasive grey squirrel. In contrast, in native red squirrels the association of FGMs and conspecific density varied between rural and suburban sites, potentially depending on differential HPA axis responses. In urban sites, this relationship did not differ significantly from that in rural and suburban ones.

Our results improve knowledge about physiological responses of native and competing invasive species, which can support conservation strategies in human-altered environments. Furthermore, our findings suggest that the invasive grey squirrels might be preadapted to cope with challenges posed by urbanisation, and thrive in areas with increased anthropic pressures, ultimately exacerbating their success and invasive potential.

A network of protected areas sampled with systematic camera trapping to assess and monitor mammals' trends and responses to human activity

Salvatori M.[1,2], Greco I.[1], Rovero F.[1]

1. Dipartimento di Biologia, Università di Firenze, via Madonna del Piano 6, Sesto Fiorentino (FI), Italia
2. MUSE – Museo delle Scienze, Corso del lavoro e della Scienza 3, 38122 Trento (TN), Italia

Camera-trapping offers unique opportunities for standardising the monitoring of large and medium-sized terrestrial mammals, yet in Italy it has never been implemented with a systematic protocol over multiple areas and during multiple years. Many large mammals have seen an increase in distribution and abundance in Europe, especially in mountainous and interior areas, following land abandonment with consequent decrease in agricultural activities and re-expansion of forests. At the same time, natural and protected areas are increasingly being visited for outdoor recreation, raising new challenges for the harmonization of wildlife conservation and the provision of recreational ecosystem services. Many medium and large-sized mammals are also species of choice for recreational hunting and wildlife management, and their abundance, distribution and behaviour are strongly affected by these human activities. Besides focal species monitoring, standardised camera-trapping has also the potential to understand the relationships between multiple species, such as the rapidly changing dynamics triggered by the comeback of the wolf and in some areas also of other large carnivores. These processes require robust sampling methodologies to evaluate spatial patterns and long-term temporal trends.

In 2020 we systematically sampled with camera-traps four protected areas and surrounding zones in the Apennines and Alps and assessed the response of 16 species of mammals to human outdoor activity in terms of amount of nocturnality, occupancy, and site use during diurnal, crepuscular and nocturnal hours. We evaluated responses both at community and species levels, also accounting for environmental preferences, using Generalised Additive Mixed Models and a multi-species multi-region occupancy model. In one of these study areas (Adamello-Brenta natural park), that we monitored systematically since 2015, we could estimate long-term trends in occupancy and trap rate, as well as the behavioural responses of mammals to intense and growing human frequentation.

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 where exposed to low levels of human activity and they markedly decreased diurnal and crepuscular site use where outdoor recreation was more intense. In the study area monitored since 2015, we found that even though outdoor recreation increased, mammals' occupancy was stable or even on the rise. Community level metrics, such as the Wildlife Picture Index, were also increasing.

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 for animals, that might affect population trends on a longer time frame. Inter-specific interactions, including predation and herbivory, can also be altered by such changes. Our studies also show the potential of systematic camera-trapping to study ecological patterns at large spatial and temporal scale, both at species and community levels.

The church of Saint Francis and its colony: brief history of a Chiroptera nursery during 10 years of monitoring

Scalisi M.[1], Palombi A.[2], Colonnelli L.[2], Piazzai M.[2], Belisario F.[2], Tomassini A.[3]

1. Regione Lazio, Direzione Regionale Ambiente CCTESP, Roma.
2. Regione Lazio, RNR Monte Rufeno, Acquapendente
3. Associazione Tutela Pipistrelli APS, Roma

The bell tower of Saint Francis in Acquapendente (VT – Italy) hosts a mixed colony of *Rhinolophus ferrumequinum* (30%) and *Myotis emarginatus* (70%). Since its first discovery in 2011, the colony has been monitored using various techniques and experimenting different approaches, due to the anthropic disturbing context in which it's based; actually, not only disturbance linked to streetlights and the nearby cloister but also noise linked to the access to the bell tower itself.
From 2012 to 2024 the colony has been monitored each year using a Evening emergence counts technique, when bats fly away at sunset through two openings in the wall based in the same terrace. For this reason, monitoring has always been performed by two operators that check two separate well-defined sectors of sky, so to avoid double counting.
In order to investigate breeding success, evening counts have been performed, when possible, every ten days from June to October. Unique exception was the year 2020 when, because of pandemic, only one count was carried out. Moreover, for three years contemporary counts were performed both with emergence count and thermal imager, while in one year monitoring was performed by means of a *Bat Counter*, covering with a blanket one of the two exits.
Count's highest number was always detected in the third decade of July, thanks to the exit from the roost of the juveniles. No peak occurred in 2017, while during the last two years peaks were anticipated and took place during the second decade of July. Colony is always present during the month of June, and presumably also a few weeks before, while it usually disappears during the second decade of October.
The few thermal imaging counts performed have always highlighted a higher effectiveness of this method, showing differences of 25-33% more compared to the emergence count, except when the cloister was well-lit (as it happened in 2016 when the difference between the two methods decreased to 2%). A similar low gap (4%) was recorded using the *Bat Counter*, but in that case the expected number of individuals was almost halved, influencing the quantity of those remained in the roost.
The mixed colony displays periods of births and emancipation that are different between the species, but not recognizable relying on counts. Even though a bimodal distribution was clearly evident for some years, no sound data could be obtained to establish the consistency of the juveniles. Although gathered data are not yet sufficient, it is possible to hypothesize that the climate changes occurred during the last two years have affected the period of births, bringing forward the release of the juveniles from the roost by a decade.
It can finally be hypothesized a better effectiveness of counts with the use of thermal imager.

First steps towards the morphological and genetic characterization of the Sardinian Wildcat

Lecis R.[1], Mattucci F.[2], Di Bella L.[1], Caniglia R.[2], Monti I.[1], Muzzeddu M.[3], Sforzi A.[4], Scandura M.[1]

1. Dipartimento Medicina Veterinaria, Università di Sassari, Via Vienna 2, 07100, Sassari, Italy
2. Area Genetica della Conservazione BIO-CGE ISPRA Via Cà Fornacetta, Ozzano dell'Emilia (BO), Italy
3. Centro Recupero Fauna Selvatica – Agenzia FORESTAS, Loc. Bonassai (SS), Italy
4. Museo di Storia Naturale della Maremma, Grosseto, Italy

The Sardinian wildcat (*Felis silvestris lybica*) belongs to a North-African lineage that reached the Mediterranean island in ancient times. While numerous studies have been conducted on the European wildcat (*Felis silvestris silvestris*), very little is known on the Sardinian wildcat ecology, genetics, and conservation status.

Given this lack of knowledge, it is paramount to investigate the current distribution and genetics of the Sardinian population of *F.s. lybica*, previously described as var. *sarda*. In this work preliminary steps were taken to: firstly, define the morphological and molecular characteristics of pure Sardinian wildcats; secondly, ascertain areas of presence on the island; and thirdly, assess the degree of hybridization with domestic cats in these areas. To reach these goals, an integrated approach has been adopted, involving citizen science, questionnaire distribution and interviews to local people, morphological and genetic investigation on road-killed individuals, and the adoption of a non-invasive monitoring protocol based on camera trapping.

Questionnaires and interviews allowed us to build a preliminary alleged distribution map of the species, and to select candidate areas for non-invasive monitoring. The morphological and genetic characterization of a dozen road killed individuals during the first phase of the project allowed us to identify pure individuals and wild x domestic hybrids, paving the way for a better characterization of the Sardinian wildcat.

Further steps of the research will allow to shed light on this elusive presence on the island and to improve its conservation.

Bat popoulation trends in the continental biogeographical region: the case of Emilia Romagna

Scigliano L.[1], Panzeri M.[1], Tattoni C.[1], Preatoni D.[1], Martinoli A.[1], Spada M.[1]

1. Unità di Analisi e Gestione delle Risorse Ambientali, Guido Tosi Research Group, Dipartimento di Scienze Teoriche e Applicate, Università degli Studi dell'Insubria Varese (Italy)

To evaluate the conservation status of threatened species, population size and trend are paramount factors to consider. In Italy, the most recent document analyzing bat population size and trends is the 4° report of the Habitat Directive, where these factors were listed only on experts' accounts without specific analysis or robust data. The next reporting due in 2025 will mark and important step to update this information using new standardized methods and thus allowing a correct evaluation of bats' conservation status.

