



SMALL MAMMAL CONSERVATION CONFERENCE

21 – 25 SEPTEMBER 2026

FACULTY OF BIOLOGY, SOFIA UNIVERSITY, SOFIA, BULGARIA



Programme and Book of Abstracts

Organised within the framework of the LIFE project 'Securing the recovery of the endangered Saker Falcon in Bulgaria and Southern Romania (LIFE20 NAT/BG/1162)', and is a joint event with the 33rd Hamster Working Group meeting & the VIIIth European Ground Squirrel meeting.





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PROGRAMME AND BOOK OF ABSTRACTS

All abstracts are also available on the conference website:

smcc.habitatfoundation.org



The Habitat Foundation

Boomkikkerlaan 9
4105 SB Culemborg
The Netherlands16
info@thehabitatfoundation.org



Institute of Biodiversity and
Ecosystem Research

2 Gagarin Street
1113 Sofia
Bulgaria
office@iber.bas.bg



FACULTY OF BIOLOGY
SOFIA UNIVERSITY

8 Dragan Tsankov Blvd.
1164 Sofia, Bulgaria
bf-decanat@biofac.uni-sofia.bg



Dear colleagues,

On behalf of the Organising and Scientific committees, we are pleased to welcome you to the first Small Mammal Conservation Conference at the Faculty of Biology, Sofia University, Sofia, Bulgaria.

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Netherlands

Awards

The SMCC will give 4 awards for Best Talk and Best Poster. The awards are kindly donated by Pensoft Publishers and the European Mammal Foundation. Two winners will receive a free-of-charge publication in the Biodiversity Data Journal of Pensoft Publishers, and two winners will receive the newly printed Atlas of European Mammals.



Help Us Renew the Home of Biology — Before Our 100th Anniversary

For almost 100 years, the Faculty of Biology at Sofia University has been home to generations of students, teachers, and researchers dedicated to understanding and protecting the living world.

As we approach our **100th anniversary**, we have an important opportunity: to restore and modernise the building that has witnessed a century of Bulgarian biological education and scientific discovery.

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Use the QR code to donate to the renovation of the Biology Faculty building. It is a beautiful building, but it needs repairs to preserve it for future generations of researchers and students.



PROGRAMME

Monday, 21st September 2026

11:00 – 13:00 Registration, Welcome coffee/tea & Placing posters

13:00 – 14:00 Opening ceremony

Chair: Dennis & Svetlana

13:00 – 13:15 Opening words by Stoycho Stoychev, Conservation Director of BSPB

13:15 – 13:30 Opening words by Prof. Dr Lyuben Zagorchev, dean of the Biology faculty, Sofia University

13:30 – 13:45 Opening words by Prof. Dr Boyko Georgiev, the chairman of the scientific committee of IBER

13:45 – 14:00 Announcement of the statement. Attendees can react till Thursday morning

14:00 – 16:00 Survey techniques & Citizen science

Chair: Eva Millesi

14:00 – 15:00 Keynote speaker Csongor Gedeon: More than burrows: Why and how we should keep an eye on burrowing mammals (i.e. hamsters, ground squirrels).

15:00 – 15:20 *Jazz Woollard et al.*: Footprints for the future - Using AI to change how we monitor UK small mammals

15:20 – 15:40 *Matt Larsen-Daw et al.*: Searching for Shrews: tracking the spread and ecological impact of a non-native shrew in the UK

15:40 – 16:00 *Kiamos Nikolaos et al.*: War of the Shrews: Investigating the ecology of the Cretan shrew and the congeneric Gldenstdt's shrew in the island of Crete, with a focus on conservation.

16:00 – 16:30 Coffee/tea break

16:30 – 18:00 Survey techniques & others

Chair: Henri Thomassen

16:30 – 16:50 *Tihamr Flp*: Improving density estimation of European ground squirrel (*Spermophilus citellus*) populations using activity indices in two Natura 2000 sites from north-western Romania

16:50 – 17:10 *Dimitra-Lida Rammou et al.*: Assessing Long- and Medium-Term Stress Responses of the European Ground Squirrel to Wind Farm Construction Activities in Northern Greece

17:10 – 17:30 *Matt Larsen-Daw et al.*: Lessons from citizen science for small mammal conservation monitoring in Great Britain

17:30 – 17:40 *Luk Polednk et al.*: Use of drones for monitoring the European Hamster (*Cricetus cricetus*)

17:40 – 18:00 *Maurice La Haye et al.*: The use of environmental DNA to survey root voles (*Alexandromys oeconomicus*)

18:00 – 20:00 Sofia City tour

20:00 – Dinner on your own

Tuesday, 22nd September 2026

09:00 – 11:00 Reintroduction / translocation

Chair: Nedko Nedyalkov

- 09:00 – 10:00 Keynote speaker Hendrik Schoukens: The unlikely Odyssey of the European hamster in Europe's courts
- 10:00 – 10:20 *Lydia Hönig et al.*: How to conserve the common hamster in southern focal areas of Saxony-Anhalt, Germany
- 10:20 – 10:40 *Andrzej Kepel et al.*: Reintroduction of the European ground squirrel *Spermophilus citellus* in Poland: lessons learned from two decades of active conservation
- 10:40 – 11:00 *Jitka Matoušová et al.*: Overview of conservation measures implemented for the European ground squirrel (*Spermophilus citellus*) in the Czech Republic

11:00 – 11:40 Coffee/tea break

11:40 – 13:00 Reintroduction / translocation

Chair: Olivér Váczi

- 11:40 – 12:00 *Selene Weidenkopf et al.*: 20 Years of ex-situ conservation of the common hamster (*Cricetus cricetus* L. 1748) in Baden-Württemberg, Germany
- 12:00 – 12:20 *Irena Schneiderová et al.*: Enclosure effects on body mass and reproduction in the European ground squirrel: insights from 12 years of management
- 12:20 – 12:40 *Štěpánka Říčanová et al.*: Genomic assessment of historical and contemporary genetic diversity in the European ground squirrel (*Spermophilus citellus*) for conservation management in the Czech Republic
- 12:40 – 13:00 *Maria Kachamakova et al.*: Genetic monitoring during and after conservation reinforcement reveals the pattern of recovery of the genetic diversity in the recipient population

13:00 – 14:30 Lunch

14:30 – 16:00 Captive or Ex-situ breeding

Chair: George Mitsainas

- 14:30 – 14:50 *Maria Kachamakova et al.*: Captive breeding of Romanian hamsters (*Mesocricetus newtoni*)
- 14:50 – 15:10 *Thomas Liebenstein et al.*: Zoo Leipzig's extended reinforcement and further conservation efforts for common hamsters (*Cricetus cricetus*) in Central Germany
- 15:10 – 15:30 *Urszula Eichert*: Acoustic communication as a potential tool in the captive breeding of European hamsters

- 15:30 – 15:40 *Ewa Szczuka et al.*: Prevalence of *Staphylococcus xylosus* in the skin microbiota of captive-bred European hamsters (*Cricetus cricetus*)
- 15:40 – 15:50 *Niya Toshkova et al.*: Expanding the phylogenetic distribution of temperature-sensitive antibodies

15:50 – 17:00 Coffee/tea break & Poster session

17:00 – 18:30 Diet and conflicts

Chair: Caroline Hahold

- 17:00 – 17:20 *Ferre Smekens et al.*: Animal protein increases reproductive output in one-year-old European hamsters (*Cricetus cricetus*)
- 17:20 – 17:40 *Barbara Győri-Koósz et al.*: Diet and habitat preference of the European ground squirrels (*Spermophilus citellus*) in South-Western Slovakia
- 17:40 – 18:00 *Kateřina Poledníková et al.*: European ground squirrels in gardens and crop fields: potential for conflict
- 18:00 – 18:10 *Magdalena Hędrzak et al.*: Perceptions of the threats posed by domestic carnivores and road mortality to the survival of the European hamster among urban and rural residents in Poland
- 18:10 – 18:30 *Olivér Váczi et al.*: CitellusLIFE - trend-breaking safety net for EGS of the Pannonian region

18:30 – 20:00 Workshop towards comprehensive international cooperation in the conservation of EGS

20:00 – Dinner on your own

Wednesday, 23rd September 2026

09:00 – 18:00 Trip to a souslik colony near the Belmeken Reservoir, Rila National Park

- 09:00 – 09:30 Gathering at departure point: Vasil Levski Stadium, Borisova Gradina, Evlogi i Hristo Georgiev Blvd 38, 1164 Sofia
- 09:30 – 12:00 Travel to the souslik colony
- 12:30 – 14:00 Lectures about the National Park, the souslik colony and biodiversity
- 14:00 – 15:30 Lunch and visiting the colony
- 15:30 – 18:00 Travel back to Sofia

18:00 – Dinner on your own

Thursday, 24th September 2026

09:00 – 11:00 Distribution / Conservation status

Chair: Maurice La Haye

- 09:00 – 10:00 Keynote speaker Eva Millesi: European ground squirrels and Common hamsters: Life history strategies and conservation aspects in urban and suburban areas

- 10:00 – 10:20 *Kerstin Mammen et al.*: From agricultural pest to a nearly extinct species – the status of the Common Hamster (*Cricetus cricetus*) in Saxony-Anhalt
- 10:20 – 10:40 *Jan Matějů et al.*: Recent population trends of the European ground squirrel (*Spermophilus citellus*) in the Czech Republic
- 10:40 – 11:00 *Attila Németh et al.*: Population changes of the European ground squirrels in the management area of Hortobágy National Park Directorate

11:00 – 11:30 Coffee/tea break

11:30 – 13:00 Distribution / Conservation status

Chair: Maria Kachamakova

- 11:30 – 11:50 *Zsolt Hegyeli et al.*: New records of the grey dwarf hamster (*Nothocricetulus migratorius*) from Romania
- 11:50 – 12:10 *Nedko Nedyalkov et al.*: Strong decline of the distribution and abundance of *Cricetus cricetus* and *Mesocricetus newtoni* (Mammalia: Cricetinae) in Bulgaria
- 12:10 – 12:30 *Virág Nyíri et al.*: Phylogeography and conservation genomics of common hamster (*Cricetus cricetus*, Cricetidae) in Central-Eastern Europe
- 12:30 – 12:50 *Gábor Sramkó et al.*: Genomic approaches for the conservation of the last Hungarian birch mouse (*Sicista trizona trizona*, Sminthidae) population

13:00 – 14:30 Lunch

14:30 – 16:00 Habitat use

Chair: Diana Zlatanova

- 14:30 – 15:30 Keynote speaker Fiona Mathews: Small mammal declines and why they matter
- 15:30 – 15:40 Fiona Mathews: Declaration on small mammal conservation in Europe
- 15:40 – 16:00 *Attila Németh et al.*: Rescuing 'invisible mammals': Conservation efforts for the blind mole rat species of Hungary

16:00 – 17:00 Coffee/tea break & Poster session

17:00 – 18:00 Habitat fragmentation / Connectivity

Chair: Diana Zlatanova

- 17:00 – 17:20 *Jan Matějů et al.*: Beyond the grassland: dispersal and colonisation of the European ground squirrel (*Spermophilus citellus*) in a fragmented landscape
- 17:20 – 17:40 *Kiamos Nikolaos et al.*: Awakening the Thracian Dormice: An investigation into the ecology and conservation of *Myomimus roachi* and sympatric glirids.
- 17:40 – 18:00 *Pia Stein et al.*: How is the flow? – A view on landscape permeability for the common hamster

18:00 – 20:00 Sofia City tour

20:00 – 22:00 Gala dinner at the university & dances & presentation about the faculty

Friday, 25th September 2026

09:00 – 11:00 Habitat fragmentation / Connectivity

Chair: Dennis Wansink

- 09:00 – 09:20 *Victoria Nistoreanu et al.*: Current status of ground squirrel species (*Spermophilus citellus* and *Spermophilus suslicus*) in the Republic of Moldova
- 09:20 – 09:40 *Franz Suchentrunk et al.*: Habitat use and population dynamics of European ground squirrels in a vineyard-dominated landscape
- 09:40 – 10:00 *Mikhail Rusin*: Rapid urbanisation of the European hamster (*Cricetus cricetus*) in Ukraine
- 10:00 – 10:20 *Julianna Szulamit Szapu et al.*: An underestimated and overlooked threat: The hidden impact of roadkill on the European hamster (*Cricetus cricetus*)
- 10:20 – 10:30 *Monika Petković et al.*: Why don't we do anything? The European hamster (*Cricetus cricetus*) as a conservation challenge in Croatia
- 10:30 – 10:50 *Ben Fleischer et al.*: Insights into the current progress of the LIFE4HamsterSaxony project and the implementation of its first innovative measures

11:00 – 11:30 Coffee/tea break

11:30 – 13:00 Causes of death & predation

Chair: Csongor Gedeon

- 11:30 – 11:50 *Ivaylo Danchev Angelov*: How Golden eagles hunt sousliks: A review of hunting strategies
- 11:50 – 12:10 *Benedek Juhász et al.*: Prey composition of the Saker Falcon (*Falco cherrug*) based on two different methods
- 12:10 – 12:30 *Yana Andonova et al.*: Reintroduced Saker Falcons (*Falco cherrug* Gray, 1834) are dependent on European ground squirrels during the breeding period in Bulgaria
- 12:30 – 12:40 *Anton Stamenov et al.*: Foraging and parental behaviour of a Saker falcon pair raising five fledglings: implications for territory quality and prey demand

12:40 – 13:00 Presenting awards

13:00 – 15:00 Lunch

15:00 – Departure of participants



Talk abstracts





More than burrows: Why and how we should keep an eye on burrowing mammals (i.e. hamsters, ground squirrels)

Csongor I. Gedeon^{1, 2}; Olivér Váczi¹; Vilmos Altbäcker³

1 - Herman Ottó Institute Nonprofit Ltd., 1223 Budapest, Hungary

2 - Institute for Soil Sciences, HUN-REN Centre for Agricultural Research, 1116 Budapest, Hungary

3 - Institute for Wildlife Management and Nature Conservation, Hungarian University of Agriculture and Life Sciences, 7400 Kaposvár, Hungary

Corresponding author: Csongor Gedeon (gedeon.csongor@hoi.hu)

Abstract

Burrowing mammals are great ecosystem engineers. Beavers get all the press as hydrologists, but ground squirrels, common hamsters and similar burrowing mammals dig, translocate, and mix soils, contributing to soil functions and development. Their burrows, mounds, and subterranean activity create fine-scale, belowground heterogeneity, enhance water infiltration and aeration, redistribute organic matter, and support diverse plant and invertebrate communities.

Yet many burrowing mammals are undergoing population declines driven by anthropogenic activities. Their loss represents not only a biodiversity crisis but a functional erosion of soil processes and functions that can underpin the resilience of primarily grassland ecosystems. Moreover, observing and monitoring these animals, detecting and understanding these population declines are complicated, labour-intensive, and often invasive due to the challenges of their underground lifestyle and their non-continuous activity pattern, inter alia.

During the last decades, we conducted field, lab, and long-term data studies aimed at investigating population trends, activity and hibernation patterns, reintroduction ecology, and, more recently, developing novel, non-invasive monitoring methods to map burrow systems and improve population estimation methods. Our studies focused on ground squirrels primarily, but the results could be extended to comparable species, such as hamsters, moles, etc.

Our keynote speech plans to show how multifaceted research, sometimes driven by available resources and not by big ideas, can explain how soil megafauna becomes a functional domain. It will illustrate the benefit of targeted behavioural and ecological studies that can provide evidence for conservation measures. Moreover, it will show the disappointing results of time-series analysis, but the long-term potential of conservation measures, such as translocations or captive breeding programs, to counterbalance declines. Eventually, the recent experience and advances in non-destructive, high-resolution monitoring technologies using proximal sensing offer new ways for animal surveys or non-destructive monitoring. In simple terms, our research has been developing ways of learning more about them or their habitat, so that we can better protect them and the ecosystem they live in.

Keywords

burrowing mammals, soil ecosystem, evidence, proximal sensing, conservation



Footprints for the future - Using AI to change how we monitor UK small mammals

Jazz Woollard¹, Sky Alibhai² and Zoe Jewell²

1 - Wildwood Trust, Kent, United Kingdom

2 - Wild Track, zoe@wildtrack.org

Corresponding Author: Jazz Woollard (jazz.woollard@wildwoodtrust.org)

Abstract

Monitoring small mammal populations provides crucial insights into evaluating species conservation status, the success of management strategy interventions, and provides insights into habitat health and ecosystem function. Traditionally, small mammal data have been collected using live trapping in the field, often using capture-mark-recapture (CMR) methods. Although widely used, little is known about the behavioural, physiological, psychological, and ecological impacts that trapping has on individuals and the ecosystems they are a part of. Therefore, it is important to explore non-invasive methods of data collection where possible and practicable. WildTrack, a US-based organisation, has been developing Artificial Intelligence (AI) technologies to support non-invasive monitoring of terrestrial mammals. This approach uses Footprint Identification Technology (FIT) to identify species from their footprints. This project, in collaboration with WildTrack, aims to collect a baseline dataset of UK small mammal footprints to train FIT by providing images from known individuals. These data will allow FIT to look for differences between species, sexes, and age groups. While developing non-invasive survey techniques is essential, it is equally important to consider the welfare of animals involved in data collection. The primary focus of this project has therefore been to design a collection method that minimises behavioural disturbance and welfare impacts. This has involved creating and refining a footprint collection box that reduces stress while capturing high-quality prints. This talk will outline the methodology and challenges of applying FIT to small mammals, emphasise the importance of animal welfare and behaviour in data collection, and demonstrate how AI complements conventional wildlife monitoring.

Keywords

small mammals, non-invasive monitoring, behaviour and welfare, footprints

Searching for Shrews: tracking the spread and ecological impact of a non-native shrew in the UK

Afrika Priestley¹, Matt Larsen-Daw¹

1 - Mammal Society, International House, 55 Longsmith Street, Gloucester, GL1 2HT, United Kingdom

Corresponding author: Afrika Priestley (afrika@mammal.org.uk)

Abstract

Searching for Shrews is a citizen science initiative led by The Mammal Society, aiming to track the spread of the greater white-toothed shrew (*Crocidura russula*, GWTS) and assess its ecological impact on native small mammals in the UK. In its first year, with the help of 94 volunteers/groups, 564 barn owl (*Tyto alba*) pellets were dissected, identifying 3,912 prey items from 112 sites. GWTS were detected at 13 of these sites, with 76 individuals recorded.

To evaluate whether GWTS presence and abundance influence small mammal community composition, a Principal Coordinate Analysis (PCoA) based on Bray-Curtis dissimilarities was conducted, followed by PERMANOVA testing. The results indicated that GWTS presence had a marginal effect on community structure (PERMANOVA, $R^2 = 2.7\%$, $p = 0.057$), while GWTS abundance had a significant, though small, effect (PERMANOVA, $R^2 = 3.3\%$, $p = 0.038$). Dispersion analysis revealed that sites with higher GWTS abundance exhibited significantly greater variability in species composition ($F = 2.8753$, $p = 0.0083$), suggesting localised or site-specific impacts. The PCoA further showed a subtle gradient in species composition associated with increasing GWTS abundance.

These early findings suggest that the ecological impact of GWTS is primarily driven by its abundance rather than just its presence. The increased variability highlights non-uniform impacts across sites, likely due to localised environmental conditions or competitive interactions, and raises further questions about how these factors mediate the impact of GWTS on native small mammal communities. This study demonstrates the value of citizen science in generating large-scale data needed to understand the ecological implications of non-native species on native biodiversity.

Genetic analysis suggests these populations were derived from continental European introductions, but not from Ireland, where this non-native species has been present since at least 2007. Further investigation to identify the source and point of origin will continue.

Keywords

greater white-toothed shrew, *Crocidura russula*, non-native species, barn owl pellets, small mammal communities, citizen science

War of the Shrews: Investigating the ecology of the Cretan shrew and the congeneric Güldenstädt's shrew on the island of Crete, with a focus on conservation.

Nikolaos Kiamos¹, Eleutherios Bitzilekis¹, Manos Stratakis^{1,2}, Aggelos Bintitinis², Georgios Papamichail⁴, Maria Kolendrianou³, Nikos Poulakakis^{1,2}, Petros Lymberakis¹

1 - Natural History Museum of Crete, University of Crete, 71409 Heraklion, Greece

2 - Department of Biology, School of Sciences and Engineering, University of Crete, Heraklion, Greece

3 - Psiloritis UNESCO Global Geopark, 74051 Anogia Rethymno, Crete, Greece

4 - Freelance researcher

corresponding author: Nikolaos Kiamos (kiamosn@uoc.gr)

Abstract

The Cretan shrew, *Crocidura zimmermanni*, is the only endemic mammal of Greece and the sole surviving mammal species from the Pleistocene fauna of Crete. Today, it persists in the three main mountain ranges of Crete. The prevailing hypothesis regarding its current distribution is that it was displaced to higher altitudes by *C. gueldenstaedtii*. Extensive trapping was conducted between 2023 and 2026 to study the species. Species distribution models were developed using occurrence records from the Natural History Museum of Crete, University of Crete, and successfully predicted four new localities. The capture rate was 0.13 (*C. zimmermanni*) and 0.07 (*C. gueldenstaedtii*) per 100 trap-nights. Our data show an extensive contact zone at elevations between 700 and 1500 meters, where the two species are found in sympatry and – in some cases – in syntopy. Fieldwork also provided new insights into the habitat preferences of the two species. However, further research is needed to better understand the ecology of *C. zimmermanni*. As live trapping is invasive and effort-consuming, passive acoustic recording is currently being developed to improve monitoring of the target species and other small mammals. We also plan to establish a captive breeding program to support future conservation efforts. Outreach actions have been implemented to raise public awareness of this unique cryptic mammal.

Keywords

Crocidura zimmermanni, *Crocidura gueldenstaedtii*, syntopy, distribution

Improving density estimation of European ground squirrel (*Spermophilus citellus*) populations using activity indices in two Natura 2000 sites from north-western Romania

Tihamér Fülöp¹

1 - Milvus Group Bird and Nature Protection Association, Romania

Corresponding author: Tihamér Fülöp (tihamer.fulop@milvus.ro)

Abstract

The EGS (*Spermophilus citellus*) has experienced substantial declines across much of its range due to habitat loss, fragmentation, and changes in traditional grazing practices. Between 2019 and 2020, field surveys were conducted in two Natura 2000 sites from north-western Romania (ROSCI0020 and ROSCI0021) to assess species distribution, population density, and burrow activity.