This study aims to evaluate seasonal population trends of seven bat species in the Emilia-Romagna Region (Italy). Target species are *Rhinolophus ferrumequinum, R. hipposideros, R. euryale, Miniopterus schreibersii, Myotis myotis, Myotis blythii* and *Myotis emarginatus*, all listed in the II and IV Annex of the Habitat Directive.

We collected bibliographical data from technical reports, regional and citizen science datasets and experts' accounts, in order to identify the major winter and summer sites of the target species. A field campaign was carried out in 2023 aiming to gather data about winter and summer populations of target species by roost counting inside the hibernacula, and inside nursery sites through inside or in-flight counts at night. The abundance data collected with the bibliographical study and the field activity were analyzed. Population trends were created using count data at different sites and times and imputing missing data for some years in some sites using "rtrim" package in R.

The bibliographical analysis yielded more than a thousand data going back, in some cases, to 1984; even though most of the data were collected after the year 2000 with a particular abundance of data after the year 2010. During the field activities we inspected 38 winter sites and 37 above and underground nursery sites in summer. Seasonal trends for the seven species were calculated from the year 2010 to 2023; for three of the species we built both winter and summer trends while for the others, given the lack of data, we were able to model only the summer trends. The species showed a general increase in population abundance across the years, with the only exception of *Rhinolophus Euryale*, which appears to be declining in the region.

The trends obtained during the study are to be considered a starting point to evaluate bats' trends at the continental biogeographical scale. Though our data differ in robustness due to the different number of roost counts available for each different species, the trends calculated offer a first accurate account of the state of threatened bats populations in this biogeographical region. Our results are in many cases in contrast with the trends listed in the 4th Report of the Habitat Directive and hint at an improvement in the conservation status of bats in the continental region. This could reflect the positive impact of regional, national and European legislation on nature protection and of conservation actions put in place in past years. Rhinolophus euryale is the only declining species of the seven studied.

Hence, it is important to understand which are the key factors that are contributing to its decline. This cave-dwelling species has a prevailing Mediterranean distribution and is strictly linked to karstic areas. The maintenance of a rich environmental patchwork of shrub vegetation and mixed forests near karstic areas may be the key to the conservation of this species, together with a strict protection of underground roosting sites.

The constant monitoring of bat population size is essential to derive robust datasets and long-time series necessary to obtain consistent population trends that allow to implement conservation actions in case of population decreases.

Abundance and diversity of ground-dwelling rodents in a Protected Area in Mongolia

Sclip A.[1], Mazzamuto M.V.[2], Tranquillo C.[1], Lkhagvasuren A.[3], Gansukh S.[3], Martinoli A.[1], Koprowski L.J.[2]

1. Environment Analysis and Management Unit, Guido Tosi Research Group, Department of Theoretical and Applied Sciences, Università degli Studi dell'Insubria, via J. H. Dunant 3, 21100 Varese, Italy
2. Haub School of Environment and Natural Resources, University of Wyoming, 804 E Fremont Street, Laramie, WY 82072, USA
3. Mammalian Ecology Laboratory, Institute of Biology, Mongolian Academy of Sciences, Peace Avenue 54b, 13th Khoroo, Bayanzurkh district, Ulaanbaatar 13330, Mongolia

The preservation of biodiversity is crucial in maintaining ecosystem stability and resilience; however, threats from both direct and indirect human activities such as habitat alteration, urbanization, pollution, and climate change can lead to its disruption, ultimately affecting the survival of wild species. Small mammal populations can be considered as indicators of environmental changes, providing early warning of ecosystem disruption. Mongolia is experiencing rapid social and economic development. During this process, the loss of a traditional way of life, increase in urbanization and overexploitation of natural resources can threaten the persistence of natural ecosystems for future generations.

In this study, we investigated the ground-dwelling small mammal populations living in a human-disturbed and undisturbed area within the Bogd Khan Mountain UNESCO Biosphere Reserve, at the edge of Mongolia's capital city. From May to July 2023, we carried out capture-mark-recapture, using both a transect and grid design, to compare species richness, estimate the density and the survival probability of the three most captured species: *Apodemus peninsulae*, *Craseomis rufocanus* and *Eutamias sibiricus*.

We found a similar species richness and abundance in the undisturbed and in the disturbed areas. Moreover, no significant differences in survival probability were detected between the two areas, suggesting that human disturbance did not have a notable impact on the survival of small mammals during the survey period. However, we recorded a low species richness in the area compared to the historical records, possibly indicating the local extinction of several small mammal species.

Our study is the first to evaluate the abundance of small mammal populations within Bogd Khan Mountain Biosphere Reserve. Since the human population living in the capital is expected to continue growing fast, leading to an increase in anthropogenic disturbance in the nearby Mountain, this research lays the essential groundwork for future long-term studies on these species, crucial for preserving their vital ecological roles.

Exploring new techniques to study mammalian range dynamics and conservation: two case studies for the Eurasian lynx (*Lynx lynx*) and the Eurasian beaver (*Castor fiber*) at multiple scales

Serva D.[1], Biondi M.[1], Krofel M.[2], Iannella M.[1]

1. Department of Life, Health and Environmental Sciences, University of L'Aquila, Via Vetoio—Coppito, L'Aquila, L'Aquila, 67100, Italy
2. Department of Forestry, Biotechnical Faculty, University of Ljubljana, Vecna Pot 83, 1001, Ljubljana, Slovenia

Several mammals are recently making a comeback in Europe, and some of them have returned or are still in expansion in Italy. The return of these species poses several challenges concerning their possible effect on ecosystems and their interactions with other species. Among the species recently returned in Italy, the Eurasian beaver (*Castor fiber*) and the Eurasian lynx (*Lynx lynx*) are two important cases of study. After being close to extinction, both species recovered in Europe due to legal protection and reintroduction projects. The Eurasian beaver reappeared in Northern Italy in 2018, with a natural recolonization process from Austria. Then, the species was observed in Central Italy in different regions, but these occurrences are much likely to be caused by illegal reintroductions. On the other side, the Eurasian lynx went extinct in Italy and was reintroduced in the Alps, where currently occurs.

Our objective is to apply several recently-developed modeling techniques to deepen the knowledge of different facets related to the landscape-scale management of these species, such as their possible interactions with others, the identification of optimal areas for reintroductions, connectivity assessments for habitat fragmentation mitigation, enhancing those with population viability analyses To evaluate all these aspects, we use several modeling techniques, like species distribution modelling (SDMs) in R, functional and structural connectivity analyses in Julia, and other cutting-edge resources and algorithms (e.g., the 'riverconn' R package, and individual-based models (IBMs) like the 'RangeShiftR' R package).

Our results show that the Eurasian beaver could further expand in several suitable areas at a European scale, and so it would in Central and Northern Italy, with some existing corridors enabling it to move from the northern areas to the Padano plains, and others connecting the Central Italian occurrences. Despite this, some existing barriers (i.e., manmade dams) are prioritized and detected by us, especially in the Tevere basin, where management actions should be focused. On the other hand, the SDMs built for the Eurasian lynx highlight different suitable areas in Europe, some of them in sympatry with other kleptoparasites. Several corridors are identified throughout Europe, possibly linking the isolated Central European subpopulations. If considering a hypothetical lynx reintroduction program in the Apennines, some suitable patches cluster in the Nothern and Central sectors, with a higher connectivity in the Northern than in the Central one; possible stepping-stones, if properly managed, could link these two areas. The outputs from 'RangeShiftR' package show that there are important differences based on the reintroduction scenarios considered, with an overall greater probability of persistence of the lynx in the Central Apennines, over time, compared to other areas.