Surveys were based on standardised counts of burrow entrances combined with density estimation methods adapted from the Hungarian Biodiversity Monitoring System. A total of 77 grasslands were surveyed within the Natura 2000 sites and adjacent areas. In addition to mapping the distribution of EGS colonies within the two Natura 2000 sites and estimating burrow density, juvenile-to-adult ratios were determined to characterise population age structure, while seasonal burrow activity was evaluated using activity indices.

The species was widely distributed across both Natura 2000 sites; however, colonies were generally fragmented and isolated. Average burrow densities reached 32.04 burrows/ha in ROSCI0020 and 27.79 burrows/ha in ROSCI0021, with substantial variation among grasslands. The highest recorded densities were 112.97 burrows/ha and 104.1 burrows/ha, respectively, whereas several apparently suitable grasslands showed no signs of occupancy.

Burrowing activity was assessed within randomly selected sampling quadrats by temporarily blocking active burrow entrances and subsequently recording their reopening. This method enabled the estimation of the proportion of used burrows throughout the season. More than 90% of monitored burrows were used in July, whereas the proportion of used burrows declined to approximately 56% by late August, reflecting seasonal changes associated with the onset of hibernation.

These results demonstrate that burrow counts alone may not accurately reflect population size throughout the active season. Incorporating burrowing activity as a correction factor improved density estimates and reduced seasonal bias, providing a simple tool for more reliable monitoring of EGS populations.

Keywords

burrow activity index, density estimation, population monitoring

Assessing long- and medium-term stress responses of the European ground squirrel to wind farm construction activities in northern Greece

Dimitra-Lida Rammou¹, Athanasios Samaras², Elisabeth Barnreiter³, Dimitra Georgopoulou⁴, Despina Migli¹, Constantinos G. Georgiadis⁵, Eva-Maria Rammou¹, Rafaela Panteleri⁶, Eva Millesi³, Efthimia Antonopoulou⁷, Dionisios Youlatos¹

1 - Laboratory of Marine and Terrestrial Animal Diversity, Department of Zoology, School of Biology, Aristotle University of Thessaloniki, Thessaloniki, Greece

2 - Fish Physiology Laboratory, Department of Biology, University of Crete, Heraklion, Greece

3 - Department of Behavioural and Cognitive Biology, University of Vienna, Vienna, Austria

4 - Institute of Marine Biology, Biotechnology and Aquaculture (IMBBC), Hellenic Centre for Marine Research (HCMR), Heraklion, Greece

5 - Laboratory of Benthic Ecology, Fisheries Research Institute, Hellenic Agricultural Organisation (ELGO) DIMITRA, Kavala, Greece

6 - Institute of Molecular Biology and Biotechnology, Foundation for Research and Technology - Hellas, Heraklion, Greece

7 - Laboratory of Animal Physiology, Department of Zoology, School of Biology, Aristotle University of Thessaloniki, Thessaloniki, Greece

Corresponding author: Dimitra-Lida Rammou (rdimitra@bio.auth.gr)

Abstract

The expansion of wind energy infrastructure increasingly overlaps with habitats occupied by the European ground squirrel (*Spermophilus citellus*), a threatened (Endangered, EN) grassland rodent of European and global conservation concern (IUCN). While the effects of wind farms on birds and bats are well documented, their impacts on semi-fossorial mammals remain poorly understood. This study investigated stress responses of *S. citellus* along a gradient of anthropogenic pressure associated with wind farm construction activities in Mount Vermio, northern Greece. Seasonal live-trapping surveys were conducted during 2025 across four sampling stations differing in disturbance intensity. Long-term stress was assessed through hair for cortisol concentrations, reflecting glucocorticoid accumulation over weeks to months; medium-term stress was evaluated through faeces for glucocorticoid metabolites, reflecting physiological responses over hours to days. Hormone concentrations were quantified using immunoassays, and statistical analyses were performed using linear models including spatial, seasonal, demographic, and reproductive variables. Hair-associated cortisol concentrations were significantly higher in populations exposed to recent construction-related disturbance, suggesting increased long-term physiological stress linked with habitat alteration. In contrast, faecal-associated glucocorticoid metabolites were more strongly influenced by season and reproductive state. The results demonstrated that different biomarkers can capture distinct temporal dimensions of stress and should be interpreted – complementarily rather than interchangeably – when assessing wildlife responses to renewable energy infrastructure.

Keywords

Spermophilus citellus, wind farm disturbance, physiological stress, hair cortisol, faecal glucocorticoid metabolites, conservation physiology

Lessons from citizen science for small mammal conservation monitoring in Great Britain

Afrika Priestley¹, Matt Larsen-Daw¹

1 - Mammal Society, International House, 55 Longsmith Street, Gloucester, GL1 2HT, United Kingdom

Corresponding author: Afrika Priestley (afrika@mammal.org.uk)

Abstract

Effective conservation monitoring of small mammals requires data at spatial and temporal scales that professional survey efforts alone cannot achieve. The Mammal Society has developed a portfolio of citizen science programmes that collectively address gaps in distribution knowledge, population monitoring, and invasive species detection across Great Britain, united by the Mammal Mapper smartphone app as a shared data infrastructure.

Four programmes illustrate the breadth of approaches and their outcomes. The National Harvest Mouse Survey (NHMS) uses annual standardised nest searches to build a multi-year national distribution dataset for *Micromys minutus*, a cryptic species poorly served by conventional recording, accumulating records from nearly 500 hectads over five seasons. Searching for Shrews mobilises barn owl pellet dissection networks to detect and monitor the spread of the non-native greater white-toothed shrew (*Crocidura russula*) and its ecological impact on native small mammal communities, combining indirect evidence with multivariate community analysis across 74 sites. The University Mammal Challenge (UMAC) engages student teams at universities and colleges across the UK to conduct monthly standardised line transects and ad hoc recording on their campuses, building practical survey skills in early-career conservationists while contributing data to the national recording infrastructure. Mammal Mapper itself, as a free recording platform open to all, provides a continuous stream of opportunistic and structured mammal sightings from across Great Britain, complementing targeted survey programmes with broader coverage.

Across these programmes, recurring themes emerge: the value of standardised effort data for generating reliable occupancy and abundance indices; the different trade-offs between structured and opportunistic recording; the challenge of sustaining volunteer engagement across multiple years; and the power of indirect detection methods to achieve national coverage for cryptic or elusive species. We discuss the lessons learned and their potential transferability to small mammal monitoring programmes in other European contexts.

Keywords

citizen science monitoring, small mammal surveillance, structured recording, opportunistic data, indirect detection methods, conservation evidence

Use of drones for monitoring the European hamster (*Cricetus cricetus*)

Lukáš Poledník¹, Jindřich Poledník¹, Ondřej Poledník¹, Kateřina Poledníková¹,

1 - ALKA Wildlife o.p.s., Lidéřovice 62, 380 01 Peč, Czech Republic

Corresponding author: Lukáš Poledník (lukas.polednik@alkawildlife.eu)

Abstract

The European hamster (*Cricetus cricetus*) is an endangered species in the Czech Republic. Regular population monitoring is carried out by searching for burrows through field surveys in suitable habitats, which is a relatively time-consuming method. However, hamster burrows can also be detected using drones with an RGB camera.

The main advantages of this method include speed (a drone can survey a much larger area within the same amount of time), non-invasiveness (surveyors do not trample crops in agricultural fields), and documentation of records (flight routes, landscape imagery, and images of burrows can be recorded by the drone).

However, the method also has certain disadvantages and limitations, including weather conditions, season, financial investment in the equipment, and the need for a trained pilot. Practical aspects of the method, such as administration associated with flight permits, operation of the device, potential risks in the agricultural landscape, as well as data recording and transfer, will be discussed.

Keywords

hamster, AUV, survey method, monitoring, drone

The use of environmental DNA to survey root voles (*Alexandromys oeconomus*)

Maurice La Haye¹, Kim Beijering¹

1 – Mammal Research Netherlands (Zodion), Nijmegen, The Netherlands

Corresponding author: Kim Beijering (kim.beijering@zodion.nl)

Abstract

Using environmental DNA from droppings is a successful method for mapping the distribution of the root vole (*Alexandromys oeconomus*). Our analysis shows that surveys based on eDNA are more accurate, time-efficient, and cost-effective than traditional surveys using live traps. The analysis compares the detection rates, relative sensitivity, and costs of both methods.

Detection rates are compared based on parallel studies in which both methods were applied simultaneously at the same location. These studies show that detection rates for the root vole in suitable habitat typically range from 80–100% with eDNA, compared to 50–75% with live traps. An analysis of available datasets from both eDNA and live trap surveys confirms that detection rates were higher with eDNA. Additionally, eDNA shows high relative sensitivity; in all parallel studies, we observed instances where the species was detected solely via eDNA, while live traps failed to detect it. Furthermore, our findings indicate that eDNA offers high accuracy (97%) in detecting vole species and that a single faecal sample is usually sufficient to identify the species. Finally, our research shows that the eDNA method entails 66% lower costs per location than the traditional live-trap method.

These results demonstrate that eDNA is a powerful method for large-scale surveys of the elusive root vole. Applying this method over several years makes it possible to monitor trends in distribution over time. The method also appears applicable to a wider range of small mammal species.

Keywords

root vole, *Alexandromys oeconomus*, eDNA, survey method, live trap

From pest to plaintiff: The unlikely Odyssey of the European hamster in Europe's courts

Hendrik Schoukens¹

1 - University of Ghent, Ghent, Belgium

Corresponding author: Hendrik Schoukens (hendrik.schoukens@ugent.be)

Abstract

Had you told a German farmer one hundred years ago that European hamsters would one day appear as de facto plaintiffs before national and supranational courts, he would almost certainly have dismissed the idea as absurd. Not only would litigation brought in the interest of wild species have seemed inconceivable - although animal trials, in which animals appeared as defendants, were indeed held in medieval and early modern Europe - but the European hamster itself was widely regarded as an agricultural pest. Farmers routinely culled hamsters to protect their crops.

A century later, the situation has been turned on its head. While the European hamster was well adapted to traditional low-intensity agricultural landscapes, the intensification of European farming, with its emphasis on productivity, mechanisation and pesticide use, has pushed the species to the brink of extinction. As its populations collapsed, the hamster became a strictly protected species under international nature conservation law. Since these protections were translated into binding and enforceable obligations under EU law, the species has featured in no fewer than three judgments of the Court of Justice of the European Union. These cases have concerned not only agricultural populations, but also urban populations, including hamsters living in Vienna. The species has likewise been at the centre of landmark litigation before national courts in countries such as Belgium, Germany and the Netherlands.

Yet, despite this growing body of successful litigation, the future of the European hamster remains bleak. Court victories have undoubtedly strengthened the legal protection of the species, but they have done little to address the structural drivers of its decline. Recent farmers' protests have weakened the environmental ambitions of the Common Agricultural Policy, while climate change is accelerating across the European continent, placing additional pressure on already fragmented populations. The adoption of the EU Nature Restoration Regulation offers a measure of hope by introducing legally binding restoration obligations for agricultural ecosystems. Yet here too the central question remains whether legal rules alone can reverse decades of agricultural intensification and halt the continued degradation of Europe's farmland landscapes.

Using the remarkable legal odyssey of the European hamster as its point of departure, this keynote explores the relationship between biodiversity conservation and the rule of law. It asks what environmental litigation can realistically achieve when biodiversity loss is driven by deeply embedded economic incentives, political compromise and an accelerating climate crisis. The story of the European hamster ultimately offers a broader reflection on both the transformative potential and the inherent limits of law in confronting the biodiversity crisis.

Keywords

hamster, rule of law, biodiversity, EU Court of Justice, agriculture

How to conserve the common hamster in the southern focal areas of Saxony-Anhalt, Germany

Lydia Hönig¹, Daniel Gödicke¹

1 - Deutsche Wildtier Stiftung, Lucy-Borchardt-Straße 2, 20457 Hamburg, Germany

Corresponding author: Lydia Hönig (l.hoenig@deutschewildtierstiftung.de)

Abstract

In the middle of the last century, common hamsters (*Cricetus cricetus*) were widespread mammals in agricultural landscapes with deep soils in Germany. Millions of hamsters made life difficult for farmers. However, the tables have turned. The change of land use, cultivation methods and climate is still ongoing, and wild populations of the Common hamster have decreased significantly, also in Saxony-Anhalt. Nowadays, large areas with prime soils are hamster-free. Therefore, only eight focal areas containing the last hamsters were defined for this Federal State.

For several years, the German Wildlife Foundation has cared for the areas “Köthen farmland”, “Querfurt Plateau” and “Eastern Saalekreis district”. The goal is to establish self-sustaining populations in each focal area. Wild populations should be conserved, and new populations after restocking must expand. To achieve this goal, participating farmers implement hamster-friendly measures, also to connect the habitat within an area

Using our monitoring data, we will present 1) the status of common hamsters in the three focal areas, 2) the effect of continuous hamster-friendly measures in “Köthen farmland” since the federal project “Feldhamsterland”, and 3) the effect of successful reintroduction in Saxony on the presence of Common hamsters in “Eastern Saalekreis district”.

Keywords

focus areas, Germany, hamster-friendly measures, reintroduction, Saxony-Anhalt, wild population

Reintroduction of the European ground squirrel *Spermophilus citellus* in Poland: lessons learned from two decades of active conservation

Andrzej Kepel¹, Magdalena Bruszyńska-Nowak¹, Aleksandra Lange¹, Julia Kończak¹, Grzegorz Wojtaszyn¹

1 - Polskie Towarzystwo Ochrony Przyrody 'Salamandra' (Polish Society for Nature Conservation 'Salamandra'), Poland

Corresponding author: Magdalena Bruszyńska-Nowak (magda@salamandra.org.pl)

Abstract

The European ground squirrel *Spermophilus citellus* became extinct in Poland in the 1970s. One of the main causes was habitat loss due to conversion into arable fields or the abandonment of mowing and grazing, leading to succession and scrub encroachment. Until its extinction, the species was not protected in Poland and was even actively persecuted. Since 2004, the Polish Society for Nature Conservation 'Salamandra', in cooperation with domestic and international partners, has been implementing an active conservation programme aimed at restoring the species' population at the north-western margin of its historical distribution. The presentation aims to summarise two decades of programme implementation – its outcomes and lessons learned – and to identify key challenges affecting the durability of the results. For the programme, ground squirrels from wild populations inhabiting airport areas in Hungary and Slovakia were brought to Poland. Three captive breeding facilities for the reintroduction programme were established, of which two are still operating – at the Poznań Zoo (main facility) and in Trzcinica Wołowska (auxiliary facility). The main activities include reintroduction to sites within the species' historical range in Poland, habitat management, and population monitoring. Monitoring includes assessments of population size, reproductive success, and colony persistence, carried out using standardised field methods. Since 2020, the programme has been continued under the LIFE19 NAT/SK/001069 project. Over 21 years, more than 1,000 individuals were released at seven reintroduction sites, of which three have persisted until 2026. Two of them (in Kamień Śląski and Głębowice) are relatively stable, showing fluctuations in abundance related to various factors. In the case of one population established in 2025 (in Trzcinica Wołowska), it is too early to assess its stability. The dynamics of the total population size of the European ground squirrel in Poland show marked variability, with an increase to approximately 1,500 individuals in 2019–2020, followed by a decline in subsequent seasons to around 630 in 2025. In some cases, local declines in abundance may be linked to periods of increased precipitation during the autumn–winter season (hibernation), although this relationship requires further analysis. The results indicate that re-establishment of European ground squirrel colonies at the north-western edge of the species' range is possible through active conservation measures. At the same time, population persistence depends on the interaction of demographic factors, habitat quality, and environmental variability. Observed fluctuations in abundance highlight the importance of long-term monitoring and adaptive population management. Further analyses are necessary to determine the contribution of individual factors to population dynamics. Experiences from Poland indicate that maintaining *Spermophilus citellus* populations requires long-term conservation actions extending beyond the reintroduction phase at restored sites.

Keywords

Spermophilus citellus, reintroduction, habitat management, population dynamics, long-term monitoring, species conservation

Overview of conservation measures implemented for the European ground squirrel (*Spermophilus citellus*) in the Czech Republic

Jitka Matoušová¹, Markéta Jariabková², Jan Matějů³

1 - Nature Conservation Agency of the Czech Republic, Czech Republic

2 - Zoo Hluboká

3 - Museum Karlovy Vary

Corresponding author: Jitka Matoušová (jitka.matousova@aopk.gov.cz)

Abstract

The European ground squirrel is among the rarest mammal species in the Czech Republic. Approximately 7,000 individuals survive in about 40 isolated populations. Its long-term conservation, therefore, requires not only passive legal protection but also active management. For this reason, an Action Plan for the European ground squirrel in the Czech Republic was adopted in 2008, defining both the conservation objectives and the methods for achieving them. Key measures include reinforcement of existing populations and the establishment of new populations through managed translocations.

Since 2000, seven attempts have been made to establish new populations in the Czech Republic, involving 791 individuals originating predominantly from zoo breeding programmes. To date, only one project, at Písečný vrch in the České středohoří Protected Landscape Area, can be regarded as unequivocally successful. Four other projects are still ongoing, and their final outcomes remain uncertain, although current developments appear promising. At the remaining two sites, population establishment failed in one case, while in the other, the population persisted only temporarily.

Reinforcement of small populations has so far proved to be the most successful conservation measure. Following an initial trial in 2011, the method was adopted as a regular conservation tool from 2016 onwards. Overall, it has been applied to ten populations, into which 356 ground squirrels, mostly originating from zoo breeding programmes, have been released. In four cases, reinforcement resulted in a clear and substantial increase in population size: following the release of an average of 40 individuals over two consecutive years, estimated population sizes increased from only a few individuals to several hundred within a few years. In another four cases, population size also increased, although the increase was relatively modest. In the remaining two cases, the effects of reinforcement cannot yet be reliably assessed.

Despite the generally positive outcomes of reinforcement, the successful establishment of new populations remains essential for the long-term conservation of the species.

Keywords

European ground squirrel, conservation, action plan, breeding programmes, active management

20 Years of ex-situ conservation of the common hamster (*Cricetus cricetus* L. 1748) in Baden-Württemberg, Germany

Selene Weidenkopf¹, Marco Sander¹, Sophie Luczak¹, Ulrich Weinhold¹

1 - Institut für Faunistik, 69253 Heiligkreuzsteinach, Germany

Corresponding author: Ulrich Weinhold (weinhold@institut-faunistik.net)

Abstract

The common hamster was once widespread in the federal state of Baden-Württemberg. In the last six decades, it has lost over 99 % of its former territory.

To avoid extinction, conservation breeding was established in 2004 at Heidelberg Zoo. In 2007, the first 30 hamsters were released on hamster-friendly managed fields near the city of Mannheim. Since then, yearly reintroductions have been taking place. The population is monitored with seasonal burrow counts, monthly live trapping and radio telemetry. The data derived with the help of these field methods enable us to follow population dynamics and define parameters for reintroduction success. Reintroduced hamsters migrated up to 2.5 km from the release site. We acquired data on minimum days alive, with a mean range from 42 to 94 days per year, but also on days of survival ranging from 9 to 52 days on average. Individual survival of reintroduced hamsters ranges from 1 day up to 365 days post-release, but individuals of the next generation survived up to 685 days. Live trapping has been giving us an insight into the demography and proportion of unmarked individuals in the overall trapping sample, ranging from 17 - 50 % per year. The proportion of females surviving at least 42 days post-release is essential for the successful raising of one litter. On average, 39 % of the females survive at least these 42 days.

In conclusion, the Common hamster has been saved from extinction but is far from establishing a viable population, due to a lack of suitable habitats in the vicinity of the release sites and a concept to recolonise its historical range. The future of the Common hamster in Baden-Württemberg is also threatened by financial cuts as a consequence of the difficult economic situation and political decisions focusing on other environmental topics.

Keywords

conservation, reintroduction, monitoring, population dynamics, hamster

Conservation of European ground squirrel in Slovakia

Katarína Tuhárska¹

1 - BROZ - conservation association, Na Riviére 7/a, 841 04 Bratislava, Slovakia

Corresponding author: Katarína Tuhárska, tuharska@broz.sk, +421915767762

Abstract

The decrease of the European ground squirrel (*Spermophilus citellus*) population in Slovakia resulted in a dramatic drop from a population of several million in the 1950s to only 20,000 individuals in 2020. To mitigate the critical situation, BROZ – a conservation association – carries out the LIFE project to conserve the species. Several case studies of various conservation measures within the project will be presented.

Besides grazing and mowing restored on 207 hectares as the most suitable large-scale grassland management, the project focuses on restoration of populations by restitutions and translocations of individuals. Based on a genetic study carried out in 2021, ground squirrels were captured at three donor sites and translocated to 21 colonies with small numbers of animals and poor genetic structure, as well as 8 newly established colonies. 3942 individuals were already translocated and activity is still ongoing. The effect will be confirmed by a comparative genetic study at the end of the project. However, the fitness of the population, an increase in young in litters and rising numbers in colonies are already visible.

The small-scale measures to increase biodiversity of project localities, provide food sources to sousliks and decrease the predatory pressure were also introduced, such as planting fruit trees, creation of small wetlands, burning small spots, leaving ungrazed vegetation and unmowed strips, installation of boxes for birds and small mammals or preservation of rock formations. All these measures had a direct effect on ground squirrel colonies, which resulted in the increase of their population to 60 000 individuals in five years.