These outputs show how ecological modeling could serve as a tool to accurately assess different aspects to promote mammal conservation and management, especially in the face of the recent challenges posed by global change and anthropogenic-related impacts. From the application of SDMs and connectivity analyses on these cases of study, we gathered important information about the landscape-scale trends in time and space. In fact, we inferred how these species could further expand or reduce in the future, where to focus management actions to prevent possible negative interactions with potential kleptoparasites, to link the isolated subpopulations, and to mitigate barriers impact. Finally, with the implementation of recently-developed IBMs, we assessed the success of different possible reintroduction scenarios, checking for population viability analysis, occurrence probabilities, and colonization time, in order to support a possible return of the lynx in the Apennines.

Temporal activity patterns and overlaps of introduced leporids and their mesopredators

Sogliani D.[1,2], Bignami L.A.[3,4], Scabini E.[3,5], Ancillotto L.[6,7], Di Bari P.[8], Quaranta S.[1], Queiros J.[9,10], Mori E.[6,7]

1. Department of Biology and Biotechnology, University of Pavia, via Adolfo Ferrata 9, 27100 Pavia, Italy.
2. Ca' della Paglia College, Ghislieri Foundation, 27100 Pavia, Italy.
3. WWF Martesana Sud Milano, Operative Unit of South-East Milan, via Battisti 19, 20097 San Donato Milanese (Milan), Italy.
4. Department of Earth and Environmental Sciences, University of Milano-Bicocca, piazza dell'Ateneo Nuovo 1, 20126 Milan, Italy.
5. Department of Earth and Environmental Sciences, University of Pavia, via Ferrata 1, 27100 Pavia, Italy.
6. Research Institute on Terrestrial Ecosystems (CNR-IRET), via Madonna del Piano 10, 50019 Sesto F.no (Florence), Italy.
7. National Biodiversity Future Center (NBFC), 90133 Palermo, Italy
8. Department of Biological, Geological and Environmental Sciences – Animal Biology Section, University of Catania, via Andreone 81, 95124 Catania, Italy
9. Departamento de Biologia, Faculdade de Ciencias da Universidade do Porto, Porto, Portugal
10. CIBIO, Centro de Investigação em Biodiversidade e Recursos Genéticos, InBIO Laboratório Associado – BIOPOLIS Program in Genomics, Biodiversity and Land Planning, Campus de Vairão, Universidade do Porto, Vairão, Portugal

Understanding prey-predator interactions elucidates mechanisms of coexistence. For instance, predators influence distribution and behaviour of prey populations, and changes in their abundance can have ripple effects throughout the food web. In addition, the conservation of endemic lagomorphs juxtaposes the management of introduced ones. In Italy, the European rabbit *Oryctolagus cuniculus* and the Eastern cottontail *Sylvilagus floridanus* were introduced from the Iberian Peninsula and the Americas, respectively. Despite morphological similarities, their distinct eco-ethological traits differentiate their interactions with the ecosystem.

We aimed to decipher temporal activity rhythms and overlaps among these leporids and three mesopredators (red fox, European badger, domestic cat) in a peri-urban oasis located in northern Italy. Employing camera trapping over 2,116 trap-nights, cottontails dominated detections followed by rabbits. In the warm season, cottontails and rabbits were mostly diurnal, foxes and cats cathemeral, while badgers nocturnal. Temporal overlaps were "high" between lagomorphs and between cottontails and foxes, while "moderate" between rabbits and foxes. In the cold season, cottontails became mostly nocturnal, rabbits cathemeral, and foxes mostly nocturnal. The overlap was "moderate" between rabbits and cottontails, while overlaps were "high" between leporids and foxes. Cottontails in both sympatry and allopatry with rabbits exhibited similar activity patterns and overlaps, suggesting limited competition due to potential niche partitioning. Finally, through the genetic analysis of sixteen rabbits, we have shed light on which subspecies was introduced in northern Italy and thus the invasion mechanism.

Our findings underscore the importance of studying temporal dynamics to unravel interspecific interactions, essential for effective management of alien species.

Exploring mammalian diversity and conservation in Lebanon Nature Reserves

Cremonesi G.[1], El Indary S.[3], Rota Martir S.[2], Spada M.[1,2], Panzeri M.[1], Gagliardi A.[1], Bisi F.[2]

1. Istituto Oikos E.T.S. via Crescenzago 1, 20134 Milano, Italy
2. Environment Analysis and Management Unit, Guido Tosi Research Group, Department of Theoretical and Applied Sciences, University of Insubria, Via J.H. Dunant, 3, 21100 Varese, Italy
3. Association for Bird Conservation in Lebanon, Biodiversity Unit, Beirut, Lebanon

In an environment as complex and diverse as Lebanon, which faces socio-political challenges, crises and wars, natural landscapes face unprecedented threats, and the importance of Nature Reserves cannot be understated. With rapid urbanization and anthropogenic pressures, these protected areas serve as vital sanctuaries for biodiversity, safeguarding delicate ecosystems and endemic or threatened species. However, understanding the dynamics of these ecosystems, particularly for mammal populations, remains largely unexplored in Lebanon. The use of innovative technologies such as camera traps offers an excellent tool to fill this knowledge gap. In this study, we carried out a first country-scale monitoring within the 18 Lebanon Nature Reserves under the project "STEPping up Nature Reserves Capacity – STEP4Nature". By combining the deployment of camera traps and the detection of indirect signs of presence along transects, we aimed to obtain valuable information on mammal species, completing the checklist for some site and creating the first one for others.

The 18 Nature Reserves cover all the country from South to North, ranging from the sea level to 2800 m a.s.l. for the highest (Mount Hermon). The size is highly variable ranging from 20 hectares for smaller sites to more than 15000 for the Shouf Biosphere Reserve. In 2023-2024 we carried out two different monitoring campaigns covering the two different seasons (wet and dry). We focused on non-volant terrestrial mammals. Cameras were placed at 60 cm above the ground and set up as follows: (1) 20 s videos, (2) with a two-minute-interval between consecutive videos; and (3) a passive infrared sensor (PIR) sensitivity set as "medium" with side PIR sensors active. Cameras were active 24 h per day. The number of cameras ranged according to the size of the area with a system of 5x5 km grid, in order to standardize as much as possible the cameras deployment and relative effort, and ranging from 1 camera for smaller reserve to 10 for the largest. Since the goal was to do a checklist, we used baits during the second monitoring campaign to monitor also differences in both methodologies. Line transect sampling technique was also adopted observing mammals' tracks (footprints, droppings, burrowing etc.) along a specific tract on foot with a 4 m sight range. The transect lines and camera traps were selected to cover the main habitats existing in the targeted areas.

At the end of the surveys more than 2000 mammals' videos have been recorded in addition to more than 118 transects ranging from 3 to 12 km. We deployed a total of 47 camera traps for a total effort of more than 1400 trapping days. For some areas, we were not able to deployed cameras for logistic and/or security reasons: among the 18 Nature Reserve we covered 10 with both cameras and transects and 7 with only transects while for one reserve we were not authorised to access. We recorded a total of 19 different medium sized mammalian species. Among these, we found 2 vulnerable species by the Red List IUCN (the marbled polecat, *Vormela peregusna* and the striped hyena, *Hyena hyena*) and other locally highly threatened species as the wolf (*Canis lupus pallipes*), the Eurasian otter (*Lutra lutra*), the jungle cat (*Felis Chaus*), the Rock hyrax (*Procavia capensis*) and the wildcat (*Felis sylvestris*). For some areas, this was the first mammals' monitoring and resulted in the first checklist, for others, species were confirmed or added to previous monitoring that dated far back. We were not able to ascertain the presence of the caracal (*Caracal caracal*), threatened species in the Mediterranean area, suggesting to continue the monitoring effort and to keep this species under a questions mark.

In conclusion, our study represents a significant step forward in understanding and conserving Lebanon's rich biodiversity in the face of multifaceted challenges. These monitoring efforts are critical to inform conservation management strategies that ensure the long-term viability of Lebanon's mammal populations with growing environmental challenges.