Keywords

European ground squirrel, conservation measures, restoration of populations

Genomic assessment of historical and contemporary genetic diversity in the European ground squirrel (*Spermophilus citellus*) for conservation management in the Czech Republic

Štěpánka Říčanová^{1,5}, Masoud Nazarizadeh^{1,2}, Michaela Uhrová¹, Radka Piálková¹, Anna Míčková¹, Jan Matějů³, Irena Schneiderová⁴, Vladimír Vohralík⁴, Markéta Jariabková⁵, Kateřina Poledníková⁶, Lukáš Poledník⁶, František Sedláček¹, Oldřich Říčan¹

1 - Faculty of Science, University of South Bohemia, Branišovská 1760, 370 05 České Budějovice, Czech Republic

2 - Biology Centre, Czech Academy of Sciences, Branišovská 31, 370 05 České Budějovice, Czech Republic

3 - Karlovy Vary Museum, Pod Jelením skokem 393/30, 360 01 Karlovy Vary, Czech Republic

4 - Faculty of Science, Charles University, Albertov 6, 128 00 Praha 2, Czech Republic

5 - South Bohemian Zoological Garden Hluboká nad Vltavou, Ohrada 417, Hluboká nad Vltavou 373 41, Czech Republic

6 - ALKA Wildlife o.p.s., Lidéřovice 62, 380 01 Peč, Czech Republic

Corresponding author: Štěpánka Říčanová (stepankaricanova@seznam.cz)

Abstract

The European ground squirrel (*Spermophilus citellus*) is classified as critically endangered in the Czech Republic, where a national conservation program has been implemented since 2008. The species is primarily threatened by habitat loss, population fragmentation, and a consequent decline in genetic diversity due to limited or absent gene flow among isolated colonies. The ongoing project builds on a unique long-term and continuous monitoring framework, enabling direct comparison of historical and contemporary genetic diversity based on an extensive collection of archival and recent samples. Genome-wide SNP analyses reveal pronounced differences in genetic diversity among populations. Unmanaged and long-term isolated colonies consistently exhibit lower levels of genetic variability, whereas reinforced or reintroduced populations show higher values. Within the Czech Republic, slightly higher values occur only in southern Moravian populations, likely reflecting natural dispersal among nearby colonies. Temporal comparisons between historical and contemporary samples demonstrate a clear decline in genetic variability over approximately two decades. In most studied localities, historical populations exhibit higher genetic variability than their contemporary counterparts. Ex situ populations also show substantial heterogeneity in genomic diversity and levels of inbreeding. Some ex-situ breeding sites (zoos and rescue centres) retain high genetic variation, while others are affected by reduced diversity and increased homozygosity due to genetic drift and inbreeding. Population structure analyses indicate that ex situ populations do not form a single homogeneous conservation unit but rather a set of genetically differentiated lineages shaped by founder effects, reinforcement history, and management intensity. The novelty of the project lies in the application of next-generation sequencing, specifically ddRAD-based genome-wide SNP analysis, enabling high-resolution reconstruction of spatial and temporal genetic structure. Based on these data, a population-genetic framework for assisted translocations will be developed to optimise source-sink selection, minimise inbreeding risk, and maximise the retention of genetic diversity.

Keywords

genetic diversity, assisted translocation, conservation genetics

Genetic monitoring during and after conservation reinforcement reveals the pattern of recovery of the genetic diversity in the recipient population

Maria Kachamakova¹, Matúš Búci^{2,3}, Yordan Koshev¹, Barbora Rolečková⁴, Anna Bryjová⁴, Yassen Mutafchiev¹, Dagmar Čížková⁴, Josef Bryja⁴

1 - Institute of Biodiversity and Ecosystem Research at the Bulgarian Academy of Sciences (IBER), Sofia, Bulgaria

2 - Institute of Forest Ecology, Slovak Academy of Sciences, Zvolen, Slovakia

3 - Faculty of Ecology and Environmental Sciences, Technical University in Zvolen, Zvolen, Slovakia

4 - Institute of Vertebrate Biology of the Czech Academy of Sciences, Studenec, Czech Republic

Corresponding author: Maria Kachamakova (maria.n.kachamakova@gmail.com)

Abstract

The European ground squirrel (*Spermophilus citellus*) is a hibernating rodent endemic to the open grasslands of Central and Eastern Europe. In 2020, the species was declared 'Endangered' by the IUCN. The conservation efforts aimed at improving its status have included multiple translocations in Bulgaria, with varying levels of success. However, the genetic consequences of these translocations have not been investigated. Here, we present a five-year genetic monitoring study conducted before and after the reinforcement of a souslik colony from southeastern Bulgaria. Between 2017 and 2019, a total of 213 individuals were translocated, and both the source and recipient populations, as well as their offspring, were sampled. We analysed genome-wide SNP data from 354 individuals and estimated four Essential Biodiversity Variables (EBVs) to evaluate the genetic outcomes of the translocation. Our results revealed significant genetic differentiation between the source and recipient populations, indicating long-term isolation before reinforcement. Before translocation, the recipient population showed significantly higher levels of inbreeding than the source population. However, post-translocation inbreeding levels declined to values comparable to those observed in the source population. Successful reproduction of translocated individuals was demonstrated by a progressive increase in genomic admixture across consecutive years. Following reinforcement, the recipient population exhibited a gradual increase in individual heterozygosity and effective population size. Statistical analyses also revealed higher body mass index (BMI) and body weight in individuals from the reinforced population six years after the initial translocation. Overall, the reinforcement can be considered successful. The observed improvements in genetic diversity and fitness-related traits may enhance the adaptive potential of the reinforced population, thereby increasing its long-term viability in the face of ongoing environmental change.

Keywords

conservation genetics, population reinforcement, SNPs, ddRAD sequencing

Captive breeding of Romanian hamsters (*Mesocricetus newtoni*)

Maria Kachamakova¹, Kalina Miteva¹, Yordan Koshev¹

1 - Institute of Biodiversity and Ecosystem Research at the Bulgarian Academy of Sciences (IBER-BAS), Bulgaria

Corresponding author: Maria Kachamakova (maria.n.kachamakova@gmail.com)

Abstract

The Romanian hamster (*Mesocricetus newtoni*) is a rare rodent endemic to Europe, with a highly restricted distribution limited to northern Bulgaria and southeastern Romania. Globally, the species is classified as Vulnerable on the IUCN Red List, and it is also listed as Vulnerable in the Red Data Book of Bulgaria.

In 2024, 2025, and early 2026, 50 pups in eight litters were born indoors. The average gestation period was around 14 days ($n = 8$). The exact moment of conception was not always clearly recorded, as several copulations occurred over a period of 3–4 days. Sex can be reliably determined at a later age. The sex ratio of surviving individuals (excluding those that died prematurely for various reasons) was skewed toward females (M:F = 1:1.64) (based on 6 litters). The young emerged from the nest on day 14 and started feeding on solid food soon afterwards.

The provided food consisted of a mixture of grains and flowers, dried mealworms, and fresh vegetables (cucumber and peppers). After copulation, the number of mealworms was doubled, and hard-boiled egg white was added. Food quantities increased proportionally and rose two- to three-fold after birth.

This pilot captive breeding was part of the LIFE20 NAT/BG/001162 project and was implemented by the research team from the Institute of Biodiversity and Ecosystem Research at the Bulgarian Academy of Sciences (IBER-BAS).

Keywords

breeding, Dobrudzha hamster, *Mesocricetus newtoni*, Bulgaria

Zoo Leipzig's extended reinforcement and further conservation efforts for common hamsters (*Cricetus cricetus*) in Central Germany

Thomas Liebenstein¹, Max Lehmann¹

1 - Zoo Leipzig, Leipzig, Germany

Corresponding author: Thomas Liebenstein (tliebenstein@zoo-leipzig.de)

Abstract

The common hamster (*Cricetus cricetus*) was once widespread in Central Germany. In the mid-20th century, as in many other parts of its former range, it was treated as a pest, hunted for fur, and killed by the millions. Land use, agricultural intensification, and climate change then led to a drastic decline of the species. Today, the common hamster is not only listed as critically endangered on the German Red List, but also by the IUCN. In 2020, the Saxon common hamster population dropped below the detection limit and was deemed to be extinct unless conservation efforts were strengthened. Concurrently, other Central German populations also experienced drastic declines.

In light of this decline in Central German populations, Zoo Leipzig joined the working group “Kooperativer Feldhamsterschutz im Freistaat Sachsen”, a cooperation for the conservation of the common hamster in Saxony, and started an ex-situ breeding facility to establish an ex-situ common hamster population as a backup population and to undertake reinforcement as well as other conservation translocation measures. As part of the EU co-funded project *LIFE4HamsterSaxony*, which began in October 2025 and is conducted in collaboration with the “State Office for Environment, Agriculture and Geology” and the “District of North Saxony”, a second, considerably larger breeding facility has been established. Furthermore, in collaboration with the “Senckenberg Society for Nature Research” and commissioned by the “Federal Agency for Nature Conservation”, Zoo Leipzig is currently involved in developing “Guidelines for Breeding and Reintroduction Measures of the Common Hamster in Germany” and participates in reintroductions as part of mitigation measures connected with network expansion and other construction initiatives.

Keywords

common hamster, conservation, breeding, reinforcement, reintroduction

Enclosure effects on body mass and reproduction in the European ground squirrel: insights from 12 years of management

Irena Schneiderová¹, Jitka Matoušová², Roman Vodička³, Jan Matějů⁴

1 - Faculty of Science, Charles University, Prague, Czech Republic

2 - Nature Conservation Agency of the Czech Republic, Prague, Czech Republic

3 - Prague Zoological Garden, Prague, Czech Republic

4 - Karlovy Vary Museum, Karlovy Vary, Czech Republic

Corresponding author: Irena Schneiderová (schneid2@natur.cuni.cz)

Abstract

Ex-situ breeding and reintroduction programs are vital for the conservation of endangered species. Yet husbandry protocols often lack long-term empirical validation, potentially causing unintended changes in populations raised for release into the wild. In the present study, we compared a predator-free, supplementary-fed semi-captive European ground squirrel (*Spermophilus citellus*) colony with an adjacent free-ranging population exposed to natural conditions, both located in the Prague Zoo. The data were obtained through 12 years of monitoring (2011–2022). Our analysis revealed that enclosure life significantly altered body mass and reproductive outcomes. Non-lactating females inside the enclosure were significantly heavier in late spring than their free-ranging counterparts, and adult males followed a similar trend. Conversely, enclosure-born juveniles were significantly lighter than those outside, pointing to potential adult-juvenile competition over easily monopolised resources. Furthermore, the semi-captive colony exhibited a high proportion of non-lactating females, departing significantly from the 9:1 ratio typically observed in wild populations. These findings emphasise that semi-captive conditions can compromise juvenile development and overall breeding success in the European ground squirrel. To optimise conservation outcomes and prevent resource waste, we recommend replacing easily monopolised, sugar-rich diets with scattered, low-sugar food mixtures that mimic natural intake. Furthermore, to maintain optimal enclosure capacity, animals bred for release should be regularly captured and translocated. This study underscores the critical need for integrating rigorous scientific evaluation and adaptive management into long-term wildlife recovery programs.

Keywords

ex-situ conservation, husbandry protocols, *Spermophilus citellus*, supplementary feeding, zoological gardens

Acoustic communication as a potential tool in the captive breeding of European hamsters

Urszula Eichert¹

1 - Forest Biology Center, Adam Mickiewicz University, Poland

Corresponding author: Urszula Eichert (urszula.eichert@gmail.com)

Abstract

Accurate detection of estrus in females is useful when pairing European hamsters in captivity. During the diestrus phase, a female may be aggressive towards a male, particularly when pairing takes place under artificial captive conditions. Analysing vaginal smears to determine whether a female is in estrus (Bier *et al.*, 2023) is difficult to perform in wild-born females, especially if the female is to be mated with a male on the same day.

In the Poznań breeding facility, we use acoustic communication to estimate estrus in females. Before introducing two individuals, in the evening, we play back to the female a previously recorded male call. If the female listens and moves towards the sound, she is likely to be in the proestrus or estrus phase. If she additionally responds with a similar call, there is a high probability that the female is in estrus. An additional confirmation of estrus is provided by the behaviour of the male and female after the cages are moved together, with the animals separated only by a single wire mesh barrier. Mutual interest, running along the separating barrier, and calling reduce the likelihood of an aggressive reaction by the female after the male is allowed access to her.

It remains unclear whether the calls of males and females differ, and whether hamsters are able to determine the sex of the calling individual. Observations in captivity suggest that the calls are similar in both sexes: both males and females have been observed responding with calls to recordings of individuals of the same sex.

Acoustic communication in hamsters remains a poorly studied area and may be a useful tool in captive breeding. However, its application requires prior behavioural experiments under controlled conditions.

Keywords

acoustic communication, breeding, European hamster

Prevalence of *Staphylococcus xylosus* in the skin microbiota of captive-bred European hamsters (*Cricetus cricetus*)

Ewa Szczuka¹, Carolinie Habold², Joanna Ziomek³

1 - Department of Microbiology, Institute of Experimental Biology, Faculty of Biology, Adam Mickiewicz University; Uniwersytetu Poznańskiego 6, 61-614 Poznań, Poland

2 - Département Ecologie Physiologie Ethologie Institut Pluridisciplinaire Hubert Curien, 67000 Strasbourg, France

3 - Department of Systematic Zoology, Adam Mickiewicz University, ul. Uniwersytetu Poznańskiego 6, 61-614 Poznań, Poland

Corresponding author: Ewa Szczuka (ewa.szczuka@amu.edu.pl)

Abstract

Studies on microbiota have attracted considerable scientific attention in recent years, including research involving wild animal species. The composition of the skin microbiota is influenced by various factors, such as geographical location, climate, urbanisation, agricultural practices, and diet. Among the microorganisms inhabiting animal skin and mucosal surfaces, staphylococci constitute a prominent component of the resident microbiota. These bacteria can be easily exchanged between animals and their environment. According to the One Health concept, the microbiota plays a key role in the complex transmission networks linking the environmental reservoirs, human activities, and animal health.

Materials and Methods

Skin samples were collected from European hamsters maintained in a breeding program at IPHC in Strasbourg. The animals were born between 2005 and 2024. The study included 24 hamsters: 12 females and 12 males. Samples were obtained by vigorously swabbing the skin of the auricle with sterile cotton swabs. Each swab sample was placed in brain–heart infusion (BHI) broth (Oxoid, United Kingdom) and incubated at 37°C for 24 h. Subsequently, the cultures were inoculated onto Mannitol Salt Agar (Oxoid, United Kingdom) and incubated for an additional 24 h. Morphologically distinct staphylococcal colonies were picked and subcultured on BHI agar to obtain pure cultures. Preliminary identification of staphylococci was performed using Gram staining and assessment of catalase and coagulase production. Species-level identification was subsequently carried out using matrix-assisted laser desorption/ionization time-of-flight mass spectrometry (MALDI-TOF MS) (Bruker, USA).

Results

Staphylococci were isolated from the auricular skin of all 24 examined hamsters. *Staphylococcus xylosus* was identified in every sample, indicating a high prevalence of this species within the studied population. Moreover, *Staphylococcus equorum* strains were recovered from two animals.

Conclusion

Staphylococcus xylosus was the predominant staphylococcal species colonising the auricular skin of captive-bred European hamsters.

Keywords

European hamster, microbiota, *Staphylococcus*

Expanding the phylogenetic distribution of temperature-sensitive antibodies

Nia Toshkova¹, Fabrice Bertile², Frédéric Touzalin³, Violeta Zhelyazkova¹, Maria Kachamakova⁴ and Jordan D. Dimitrov⁵

1 - National Museum of Natural History, Bulgarian Academy of Sciences, Sofia, Bulgaria

2 - Institut pluridisciplinaire Hubert Curien, Strasbourg, France

3 - University College Dublin, Dublin, Ireland

4 - Institute of Biodiversity and Ecosystem Research, Bulgarian Academy of Sciences, Sofia, Bulgaria

5 - Centre de Recherche des Cordeliers, INSERM, CNRS, Sorbonne Université, Université Paris Cité, Paris, France

Corresponding author: Niya Toshkova (niyatoshkova@gmail.com)

Abstract

Hibernation is characterised by profound metabolic suppression and large fluctuations in body temperature as animals repeatedly cycle between torpor and brief arousal periods. How adaptive immunity is coordinated with these rapid physiological transitions remains poorly understood. We previously showed that IgG antibodies from hibernating bats display temperature-dependent antigen recognition, with broader and stronger binding at temperatures corresponding to the active state than during torpor. This temperature-dependent behaviour raises the possibility that temperature-sensitive antibodies facilitate rapid reactivation of adaptive immune function during periodic arousals while limiting antibody activity during torpor. To investigate whether this phenotype extends beyond bats, we screened sera from phylogenetically diverse mammalian species representing hibernating and non-hibernating lineages. In addition to hibernating bats, we detected temperature-sensitive IgG activity in the European ground squirrel (*Spermophilus citellus*) and Columbian ground squirrel (*Urocyon columbianus*), whereas no comparable activity has so far been observed in non-hibernating species or large hibernators, including the brown bear (*Ursus arctos*), southern elephant seals (*Mirounga leonina*), gray mouse lemur (*Microcebus murinus*), roe deer (*Capreolus capreolus*), alpaca (*Vicugna pacos*) and non-hibernating bats: *Molossus molossus*, *Rousettus aegyptiacus* and *Carollia perspicillata*. Although taxonomic sampling remains limited, these findings are consistent with the possibility that temperature-sensitive antibody function is associated with true hibernation in small mammals. Ongoing analyses of additional species will further define the phylogenetic distribution of this phenotype. Our results identify temperature-sensitive antibody function in distinct hibernating mammalian lineages and provide a foundation for investigating its evolutionary origin and its potential role in coordinating adaptive immunity with the physiological demands of hibernation.

Keywords

mammals, hibernation, adaptive immunity, immunoglobulin G (IgG), thermoregulation

Animal protein increases reproductive output in one-year-old European hamsters (*Cricetus cricetus*)

Ferre Smekens¹, Minke Geense², Fenna Meulemans², Sarah Descamps¹

1 - PXL BIO-Research & Hasselt University, Hasselt, Belgium

2 - GaiaZOO, Kerkrade, The Netherlands

Corresponding author: Ferre Smekens (ferre.smekens@pxl.be)

Abstract

European hamster (*Cricetus cricetus*) populations have declined sharply across Western Europe, with reduced fecundity increasingly recognised as a key driver. While most of the previous research has focused on the role of plant-based protein sources in their reproduction, wild European hamsters supplement their diet with protein-rich prey such as soil-dwelling macroinvertebrates. Although these animal prey constitute a smaller proportion of the natural diet, animal-derived proteins may be disproportionately important because they provide a more complete amino-acid profile and exhibit higher digestibility and bioavailability than plant-derived proteins. This may be particularly important during energetically demanding stages such as pregnancy and lactation.

This study tested whether dietary protein levels and protein source (animal-based vs plant-based) differentially affect the reproductive output, measured as the litter size of the first litter of the breeding season, of female European hamsters under controlled conditions.

A total of 107 female hamsters were randomly assigned to one of three diets: a control diet containing moderate amounts of both plant- and animal-derived protein, a plant-protein-enriched diet excluding all animal items, or an animal-protein-enriched diet supplemented with limited plant material. Litter size of the first litter was analysed using mixed-effects models with maternal age as a key covariate. However, only results for one-year-old females are reported due to limited and skewed sample sizes in the older age class.

One-year-old females on an animal-protein diet produced significantly larger litters than those on the control and plant-protein diets. Both protein-enriched diets increased maternal body mass at the reproductive check.

Animal-based protein has a clear positive effect on reproductive output in one-year-old female hamsters under controlled experimental conditions. While both enriched diets improved maternal body condition, only the animal-protein diet translated into higher fecundity. These findings suggest that reduced access to animal-derived protein, such as macroinvertebrates and earthworms, may constrain reproduction and, consequently, lead to population decline of European hamsters in Western Europe. In the future, field-based studies will be executed to assess the relevance of these results for wild or reintroduced populations.

Keywords

European hamster, *Cricetus cricetus*, dietary protein, captive breeding, reproductive output, litter size

Diet and habitat preference of the European ground squirrels (*Spermophilus citellus*) in South-Western Slovakia

Barbara Győri-Koósz, Monika Chrenkova, Viera Šefferová Stanová

1 - University of Sopron, Institute of Wildlife and Game Management, Bajcsy-Zs. 4, 9400 Sopron, Hungary

2 - DAPHNE – Inštitút aplikovanej ekológie, Bratislava, Slovakia

Corresponding author: Barbara Győri-Koósz (gyorikoosz@gmail.com)

Abstract

Research of the DAPHNE Institute involved a cattle pasture (Kuchyna), two grassy airports (Boleráz, Trnava) managed by mowing, and a sheep pasture (Chtelnica) managed by cutting as well (mixed management) in South-Western Slovakia. The research aimed to estimate the average diet preference in the regional populations, with identification of the main food plants. Then compare the different habitat sites both in vegetation and diet composition. Furthermore, a search was conducted on the effect of regular extra feeding with sunflower seeds.

Starting after spring emergence and mating season, then care of the juveniles, finally the pre-hibernation – fattening time are the three seasons of the European ground squirrel active period (April, June, August) when we measured their food demands. Non-invasively picking up fresh faecal pellets from 5-10 individual burrow entrances at each measured site for diet analysis. In the meantime, vegetation as a food source was recorded in 5 quadrats by identification and botanical cover estimation of all plant species above 1% presence; also, some plant material was collected into a herbarium for later tissue references. The micro-histological analysis was performed in the lab of the University of Sopron (Hungary). As DAPHNE colleagues did regular extra-feeding with dried sunflower seeds on the sites, we divided the four areas into fed and non-fed parts and 5-10 plus individual faecal samples were picked up from those parts. Considering all seasons and sites, 44 species were revealed as preferred food plants among the 113 identified plant species. On grazed pastures, more plant species were found than on mowed airport grasses. In addition, the number of food plants was higher on grazed lands, thus ensuring more diet choice options for the ground squirrels. Diet composition showed local and seasonal differences as we compared proportions of food plants in groups like Monocots, Dicots, Poaceae, Leguminosae, Aromatic plants, Asteraceae and Sunflower seeds. Seasonal comparisons revealed strong Dicot to Monocot (Poaceae) preference in diet, especially of Leguminosae during the year, with regular aromatic plant consumption and seasonally changing Monocot, Asteraceae and seed proportions. Additional animal food was identified as Arthropods. The vegetation quality of each habitat had an effect on diet, so future conservation management should plan and apply habitat-specific measures. Extra feeding had only a moderate effect on the other plants' proportion. For the conservation of the European ground squirrels, it is essential information to evaluate their habitat regarding vegetation composition as a potential food source during the whole active period that helps to manage the sites to be ground squirrel-friendly, even to search for the most suitable target areas for reintroduction.