Evaluation of the behavioural response of the italic wolf (*Canis lupus italicus*) to different lures

Tacchella E.[1], Contini M.[1], Pedretti G.[2], Molinari L.[1], Valsecchi P.[2]

1. Appennino Tosco-Emiliano National Park, via Enzo Bagnoli 32, 42039, Ligonchio, Italy
2. University of Parma, Department of Chemistry, Life Science and Environmental Sustainability, Viale delle Scienze 17/A, 43124, Parma, Italy

In recent decades, wolf populations in the Northern Hemisphere have rebounded due to human migration from rural areas and conservation efforts, yet they remain endangered due to habitat fragmentation and conflicts with humans, including illegal killings. Hybridization with dogs poses another threat, constituted by stray dog populations. European projects aim to address this by genetically identifying and sterilizing wolf-dog hybrids. This study, part of these efforts, evaluates two scent attractants—anchovy paste and timberwolf urine—to lure wolves for genetic analysis and hybrid capture.

The study was conducted in the southern portion of the province of Reggio Emilia. Within the area, camera traps were placed to record wolf (and other wild animals) responses to lures in 12 different spots, divided in passage sites and marking sites. A baseline period of 8 nights was recorded with no attractant present. After this period, 10x10 cm cork sheet soaked in attractants (anchovy paste, urine) or clean one (control condition) were placed for 8 nights in a counterbalanced order between location and replaced with a fresh one every 4 nights.

Urine (U) specifically elicited interactions in wolves compared to other animals (i.e. foxes, wild boar and badger), especially when placed in marking sites compared to passage sites ($\chi2 = 53.217$, $p < 0.001$). Condition had a significant influence an on the time wolves spent sniffing in proximity of the attractant (full-null model comparison $\chi2 = 20.155$, $p < 0.001$). Wolves sniffed more the U compared to the C (Estimate=1.084 ± 0.243 t-value= 4.458, $p<0.001$), there was no difference between the PAand C condition while there was a tendency to significance for the wolves to sniff more the attractant in the U condition compared to the PA condition (Estimate= 0.564 ± 0.262, t-value= 2.150, p=0.079). No significant difference was found for the location type (passage site or marking site) while wolves sniffed more the attractant when it was fresh compared to when it was older (Estimate=-0.134 ± 0.040 t-value= -3.356, $p<0.001$).

The study underscores attractants' utility in studying elusive species like wolves. The research suggests potential useful indication for the use of attractants in wildlife management and conservation, for example, can be used for behavioural studies or to make capture of wild animals more efficient.

The impact of beech mast on human-bear conflicts in the Italian Alps

Tattoni C. [1], Bisi F.[1], Corradini A[2]., Chianucci F[3]., Ciolli M.[4,5], Martinoli A.[1], Preatoni D.G.[1]

1. Dipartimento di Scienze Teoriche e Applicate,Università degli Studi dell'Insubria, Varese, Italy
2. Fondazione Edmund Mach, San Michele all'Adige (TN), Italy
3. CREA, Agricultural Research Council, Arezzo, Italy
4. DICAM - Università di Trento, Italy
5. C3A - Centro Agricoltura Alimenti Ambiente, San Michele all'Adige (TN), Italy

Mast seeding, characterized by variable and intermittent seed production, profoundly influences ecosystem functioning, particularly within the food chain Pulsed resources highly affect the producer-consumer relationship and often drive vertebrate behaviour. The study was carried out in the Italian Alps, specifically focusing on brown bear population (*Ursus arctos*) inhabiting the central eastern part. In this area, bears also frequent broadleaved forests where one of the most widely represented species is the beech (*Fagus sylvatica*). In this context, beech nuts represent the one of the most important food source for bears during hyperphagia.
To understand the availability of this resource, we conducted a study utilizing historical data from the MASTREE+ database, coupled with field sampling, and collections of beechnuts in 2020 and 2021. We also incorporated data provided by the "Centro Nazionale Carabinieri per la Biodiversità di Peri". Less damage to agriculture and cattle are expected in autumn during mast year, when beechnuts are consumed during hyperphagia, because bears trophic needs are satisfied by natural food. On the other end, we expected an increase of damage during poor years of beech production.
Beech seed production was classified according to Rohmeder's standard classification, using 4 classes ranging from absent to mast. We integrated this data with records of bear-related damage to livestock, crops, and property collected by the Wildlife Office of the Province of Trento. The final dataset spanned from 2007 to 2021. The number of damages caused by bears to agriculture, beekeeping, livestock and others kind of damage were normalized based on bear population size.
Results revealed a significant correlation between mast seeding and decreased damage to agriculture and livestock. This finding suggests that bears primarily rely on natural food sources during mast years, thereby reducing human-wildlife conflicts in sensitive areas.
This work provides insights on the ecological dynamics and conservation implications of brown bears in the study area. By identifying mast or poor years through observations of beech flowering in spring, adaptive management strategies can be developed to prevent damages in sensitive areas. Such proactive measures could be implemented months in advance, contributing to effective wildlife conservation and management practices.

Behavioral responses of the roe deer to human activities and predator presence in north-western Italy

Torretta E.[1], Ruffoni G.[1], Bergantin E.[1], Frigerio E.[1], Meriggi A.[1]

1. University of Pavia, Italy

The roe deer represents a primary prey species for large carnivores and a game species for hunters. Consequently, it is expected to exhibit distinct responses aimed at minimizing exposure to both humans and predators, generating a complex landscape of fear. This study aims to assess a non-invasive and cost-effective method for collecting useful data to analyze population parameters and behavioral responses shaped by the landscape of fear.
Over a two-year research period, from December 2020 and November 2022, we collected roe deer data through camera-trapping and direct observations from vantage points across seven study areas in north-western Italy, characterized by variations in the presence of wolves, landscape composition, and species management. Our data analysis focused on activity patterns and time budgeting; among the observed behaviour, particular focus was given to vigilance.
Based on the obtained results, we identified the most suitable areas for species persistence and the key factors negatively impacting population parameters. Notably, we observed considerable adaptability in roe deer responses to spatio-temporal variations in risk perception, with human disturbance emerging as a primary influencer on roe deer behaviour.
In summary, our study provides valuable insights into the dynamics of roe deer populations and their behavioral adjustments in response to environmental factors, particularly human presence.

Management of invasive alien species in unsuitable and highly fragmented habitats - the case of the grey squirrel in the Po valley

Tortini A.[1], Panebianco M.[1], Santicchia F.[1], Wauters L.M.[1], Preatoni D.G.[1], Martinoli A.[1], Bisi F.[1]

1. Environment Analysis and Management Unit, Guido Tosi Research Group, Department of Theoretical and Applied Sciences, Università degli Studi dell'Insubria, Via J.H. Dunant, 3, 21100 Varese, Italy

The eastern grey squirrel (*Sciurus carolinensis*) is a North American species that has been introduced into several areas outside its range over the last two centuries. In Europe, since 2016 it has been added to the list of invasive alien species (IAS) of Union concern (EU regulation 1143/2014). The presence of IAS affects the presence of native species and in some cases results in their local extinction. In Italy, Great Britain and Ireland this alien species is overtaking the native Eurasian red squirrel (*Sciurus vulgaris*). In its native range, the species is mainly associated with deciduous forests, but its ecological plasticity gives grey squirrels the ability to colonize also urban and suburban areas. Once introduced, in the absence of control measures, the species is able to spread into new areas within a very short period of time. The eastern grey squirrel is able to cross anthropogenic barriers such as roads or bridges. In Lombardy region there is a nucleus of grey squirrel at the southernmost border, in particular along the Adda river towards the confluence with the Po river, at the border with Emilia Romagna. The objective of the research is to test removal methods to prevent the species to colonise new areas.

Following guidance of the Italian Regulation D.L. 230/2017, which contain provisions for the prevention and control of the introduction and spread of invasive alien species and the grey squirrel national management plan, we used live trapping to remove individuals from a very anthropic area.

Live capture is the most effective method as it offers selectivity, efficiency and reduced disturbance, allowing it to be used in different habitats.

The target species has been captured using trap-cages. Captured animals were euthanised in accordance with the animal welfare requirements of CE Regulation 1099/2009 as soon as possible after capture. The sex, weight, reproductive status and length of the right hind foot of each individual caught were recorded. Results show that a pre-baiting period is fundamental to increase capture probability. Animals were caught both in areas of higher naturalistic value in the Po Valley, and in small forest patches in the typical agricultural landscape.

In the intervention areas, the habitats suitable for the presence of native species are limited and located within a highly anthropized matrix. Control of IAS along these potential corridors is fundamental to prevent IAS expansion along large areas crossing several administrative borders and to facilitate the possible recolonisation by the European red squirrel.

Wolf coverage and framing by newspapers across the Italian Eastern Alps

Trainotti N. [1,2], Fedrigotti C. [2], Malavasi S. [1], Pedrini P. [2], Bombieri G. [2]

1. Dipartimento di Scienze Ambientali, Università Ca' Foscari di Venezia, Venezia Mestre, Italy
2. MUSE-Museo delle Scienze, Ufficio Ricerca e Collezioni, Ambito Biologia della Conservazione, Trento, Italy

After a century-long absence from the Alps, wolves are successfully recolonizing their former range, with a rapid increase in numbers and distribution. Human viewpoints and attitudes are diverse and sometimes polarized, reflecting both real and perceived risks and benefits of the species. Understanding public attitudes and media framing is crucial for wolf conservation, however, research on media coverage in the Alps is limited. To address this gap, we analysed newspaper articles in the Eastern Italian Alps to assess public discourse, attitudes, and coverage of wolf-related topics. By evaluating news valence and identifying most prevalent topics, we aim to better understand how newspapers depict wolves in this region and identify potential local differences.

We conducted a content analysis of newspaper articles published between 2019 and 2020 in the provinces of Trento and Bolzano, and Veneto region. Content analysis included assessing media coverage, valence evaluation of news elements (title, subtitle, text, and images/videos), identifying attitude expressions, main topics, false information, and stakeholders mentioned or interviewed in the news. Most analyses were conducted both on Italian and German articles (for Bolzano province), in-depth analysis of news text was limited to Italian articles. Four hypotheses were tested: 1) differences in overall news valence across study areas, 2) variations in coverage and valence among newspapers, 3) discrepancies in main topic prevalence across study areas, and 4) associations between main topics and valence.

We collected and analysed 803 news articles, and found variations in coverage and framing among both study areas and newspapers. Most articles were published in Veneto (43%), particularly in Belluno province (72% of the total news collected in Veneto). Overall, 43% of news were neutral, followed by negative (37%) and positive (20%) news. A in-depth content analysis showed that, in general, titles (63%) and subtitles (61%) tended to be neutral, while images/videos were mostly neutral (73%) or negative (25%). Neutral news texts were most common (54%), followed by negative (28%) and positive (18%) texts. Considering the three main study areas (Belluno, Bolzano, Trento) separately, significant differences were found. Results show higher prevalence of neutral news in Bolzano (52%) and Trento (54%). In Bolzano province, German news had more negative titles (26%) and negative overall valence (40%) compared to Italian news (31%). Belluno published mostly negative (54%) news, with a higher proportion of negative expressions (69%), especially regarding the negative impact of wolves on human activities. Trento and Bolzano had the same percentages of negative (53%) and positive (47%) expressions. Significant differences among study areas were also found in topic prevalence, with Bolzano and Trento focusing more on wolf management (respectively 35% and 23%), and Belluno on predations (37%). Breeders (18%), management authorities (30%), and wolf experts (17%) were the main subjects interviewed or mentioned. False information was present in 8% of the articles, with 53% of them having negative valence.

Our study offers insights into wolf media coverage in the Eastern Italian Alps, revealing variation of coverage and framing of wolves across areas and newspapers. Geographic variations likely reflect differences both in wolf presence and pressure on human activities as well as political orientations, prior experiences with large carnivores, and management approaches. Strong variation among newspapers also highlights the important role of journalists and communicators in general in influencing portrayal style of the species, which aspect is crucial to improve coexistence. Our results suggest that consistent differences can exist even within neighbouring and apparently similar geographic contexts, highlighting further complexity of factors driving media depiction and attitudes toward wolves. To conclude, we underline the importance of promoting objective information, encouraging constructive dialogue, and combating misinformation to improve human-wolf coexistence.

Badgers in the city

Grespan P.[1], Sanguinetti F.[1], Bressani P.C.[1], Tranquillo C.[1], Carlini E.[2], Martinoli A.[1], Bisi F.[1]

1. Environment Analysis and Management Unit, Guido Tosi Research Group, Department of Theoretical and Applied Sciences, Università degli Studi dell'Insubria, Via J.H. Dunant, 3, 21100 Varese, Italy
2. Istituto Oikos srl - Impresa Sociale, via Crescenzago 1 - 20134 Milano Italy

Many carnivore species have colonized urban environments in recent decades, with the red fox (*Vulpes vulpes*) now likely the most widespread wild carnivore in European urban areas. In addition to red foxes, Eurasian badgers (*Meles meles*) have also established clans at the edges of cities and, at times, within urban parks. In anthropized habitats, these animals can exploit advantages such as easy access to new food sources and, sometimes, the presence of human artifacts could facilitate sett digging. On the other side, city life presents challenges, including cohabitation with pets and a higher road density compared to rural areas, leading to roadkill incidents. In this context, understanding badger behavior, such as activity patterns and space use in relation to habitat connections, becomes crucial.

Our study areas include an urban park in Varese (area 1), situated in town center, and a peri-urban area in Rile-Tenore-Olona PLIS (area 2). Area 1 is surrounded by residential and commercial buildings and roads, featuring a small wood patch and good shrub cover, as well as another open area accessible to citizens. Area 2 is characterized by significant tree cover, alongside agricultural fields in proximity. Three smaller towns are within 1 km from the badger sett. For both areas, we mapped sett entrances, latrines, and paths. Subsequently, we used camera traps opportunistically to monitor badger activity in the sett surroundings.

Through monitoring activities, we documented the presence of several species beyond badgers, including red foxes, beech martens, cats, deer (only in area 2), and wild boars, even in the town center but with lower frequency. The city park (area 1) experiences higher human and dog presence, while in area 2 also hares and cottontails have been recorded. During autumn, human presence in area 2 could be associated with hunting activity. We counted 8 sett entrances and 3 latrines in area 1, while in area 2, there were 32 entrances and 7 latrines. Badgers resulted strictly nocturnal, and their activity patterns in the two areas highly overlapped (80%). This analysis also revealed significant time overlap with other carnivores, particularly red foxes and domestic cats. Conversely, the overlap with humans and dogs, mainly active during daylight hours, is reduced.

In area 1, we detected up to 4 individuals together, but it is not yet known whether there is only a couple or a larger number of resident individuals. Our hypothesis is that these individuals are connected to the population of the protected area Campo dei Fiori regional park. In area 2, we recorded only 3 individuals together, but the number of entrances and latrine sizes suggest a potentially bigger clan. Activity patterns in the two areas apparently show that human presence does not significantly affect badger circadian rhythms. Red foxes, cats, and badgers are active during nighttime. In area 1, badgers exploit cement manufacturing for their setts, while in area 2, cats randomly use badger setts. Sett co-habitation is known, particularly with red foxes, and it will be interesting to further investigate interactions with domestic cats.

Anthropogenic noise impact on bat communities

Trombin D.[1], Miraglino R.[2], Morra L.[2], Bertolino S.[1]

1. Dep. of Life Sciences and Systems Biology, University of Turin, Turin, Italy
2. Ai Engineering, Turin, Italy

Anthropogenic noise is a globally increasing environmental disturbance with several implications for wildlife. However, our understanding is still limited. Many studies have been confined to laboratory, focusing on few species and on short-term (≤ 24 h) effects. Moreover, few studies have explored wildlife responses both during and after noise exposure. Bats are important indicators of environmental quality due to their sensitivity to a wide range of environmental stresses and their rapid response mechanisms. The study aimed to investigate the impact of anthropogenic noise on bat communities.