Keywords

grassland key-species, micro-histological analyses, vegetation composition. grassland conservation, small mammals, herbivore-plant interaction

European ground squirrels in gardens and crop fields: potential for conflict

Kateřina Poledníková¹, Fernando Mateos-González¹, Lukáš Poledník¹

1 - ALKA Wildlife o.p.s., Lidéřovice 62, 380 01 Peč, Czech Republic

Corresponding author: Kateřina Poledníková (katerina.polednikova@alkawildlife.eu)

Abstract

The European ground squirrel (EGS) (*Spermophilus citellus*) was historically managed as an agricultural pest in the Czech Republic. State-supported culling, combined with landscape changes, precipitated a severe range contraction. Today, EGS persists mainly in marginal habitats outside intensive agricultural areas (e.g. airports). Yet these colonies often border cropland, where perceived or real damage can trigger conflicts with land users — conflicts that may determine the persistence of local EGS populations. Despite its management relevance, the nature and extent of EGS-induced crop damage remain poorly quantified.

We conducted a two-site field study to assess crop vulnerability, spatial patterns of damage, environmental drivers, and practical mitigation measures. (1) At Hrušovany u Brna, we established experimental garden plots with diverse vegetables to quantify damage and to test technical mitigation measures. (2) At Miroslav, we deployed wire-mesh enclosures within field margins (grain, legumes, alfalfa) to compare damage under EGS access versus exclusion.

EGS can cause substantial damage to certain crops, but the risk is predictable and therefore manageable. We recorded damage patterns across 25 crop types. Crop susceptibility and magnitude of damage vary with crop type and distance from the colony. Vegetables, legumes, root crops, grains, and forage crops were affected. *Allium* species (onion, garlic, leek) showed no damage. In arable fields, damage was confined to field edges up to 16 m from the colony, except in perennial forage crops (e.g. alfalfa), where colonies can establish well inside fields. Extended dry periods modulate damage. Potatoes were affected only during drought. Providing alternative water sources during drought could reduce this damage. In gardens, physical barriers (e.g. fencing, hotbeds, or cold frames) reduce damage.

Our findings demonstrate that EGS-related crop loss is spatially constrained and crop-specific, enabling targeted mitigation that can minimise conflict while supporting EGS conservation. Risk mapping, drought-contingent measures (including supplemental water), strategic crop placement, and simple physical barriers offer practical, scalable tools for coexistence.

Keywords

European ground squirrel, human-wildlife conflict, damages, preventive measures

Perceptions of the threats posed by domestic carnivores and road mortality to the survival of the European hamster among urban and rural residents in Poland

Magdalena Hędrzak¹, Joanna Ziomek², Magdalena Pieszka³

1 - Department of Zoology and Animal Welfare, University of Agriculture in Kraków; Mickiewicza str. 24/28, 31-120 Kraków, Poland

2 - Department of Systematic Zoology, Adam Mickiewicz University, Uniwersytetu Poznańskiego str. 6, 61-614 Poznań, Poland

3 - Department of Animal Genetics, Breeding and Ethology, University of Agriculture in Kraków, Mickiewicza str. 24/28, 31-120 Kraków, Poland

Corresponding author: Magdalena Hędrzak (magdalena.hedrzak@urk.edu.pl)

Abstract

This study assessed the extent and perception of predation by domestic dogs and cats on the European hamster, as well as road mortality, using occurrence reports collected through an online research questionnaire (2021–2026) and submissions to the national coordinator of the State Monitoring Programme for the European hamster (2004–2026). Respondents' perceptions of threats to the species were also analysed based on open-ended survey responses.

A total of 1,079 records from the Polish provinces where the European hamster still occurs were analysed, including 991 questionnaire responses and 88 reports submitted directly to the monitoring programme. Of all records, 237 (22%) were based on hamster remains brought home by dogs or cats, while 252 (23%) concerned road-killed individuals. Road mortality was reported more frequently in urban areas, whereas predation by dogs and cats was more commonly reported in rural areas, a difference that was statistically significant ($\chi^2 = 7.40$, $p = 0.007$).

Among respondents who identified threats to the species ($n = 525$), 34% considered predation by domestic dogs and/or cats an important threat, compared with 27% who identified predation in general or by wild predators. Deliberate persecution by humans (19%) and road mortality (8%) were mentioned less frequently. Although rural respondents more often reported hamsters killed by their own dogs or cats, they were significantly less likely than urban respondents to perceive domestic animal predation as a major threat to the species ($\chi^2 = 7.69$, $p = 0.006$). This discrepancy likely reflects the continued social acceptance in rural Poland of allowing cats to roam freely and dogs to move without supervision, highlighting an important challenge for European hamster conservation.

Keywords

European hamster, domestic carnivorans, dogs, cats, road mortality

CitellusLIFE - trend-breaking safety net for European ground Squirrel of the Pannonian region

Olivér Váczi¹, Csongor Gedeon¹, Zsuzsanna Gáll¹

1 - Herman Ottó Institute Nonprofit Ltd, Hungary

Corresponding author: Oliver Vaczi (volivoli@gmail.com)

Abstract

Based on the results and analyses from Hungary, the nationwide European ground Squirrel (EGS) population trend continues to decline despite all conservation efforts. In light of these findings, we have designed the recently launched seven-year project titled “Ensuring the survival of a viable European ground Squirrel population in the Pannonian region (CitellusLIFE),” which involves 11 partners. The backbone of the Nature and Biodiversity topic project is a colony-level log sheet system covering the entire region. As part of this, a detailed log sheet will be completed for each ground squirrel colony, containing findings regarding the habitat and the EGS, as well as threats and both planned and implemented measures. In addition, potential EGS habitats that are suitable for the species but do not currently host a living colony for some reason (e.g., isolation) are also assigned log sheets. This log sheet system is designed to ensure that necessary interventions are carried out in a coordinated manner at the regional level. With its help, it can be determined on time which interventions are the most urgent and important for which colonies, so that this is most beneficial for the population of the overall region. The activities and measures planned under the project — such as captive breeding, release and translocation, and improvements to the size, quality, and connectivity of habitats — will be implemented where and when they can be most effective. We hope that coordinated interventions will halt and reverse the negative trend observed in the region, which will have a sustainable impact in the long term.

Keywords

long-term monitoring, population trend, CitellusLIFE, Hungarian Biodiversity Monitoring System

European ground squirrels and common hamsters: Life history strategies and conservation aspects in urban and suburban areas

Eva Millesi¹, Carina Siutz¹

1 - University of Vienna, Austria

Corresponding author: Eva Millesi (eva.millesi@univie.ac.at)

Abstract

European ground squirrels (*Spermophilus citellus*) and common hamsters (*Cricetus cricetus*) share several traits related to a limited active period and thus pronounced time and energy constraints. Due to the loss of dry grass and steppe habitats in many parts of their distribution range, both species occur in increasingly human-shaped areas. In and around Vienna, they can locally reach relatively high population densities, but on the other hand, face severe threats, mainly caused by the high human impact, particularly in urban and suburban habitats. Although both species hibernate, they differ in overwintering strategies in that European ground squirrels are obligate hibernators and rely on body fat reserves, while common hamsters cache food in their burrows, leading to more flexibility and thus high variation in the use of torpor. These differences are reflected in a rather strict annual schedule in the ground squirrels, with only one litter per year and, in contrast, an opportunistic reproductive strategy in the hamsters with up to three litters per season. Nevertheless, the need to accumulate energy reserves for several months underground caused similar seasonal adaptations in both species.

During long-term field studies in or near Vienna, we investigated the timing of different seasonal processes, reproductive behaviour and output, the accumulation of energy reserves, hibernation patterns and local survival rates in both species. Capture-mark-recapture techniques, non-invasive physiological analyses and behavioural observations were carried out throughout the active season. During the hibernation period, body temperature changes were recorded using temperature-sensitive data loggers.

Analyses over many years revealed a very robust and highly significant relationship between vernal emergence and reproductive success. Females that emerged early in spring mated earlier and produced more offspring than females which started surface activity later in the season. Adaptations facilitating an early onset of reproductive activity were therefore detected in females of both species. Furthermore, maternal effort varied with female condition, litter size and seasonal timing. Time-saving strategies enabled more offspring and still sufficient time to prepare for winter. In males, intrasexual competition peaked during spring, although common hamsters remained sexually active until late summer, while in *S. citellus*, mating was limited to a short period in April. High variation in individual reproductive success reflected male mating strategies related to age, physical condition and time of season. Finally, efficient energy accumulation after the breeding period affected hibernation duration and reproductive performance in the subsequent year. In general, the results demonstrate seasonal adaptations, which are related to an accurate timing of the annual cycle but still enable flexibility in individual reproductive and overwintering strategies.

Keywords

European ground squirrel, Common hamster, seasonal adaptations, hibernation patterns, reproductive strategies, conservation

From agricultural pest to a nearly extinct species – the status of the common hamster (*Cricetus cricetus*) in Saxony-Anhalt

Kerstin Mammen¹, Ubbo Mammen¹

1 - ÖKOTOP GbR, Halle, Germany

Corresponding author: Kerstin Mammen (kerstin.mammen@oekotop-halle.de)

Abstract

The common hamster (*Cricetus cricetus*) was in the past a characteristic species of the agricultural landscape in Saxony-Anhalt. While it was intensively persecuted as an agricultural pest due to its high population densities and was also exploited for its fur until the mid-20th century, a continuous population decline began in the early 1970s. Today, the species is classified as critically endangered in Saxony-Anhalt.

The results of the Habitats Directive (FFH) monitoring illustrate the severity of this decline: between the first statewide monitoring survey in 2010 and the most recent surveys conducted in 2024/25, recorded populations have declined by approximately 98%. The European hamster is therefore on the verge of disappearing from Saxony-Anhalt.

The presentation outlines the historical development of the species, presents the latest results of the FFH monitoring programme, and discusses potential causes of the dramatic population decline. Finally, a conservation strategy for the European hamster in Saxony-Anhalt will be presented, aimed at strengthening existing conservation measures and securing the species' long-term survival.

Keywords:

common hamster, *Cricetus cricetus*, population decline, FFH monitoring, conservation strategy, Saxony-Anhalt

Recent population trends of the European ground squirrel (*Spermophilus citellus*) in the Czech Republic

Jan Matějů¹, Jitka Matoušová²

1 - Museum Karlovy Vary, Czech Republic

2 - Nature Conservation Agency of the Czech Republic

Corresponding author: Jan Matějů, (honzamateju@seznam.cz)

Abstract

The European ground squirrel is among the most endangered mammal species in the Czech Republic. Consequently, special conservation measures are implemented through a national Action Plan. Since 2004, all known populations of the species have been monitored regularly. Surveys are conducted throughout the country by a long-term, stable team of at least two observers, usually between late June and early July. Additional surveys may be carried out at the beginning of the season, and regional collaborators also contribute according to their capacities. Whenever possible, information on local population status is obtained from landowners, farmers, vineyard managers, and airport administrators. Based on all available information, a qualified estimate of the size of each population is made at the end of the season, and its approximate geographical boundaries are mapped. Additional variables recorded during monitoring include vegetation management, predator occurrence, and inappropriate anthropogenic disturbances.