In 2023, a field experiment was conducted involving the emission of controlled white noise at 110 dB (SPL) using the dodecahedral Norsonic AS (model Nor276) sound source. Throughout the experiment, the acoustic environment in the study area was characterised using Class I phonometers.

The experimental design followed the principle of treatment versus control with a Before/After-Control/Impact (BACI) approach. Study areas chosen for noise exposure and control were selected based on habitat type and other environmental characteristics to ensure comparability. Initially, two sampling points were selected for the first replicate, positioned at distances of 100 and 200 m from the sound source. In the second replicate, the number of sampling points was increased, with locations placed at 25, 50, 100, and 200 m from the disturbance. The bat community was surveyed at each sampling point using automatic bat detectors (Wildlife Acoustics Song Meter SM4BAT FS and Song Meter Mini Bat). Acoustic data were analysed using Sonochiro® software (Biotope, Research & Development, 2018) to identify recordings containing bat calls. This first stage of the research focused only on the total number of bat calls recorded. Analyses of bat calls were conducted using Generalised Linear Mixed Models (GLMMs).

Throughout the entire field experiment, Sonochiro software identified 34,742 recordings containing bat calls, with a higher number of bat calls recorded in the treatment area compared to the control area. During the first replicate, the two sampling points investigated were too distant to detect any discernible noise effect. However, analysis of the second replicate revealed a negative correlation between sound pressure level and the number of bats calls in the treatment area. On the contrary, the natural environmental sound level in the control area did not affect bat calls as predicted. In the treatment area, bat calls decreased with increasing sound pressure level, with this effect was more pronounced at the sampling points closer to the sound source (25 and 50 m) compared to those farther away (100 and 200 m). Furthermore, when comparing silent nights to nights with disturbance in the treatment area, a significant difference in the number of calls was observed at the points closest to the sound source (25 and 50 m). Additionally, increased bat activity was recorded at sampling points closest to vegetation in both the control and treatment areas. The analysis indicated that the number of bat calls decreased with distance from the sound source, located at the centre of an open area, and increased as it approached the surrounding vegetation.

In conclusion, our study provides evidence of the impact of anthropogenic noise on bats activity, particularly within a radius of 50 m from the noise source. However, to determine whether bat species or groups are more impacted by anthropogenic noise, more research is necessary. Additionally, further research should evaluate feeding activity and analyse potential variations in feeding behaviour among different bat species exposed to noise disturbance. This comprehensive approach will contribute to a deeper understanding of the ecological consequences of anthropogenic noise on bat populations and inform effective conservation strategies.

Eureka! First data of pine marten presence in the Sibillini Mountains National Park

Marini S.[1], Capitani M.[1], Bizzarri L.[1], Rosati M.[1], Rossetti A.[2], Morandi F.[2] Vercillo F. [1]

1. WildUmbria APS, Pietralunga (Italy)
2. Parco Nazionale dei Monti Sibillini, Visso (Italy)

The pine marten, *Martes martes*, had been absent in the Sibillini Mountains since the 1970s, a fact confirmed by a study conducted by Ragni and Vercillo in the years 2012 - 2014. However, in the hypothesis of a recolonization from the nearby Laga Mountains, in the summer of 2021, researchers from WildUmbria undertook monitoring in the beech forest of Valle Canapine (Norcia), finally obtaining the first data on pine martens in the Sibillini Mountains National Park by camera trapping.
One year later, in July 2022, WildUmbria, commissioned by the National Park Authority of the Sibillini Mountains, initiated the monitoring of three carnivores of conservation interest: pine marten, wildcat, and Marsican brown bear.
This study aims to present the results obtained so far regarding only the pine marten, as it represents the true novelty for the protected area.
Considering camera trapping as the most suitable method for monitoring the species, it was decided to use this methodology, setting up the following activity program:
1. Seven camera trapping sessions with 10 capture sites for a total of 70 sites;
2. Two-month sessions with a trap check halfway through each session;
3. Food baits not accessible for consumption (sardine cans closed with small holes to let the scent out) to increase the animal's stay in front of the camera trap and increase the likelihood of a correct morphological diagnosis.
The operational phase of pine marten monitoring began on 31/08/2022.
To date, 25 camera trapping sites have been set up with bait, of which 21 have completed the planned survey session, while 4 are currently active.
A total of 1228 wildlife capture events were recorded in 1515 trap-days, including 19 pine marten events (1.55%), 306 beech marten events (24.92%), and 18 events (1.47%) of the genus *Martes*.
The pine marten was found in six sites, while the beech marten was found in all monitored sites so far. Currently, the pine marten is only present along the southeastern margin of the Park, but the research is still ongoing, and we hope to bring further positive news in the coming months. The return of a species to a territory from which it had been absent for decades has great biogeographical and conservational value, especially when this event occurs within a protected area, which is precisely aimed at safeguarding biodiversity. We believe it is likely that the range of *Martes martes* within the Park will further expand, as a consequence of the conservation measures of the protected area and the ongoing rewilding processes in the Central Apennine.

The bats of Montecristo island (Tuscany Archipelago): species and ecology

Dondini G.[1], Vergari Sim.[1], Vergari Seb.[1]

1. Museo Naturalistico Archeologico Appennino Pistoiese Via Orange, 51028 Gavinana (PT)

The islands represent important biological laboratories useful for the study of community ecology. Montecristo is a totally mountainous granite cone of 10.39 km^2, with a maximum height of 645 m. The island is managed by the Follonica Forestry Carabinieri, has been an Integral Nature Reserve since 1970. For this work, two automatic detectors were used, set to collect ultrasonic pulses from dusk to dawn. In particular, a Song Meter SM4BAT and a Song Meter Mini Bat, produced by WildLife Acoustic, were used, activated from dusk to dawn, thus collecting quantitative data on the foraging activities in the various stations. The use of this instrumentation was aimed at better defining the community of bats present on the Island of Montecristo and the foraging areas. In order to investigate the ecology of bats on the island of Montecristo, 9 ultrasonic sampling stations and one for mist net capture have been identified. The identification of the various species was performed mainly on the objective analysis of the sonograms derived from the time-expanded recordings both manually and through a specific software, Kaleidoscope 5.6.3, developed by WildLife Acoustic.
Overall, the sampling took place between 8 and 16 August 2023 from sunset to sunrise. Overall, three species present on the island were identified. In particular *Pipistrellus pipistrellus*, *Hypsugo* cfr. *darwinii* and *Tadarida teniotis*. The enormous sampling effort allowed us to record a total of 6866 vocalizations of which 3298 (48%) were confidently attributed to bats and therefore identified. The remaining 3568 (52%) vocalizations were attributed almost exclusively to Orthopterans.
Overall, 8 nights of surveys were carried out with two automatic detectors for a total of 144 hours of nocturnal surveys. A mist net capture session was carried out. The genetic material collected during the 2016 study session made it possible to establish that the individuals of the *Hypsugo* genus were attributable to *Hypsugo* cfr. *darwinii*.
A significant use of the few humid areas present during the warmer periods was highlighted.

Bird consumption by the giant noctule in the Northern Apennines determined by DNA barcoding on prey rests

Vergari Sim.[1], Bertonelli S.[2], Ancillotto L.[3,4], Mori E.[3,4], Monti F.[5], Viviano A.[3], Vergari Seb.[1], Dondini G.[1]

1. MuNAP - Museo Naturalistico Archeologico Appennino Pistoiese, via Orange, 51028 Gavinana, Pistoia, Italy
2. Department of Biology, University of Pisa, Pisa, Italy.
3. Istituto di Ricerca sugli Ecosistemi Terrestri IRET, Consiglio Nazionale delle Ricerche, Via Madonna del Piano 10, 50019 Sesto Fiorentino, Florence, Italy.
4. National Biodiversity Future Center, 90133, Palermo, Italy.
5. Istituto di Ricerca sugli Ecosistemi Terrestri IRET, Consiglio Nazionale delle Ricerche, Campus Ecotekne, 73100 Lecce, Italy.

The giant noctule *Nyctalus lasiopterus* is the largest European bat species and is considered a species of conservation concern. However, its ecology is poorly known, and much of the information on its behaviour and interspecific interactions is anecdotal. As a part of a thirty-year monitoring project in the Pistoia Apennines (Pian degli Ontani, Central Italy), analysis of fecal pellets has revealed that the giant noctule is the only European bat species that can feed not only on insects but also on small birds. Whether and how birds are preyed by *N. lasiopterus* i.e., if birds are captured in flight and/or when roosting, is though still unclear and debated. Here, we report the first DNA-barcoding data on the diet of the greater noctule based on the analysis of prey remains (feathers and muscle tissue fragments) collected from bat boxes.

In April 2023, adult *N. lasiopterus* were found in a bat box located in a beech forest in Pian degli Ontani. Tissue fragments and feathers of several birds were also found in the box. The samples were collected and stored in Eppendorf tubes containing absolute ethanol. DNA was extracted from the samples using commercial kits and amplified with the primers BirdF1 (5′-CAATACACTGGTCTTGTAAACC-3′) and BirdR1 (5′-TAATAGGAAGGCTGGGACC-3′) for the mitochondrial cytochrome oxidase I (COXI) gene, following a standard amplification protocol, previously used also on passerine birds.

The results confirmed (97-99% match on BLAST) that the tissue fragments and feathers found in the bat box belonged to two species that nest in tree cavities and occasionally in artificial boxes, the blue tit *Cyanistes caeruleus* and the European nuthatch *Sitta europaea*.

Both bird species preyed upon by the giant noctule are diurnal non-migratory species that spend night hours (i.e., when bats are active) in tree-holes. Therefore, our results highlight how predation of birds from tree cavities by the giant noctule cannot be ruled may occur, particularly upon non-migratory species.

Collecting and mapping livestock data in Central Apennines: a standardised protocol

Villa F.[1], Dragonetti C.[1], Von Kempis S.[1], Masiello G.[1], Cipollone M.[2], Visconti P.[2,3], Di Marco M.[1]

1. Department of Biology and Biotechnologies "Charles Darwin", Sapienza University of Rome, Italy
2. Rewilding Apennines, Gioia dei Marsi (AQ), Italy
3. International Institute for Applied Systems Analysis (IIASA), Laxenburg, Austria

Central Apennines are rich in biodiversity and host many endangered wildlife populations. Extensive livestock farming has traditionally played a primary role in the livelihood of local communities in this region. Yet, livestock can influence wildlife space use, compete with wild mammal grazers, alter the composition of natural ecosystems, and potentially increase the risk of zoonotic disease transmission. Grazing data are essential for research on human-wildlife coexistence in Central Apennines, but acquiring such data is often hindered by a fragmented governance of the zootechnical sector. Here we presented a standardised protocol to collect and map livestock data in Abruzzo (Central Apennines). Specifically, our study area encompasses two ecological corridors identified for the conservation of Marsican brown bear (*Ursus arctos marsicanus*) but used by many other mammal species.

We determined the number of grazing animals (i.e., sheep, goats, bovines, and equines) in 15 municipalities within our study area, by extracting them from the National Data Bank (BDN) of the competent Zooprophylactic Institute. Municipal offices provided data on lands entrusted to farmers for grazing through the "*fida pascolo*" system, which we validated and completed through farmer interviews. Finally, we geolocated the grazing areas of each farm in a GIS environment and associated them with the livestock load.

This resulted in digital maps of grazing pressure in ESRI shapefile format, revealing 8 categories of livestock data: the number and density of equines, bovines, sheep and goats, and Adult Bovine Units (a standardised livestock load measurement). In this work we developed a standardised and low-cost livestock data mapping protocol that can be applied to other areas of Central Apennines. This protocol represents a crucial tool for future studies that aim to assess the spatial interaction between grazing cattle and wildlife on a local scale, investigating conservation strategies that can find a balance between people and wildlife.

First appearance of European polecat (*Mustela putorius putorius*) more than three decades after the last secure evidence of this species in the Province of Trento (Italy)

Partel P.[1], Berchtold M.[1], Dorigatti E.[1], Volcan G.[1]

1. Nature Park Paneveggio Pale di San Martino, Loc. Castel Pietra, 2, 38054 - Primiero San Martino di Castrozza (I)

The European polecat (*Mustela putorius putorius*) is a mustelid species native to the Western Paleartic, west of the Ural Mountains. It is missing in Ireland and northern Scandinavia but is marginally present in northern Greece. In Italy its distribution is discontinuous throughout the peninsula, the mustelid is absent in Sardinia, Sicily and the smaller islands. It colonizes an altitudinal range between see level and 1.550 m a.s.l. in the Italian Alps. Due to its comparatively large distribution range the Italian red list book indicates the conservation status of the European polecat as least concern, despite of the intrinsic fragmentation of its range. The species declined notably form the 1940s on wards both following changes in agriculture practices and as a consequence of draining and depletion of watercourses.

In Trentino, in northeastern Italy, the last certain evidence of the species' presence goes back to the 1990s. Since then there was no direct or indirect sign of the animals' presence, dead or alive, no DNA sample or photographic image could be collected, not even from one of the numerous wildlife camera traps, which have been largely disseminated in recent years to enhance faunistic monitoring. The last secure evidence of the species dates back to April 1987 in the location of "Taio di Nomi" in the upper Vallagarina valley, unfortunately photographic documentation is unavailable for this observation. This is why, in the atlas of mammals occurring in the Province of Trento, the polecat was considered as probably extinct, at least with regard to the valley floors of formally populated valleys. In Primiero valley, situated in eastern Trentino, its occurrence is certain for the period before World War II, where in the year 1940 for the state-owned forest of San Martino di Castrozza the capture of 8 individuals of polecat was registered. Subsequent data is only available for the municipality of Sagron-Mis (Primiero valley), here the species occurred till to the mid 1950s.

In the past decade the Nature Park Paneveggio Pale di San Martino initiated various monitoring techniques for wildlife, including a systematic setup of camera traps. From May 27th to November 7th 2022 four camera traps, of the type Browning Patriot, have been installed with the goal to investigate on various faunistic issues. The camera traps attached to poles or tree trunks were positioned at a height of 70 to 150 cm above ground with registration mode set for high resolution video sequences with a duration of 20 seconds. From the end of August to the end of September 2022 five short movies could be registered showing a medium sized mustelid. In the most significant of those short movies it is carrying a prey animal. The result of a detailed analysis of the video sequences allowed the identification of the European polecat in four out of five short movies, showing one singular animal at each sequence and revealing a total presence of at least two distinct individuals.

The European polecat is a medium sized mustelid capable of using different habitat types but showing a clear preference for wetlands. The area of the sightings contains both a small lake and various peat bogs. Notifications of nearby sightings of polecat come from the adjacent Province of Belluno (northwestern Veneto region), here recent research confirmed both its occurrence and a fair distribution of the species. Of particular interest are confirmed sightings from 2020 within the borders of the neighbouring National Park Dolomiti Bellunesi; more precisely regarding the area of the municipality of Gosaldo (Province of Belluno). These observations along with a general recovery of the population are prone to contribute to an expansion of the polecat concerning also adjacent territories of the Province of Trento (such as Pirmiero valley). There is need for further research efforts for both to get a clear picture of the actual distribution of this mammal within the Province of Trento and to generate a better understanding of the evolution in the process of recolonization actually in course. Special thanks go to Dr. Luca Lapini, employed at the Museum of Natural History in the Region of Friuli, for viewing and validating the video sequences of the camera traps and for confirming the classification of the mustelid as European polecat.

Drivers of the feeding area relative preference by the alpine marmot (*Marmota marmota*) in a high-altitude pasture

Volcan G.[1], Basso E.[3], Partel P.[1], Dorigatti, E.[1], Berchtold M.[1], Pornaro C.[3], Raniolo S.[3], Forti A.[1], Ramanzin M.[3], Cassini R.[2], Marchiori E.[2], Maurizio A.[2], Marchesini G.[2]

1. Parco Naturale Paneveggio Pale di San Martino
2. Università degli Studi di Padova – Dip. MAPS
3. Università degli Studi di Padova – Dip. DAFNAE

Alpine marmots are a hibernating social rodent, with a key role within Alpine ecosystems, since they contribute in modifying the floristic structure and composition of alpine meadows and promote plant growth. They often coexist with domestic grazing animals, during the summer and little is known about the overall factors affecting their preferences in terms of foraging areas selection. The aim of this study was to understand which factors would act as drivers of the relative preference (RP) for foraging areas in the alpine marmot.

The study was performed from June to August in 2022 and 2023 in a Paneveggio Pale di San Martino Natural Park (PPSMNP) pasture (1800-1.900m a.s.l.). The area included 6 alpine marmot family units for a total of 36 individuals in 2022 and 30 individuals in 2023 of which 23 (2022) and 26 (2023) were marked with ear tags, allowing the definition of sex and age class of each marked individual. Extended observation sessions, using an orthomosaic of the area with a pixel size of 2.5 cm, consented the identification of marmots' position and activity every 5 minutes, for a total of 7177 fixes. Botanical surveys were carried out on 30 transects representative of the area using the Daget-Poissonet method in June 2022, identifying 7 main vegetation types (VT). Along these transects, herbage samples were collected and analysed for chemical composition once a month for both years, furthermore, grass height and bovine droppings density were estimated. Location distance from burrows and slopes were calculated in QGIS. Relative preference of the vegetation type during foraging activity was calculated as the ratio of the proportion of foraging records detected in a VT for an individual and the proportion of the family unit's home range (Kernel 95) contributing to that VT. RP < 1, RP = 1 and RP >1 infer that a VT was avoided, indifferent or favoured by that individual, respectively. A multiple regression was run to understand what predictors significantly affected RP.

Among the VTs, vegetation characterized by *Poa alpina*, *Achillea millefolium* and *Alchemilla vulgaris* (*Poion alpinae*) was the most favoured area for foraging by marmots (RP = 2.16±3.19), whereas the nitrophilous vegetation was the most avoided (RP = 0.02±0.13). The regression model explained the 52.2% of the variance. Among factors significantly affecting RP ($P < 0.05$), positive coefficients were found for *Poa alpina* and *Crepis aurea* (2.0), crude protein percentage (0.37), proportion of sugars on macronutrients content (0.38) and the age class of adults (0.61). Negative coefficients were instead found for herbage dry matter (-0.22), proportion of cellulose on the fibre content (-0.21) and herbage height (-0.07).

Results suggest that overall, where available, marmots favour vegetation type *Poion alpinae* for foraging, but along the summer season they change their preferences according to the herbage quality, favouring younger vegetation, rich in protein and sugars and avoiding fibre. In addition, only adults significantly selected foraging areas according to overall vegetation quality, whereas other age classes, especially young marmots, forage on different VTs according to their availability and favour areas close to the burrows. The slight negative coefficient found for herbage height might indicate that, in an extensive pasture context, sites with higher grazing intensity through cattle could be more suitable for marmot foraging, since it selected most nutritious and palatable parts of the plants, for the presence of young plant tissue. Although these results just refer to a small area and a small number of animals, they add some knowledge on factors that should be considered in the management of alpine marmot populations.

Muscardinus avellanarius in the Monte Bondone botanical garden nest boxes monitoring program

Zanfei G.[1], Tabarelli De Fatis K. [2], Scaravelli D.[1,3]

1. Museo Ornitologico di Forlì, via Pedriali 12, 47121 Forlì
2. MuSe – Museo delle Scienze di Trento, Corso del Lavoro e della Scienza, 3, 38122 Trento (TN)
3. Department of Biological, Geological, and Environmental Sciences, University of Bologna.

The Common Dormouse or Hazel Dormouse *Muscardinus avellanarius* is a species of noteworthy conservation interest, also for his validity as a bioindicator. In Trentino, information regarding the presence of the species is incomplete and affected by a total lack of data regarding structure and density of populations. From this perspective, we started to collect data during 2020 at the Alpine Botanical Garden (GBA) in Monte Bondone (Trento), a protected and controlled area, through the control of different types of nest boxes.

53 nest boxes of different types have been installed inside the Botanical Garden, in areas different for environmental and vegetation types. The control of these was carried out in 2020, 2021, 2022 and 2024, in different seasons (2020 and 2024 March, 2021 October, 2022 July), verifying presence indices such as the finding of nests and scat.

In 2020 there were 12 nest boxes occupied by *M. avellanarius* (23%), in 2021 8 (15%), in 2022 0 and in 2024 9 (17%). Out of the total of 53, 16 (30%) boxes were occupied by dormice in different years. The highest number of cases were recorded in 2020, but with non-significant differences compared to 2021 and 2024.

The 2022 survey showed no presence index of *M. avellanarius*: this is the only year in which the survey was carried out during summer, while the others were carried out at the beginning of spring or autumn. The seasonality of Hazel Dormouse phenology, with movements due to its specialized diet, could therefore be the main factor for this lack of feedback.

Considering the environmental placement of the occupied nest boxes, almost all of them (13 out of 16, 81%) are installed in ecotonal bands between wooded and open areas. The only 3 exceptions refer to small groups of 2-3 trees in the middle of prairie areas. This distributional note totally agrees with what is known about the ecology of the species, which prefers ecotonal belts and habitats rich in plant species, such as those found within the GBA. In addition, from our data, doesn't appear any preference towards conifers or broad-leaved trees.

Finally, the repeated control of the nest boxes represents a non-invasive and efficient survey method and can also report information on different groups (like birds, bats and small mammals). In particular, the possibility of placing the nest boxes in different environments and monitoring them at different times of the year guarantees the possibility of collecting data on ecology and phenology, allowing the evaluation of important parameters for the conservation of the Hazel Dormouse in alpine regions.

Does the human proximity influence the spatial dynamics of wolf predation?

Zanni M.[1], Brivio F.[1], Cavazza S. [1], Buelli C.[1], Berzi D.[1], Luccarini S.[1], Apollonio M.[1]

1. Department of Veterinary Medicine, University of Sassari, via Vienna 2, 07100 Sassari, Italy

The rapid return of a large carnivore, such as the wolf (*Canis lupus*), to increasingly anthropised contexts, is subjecting wolves to new selective pressures, also of anthropogenic origin. However, the plasticity of the wolf could allow this species to thrive in these contexts through behavioural changes. These adaptations could influence prey-predator interactions and the predator hunting success. Increasing knowledge about the behavioural response of this species in human-influenced landscapes may shed light on their ability to thrive in anthropised contexts and improve the management and conservation.

We followed a pack of wolves for 2 years (from September 2020 to December 2022), in a multi-prey context characterized by different anthropic activities (livestock farming, tourism, hunting) and different levels of anthropogenic disturbance, where the wolf has recently recolonized the area and it is in gradual recovery. We took advantage of the presence of 3 wolves equipped with GPS collars to identify the pack's kill sites. After identifying wolf location clusters, the kill sites were verified by direct field surveys during which we recorded environmental characteristics and the prey species. To investigate the environmental characteristics of kill sites and the influence of human-related characteristics on the probability of kill site selection by wolves, we adopted a resource selection approach on 192 kill sites identified as predation events by wolves on domestic and wild ungulates.

The kill sites used by the monitored wolves showed a specific clustered spatial pattern, suggesting that wolves selected specific areas where they periodically returned to prey. Contrary to our hypothesis, wolves selected kill sites near anthropic features such as human infrastructure, roads and paths. In particular, the probability of preying near human infrastructures increased with vegetation cover regardless of the species preyed upon. In contrast, the other environmental characteristics were selected differently depending on the biology of the prey species.

The findings of this study confirmed the plasticity of this predator able to adapt to human-dominated landscapes. The human-related features substantially influenced the strategies used by wolves to hunt their prey. In contrast to the "human shield hypothesis", our results suggested that wolves selected human proximity to increase their hunting success. The importance of closed habitat, as a key element which may facilitate wolves in taking advantage of anthropogenic features, could in the future increase the presence of this species near large cities, as forests are becoming increasingly close to urban settlement also attracting prey species such as wild ungulates.