In 2025, European ground squirrels were recorded at 40 sites in the Czech Republic, with the total population estimated at approximately 7,000 individuals. The number of occupied sites remained essentially stable compared to previous years; however, the estimated population size increased by approximately 1,000 individuals compared to the preceding four years. The highest estimated population size since the introduction of regular monitoring exceeded 8,000 individuals and was recorded in 2020. Our data do not reveal a clear demographic trend shared by most populations. Instead, isolated populations exhibit markedly different trends, which are likely driven by local conditions, including vegetation management, predator pressure – particularly from domestic cats – and extreme precipitation events. The pattern of precipitation during the growing season, especially during the period of juvenile rearing, may represent an important factor influencing population dynamics. Population trends may also be positively affected by external food resources.

The results of long-term monitoring indicate that the overall abundance of the European ground squirrel in the Czech Republic remains relatively stable despite year-to-year fluctuations, while trends in individual populations are primarily influenced by local environmental conditions.

Keywords

long-term monitoring, population dynamics, local environmental conditions, souslik

Population changes of the European ground squirrels in the management area of Hortobágy National Park Directorate

Alexandra Veres¹, Attila Németh², Orsolya Moldován³, Balogh Szabolcs⁴

1 - Hajdú Bihar County Government Office, Department of Environmental Protection, Nature Conservation and Waste Management, Hungary

2 - Mammal-protection Working Group, BirdLife Hungary – Hungarian Ornithological and Nature Conservation Society, Department of Nature Conservation, Zoology and Game Management, University of Debrecen, Debrecen, Hungary

3 - Department of Nature Conservation, Zoology and Game Management, University of Debrecen, Debrecen, Hungary

4 - Hortobágy National Park Directorate, Debrecen, Hungary

Corresponding author: Alexandra Veres (vszasza2001@gmail.com)

Abstract

The European ground squirrel (*Spermophilus citellus*) is a strictly protected small mammal in Hungary, associated with grassland habitats and declining at an alarming rate. In Hungary, the population has been declining for decades. It is also a globally threatened species, listed as endangered on the IUCN Red List of Threatened Species. This is a clear indication that it is significantly threatened globally, and its range is limited to a few countries. This study evaluated the spatial-temporal population dynamics of *S. citellus* over a 55-year period between 1970–2025 within the operational area of the Hortobágy National Park Directorate, Hungary. A comprehensive spatial database of 193 historical and surviving populations was constructed using archival reports, biotic databases, GIS mapping, and systematically conducted field surveys. We also aimed to understand the underlying factors of disappearances. To this end, we examined the relationship between the number of disappearances and both the average temperature and total annual precipitation of the previous year. We also investigated the impact of soil types on the fate of the ground squirrel population in question. The results reveal a severe population decline of over 50%, with 100 colonies becoming extinct and only 93 persisting to date, peaking in losses between 2001 and 2009. Regional disparities were pronounced: Jász-Nagykun-Szolnok County suffered the highest extinction rate (84.5%), whereas Szabolcs-Szatmár-Bereg County preserved the largest proportion of surviving colonies (34% loss). Soil analysis indicated that extinctions occurred predominantly on high-quality chernozem soils due to grassland conversion and agricultural cultivation, while surviving populations remained confined to lower-quality solonetz and sandy soils utilised as grazed pastures. Furthermore, statistical analysis identified a moderate negative correlation between preceding-year precipitation and colony extinction, confirming that worsening droughts exacerbate population collapse. Finally, legal territorial protection alone failed to halt the decline—with 40% of colonies disappearing inside protected areas. Thus, active conservation measures such as effective habitat protection and the restoration of degraded habitats are crucial for its long-term conservation. In addition, promoting sustainable agricultural practices, such as minimising the use of pesticides and maintaining wildlife-friendly farming methods, is essential for the long-term survival of ground squirrel populations. As well as, grazing management, translocation programs, and a dedicated national species action plan are urgently required. Our research provides valuable insights into the decline of the European ground squirrel, informing the development and implementation of effective conservation strategies in the operational area of the Hortobágy National Park and beyond.

Keywords

European ground squirrel, Hortobágy National Park, Hungary, population trend, long-term survival

New records of the grey dwarf hamster (*Nothocricetulus migratorius*) from Romania

Zsolt Hegyeli¹, Ovidiu-Sebastian Ștefîrcă¹, Zsuzsanna Aczél-Fridrich¹, Bram Conings²

1 - Milvus Group Bird and Nature Protection Association, Romania

2 - Nature & Wildlife photographer, Belgium

Corresponding author: Zsolt Hegyeli (zsolt.hegyeli@milvus.ro)

Abstract

The grey dwarf hamster (*Nothocricetulus migratorius*) is a poorly known rodent at the western edge of its distribution range, which extends through the Balkans and eastern Romania. First recorded in Romania in 1962, its historical records are relatively few, and only a handful of observations confirm its current presence in the country.

Between 2022 and 2025, we investigated the distribution of small mammals in eastern Romania using owl pellet analyses and live trapping. We collected owl pellet samples in 21 localities and conducted small mammal trapping surveys at 8 localities across the Moldavia region.

Remains of 11 individual grey dwarf hamsters were identified in four little owl (*Athene noctua*) pellet samples collected from three counties. Near two of these pellet sampling sites in Vaslui County, a female grey dwarf hamster was captured by a pitfall trap in a grassland habitat in March 2024. Four additional individuals were subsequently captured at the same site in September 2024 and May 2025 by both pitfall and Sherman traps within the grassland and an adjacent alfalfa field. To our knowledge, these represent the first confirmed cases of live trapping this species in Romania. Other small mammals recorded in the same habitat or in adjacent areas included six rodent species and two shrew species.

The new records suggest that the grey dwarf hamster may still be relatively widespread in the region, and that its apparent scarcity may largely result from insufficient survey effort rather than from a genuinely restricted distribution.

Keywords

Nothocricetulus migratorius, owl pellet analysis, live trapping, distribution records, grassland habitats

Strong decline of the distribution and abundance of *Cricetus cricetus* and *Mesocricetus newtoni* (Mammalia: Cricetinae) in Bulgaria

Nedko Nedyalkov¹, Yordan Koshev², Ivailo Raikov³, Ivanka Atanassova⁴, Orlin Dekov⁵, Ilcho Kolev⁶, Veselina Raikova³, Maria Kachamakova², Anna Stanewa⁷

1 - National Museum of Natural History, Bulgarian Academy of Sciences, Tsar Osvoboditel 1 Blvd., 1000, Sofia, Bulgaria

2 - Institute of Biodiversity and Ecosystem Research, Bulgarian Academy of Sciences, Tsar Osvoboditel 1 Blvd., 1000, Sofia, Bulgaria

3 - Museum of Natural History – Varna, 41 Maria Luisa Blvd., 9000 Varna, Bulgaria

4 - Shumen University, 115 Universitetska str., 9700 Shumen, Bulgaria

5 - Institute of Soil Science, Agrotechnologies And Plant Protection 'Nikola Poushkarov', Academy of Agriculture, 35 Panaiot Volov str., 2230 Kostinbrod, Bulgaria

6 - Studen Kladenets str., Vh.1, PO box 1, 7001 Russe, Bulgaria

7 - BirdLife International, Cambridge, United Kingdom

Corresponding author: Nedko Nedyalkov (nnedko@gmail.com)

Abstract

Here we summarise all available information about the distribution, abundance and conservation status of the common hamster (*Cricetus cricetus*) and the Romanian hamster (*Mesocricetus newtoni*) in Bulgaria. Bulgaria lies at the southernmost border of the distribution of *C. cricetus* in Europe. The Bulgarian population of *C. cricetus* is fragmented and isolated from the neighbouring ones, i.e. those in Serbia (Pannonian) and Romania, which makes the species highly vulnerable. *M. newtoni* is an endemic mammal of Europe, found only in Bulgaria and Romanian Dobrudzha. The distribution of both species overlaps in north Bulgaria – the Danube plain and Dobrogea, but cases of syntopic occurrence are rare. The population of *M. newtoni* is fragmented within its range, as there is a small, isolated population in south-east Bulgaria. Reduction in both distribution and numbers, detected by two independent methods – owl pellet analysis and trapping – in both species, might have started in the 1950's with the intensification of agriculture (introducing new technologies and land management practices), and is probably still ongoing. From a historical perspective, a considerable shrinking of the area of *M. newtoni* (that started in the late Pleistocene) has been observed: once the species was widely distributed in the Balkans, reaching NW Italy, and nowadays it is restricted to an area of about 40,000 km². Although both hamster species are strictly protected under Annex IV of the EU Habitats Directive (92/43/EEC) and listed as Vulnerable in the Red Data Book of Bulgaria (2015), there is still no active conservation project for them. Thus, urgent conservation measures should be applied for protecting and improving the populations of *C. cricetus* and *M. newtoni* in Bulgaria.

Keywords

review, Romanian hamster, European hamster, historical biogeography.

Phylogeography and conservation genomics of the Common hamster (*Cricetus cricetus*, Cricetidae) in Central-Eastern Europe

Virág Nyíri¹, Tamás Cserkész², Lajos Szatmári³, Natalia Feoktistova⁴, Alexey V. Surov⁴, Zsolt Hegyeli⁵, Gábor Sramkó⁶

1 - Department of Evolutionary Zoology, University of Debrecen, Hungary

2 - Hungarian Natural History Museum, Budapest, Hungary

3 - Bükk Mammalogical Research Society, Hungary

4 - A.N.Severtsov Institute of Ecology and Evolution, Russian Academy of Sciences, Russia

5 - Milvus Group, Romania

6 - Evolutionary Genomics Research Group, Department of Botany, University of Debrecen, Debrecen, Hungary

Corresponding author: Gábor Sramkó (sramko.gabor@science.unideb.hu)

Abstract

Genetic structure is critical for effective conservation because it clarifies the factors shaping the resilience of threatened populations and guides region-specific management strategies. The common hamster (*Cricetus cricetus*) has undergone severe declines across Europe, yet conservation initiatives have historically focused on long-declining western populations, while eastern ranges—particularly those in Hungary—have remained understudied. In Hungary, where the species was long regarded as an agricultural pest, no comprehensive genetic assessment had previously been conducted despite the region's potential importance as both a historical stronghold and an ancestral source area. To address this gap, we carried out extensive sampling between 2021 and 2025 across the species' key distribution areas in the Pannonian region, stretching from the Vienna Basin to Transylvania, and Russian outgroup samples. Using a RAD-seq approach, we reconstructed the genetic structure and phylogeographic patterns of 161 individuals from the eastern part of the distribution.

Our analyses revealed that most populations formed distinct monophyletic groups with minimal admixture, indicating substantial genetic isolation among regions. Partial intermixing was detected only in geographically adjacent populations. Phylogenetic reconstruction demonstrated that the deepest lineages occur in Transylvania, suggesting a historical refugium there. Whole mitochondrial genome genotyping assured the position of these samples within the previously identified Pannonian lineage. Subsequent westward expansion likely gave rise to a southern Pannonian refugial population, which later split into two major lineages separated by the Danube River. Eastern populations exhibited a clear northward colonisation trajectory, repeatedly crossing the Tisza River and progressively establishing populations further to the north. Nucleotide diversity estimates indicate moderate genetic diversity but strong contemporary structuring consistent with ongoing fragmentation. Together, these findings provide the first high-resolution overview of hamster population structure in Central-Eastern Europe and offer an essential foundation for developing targeted, region-specific conservation measures across the eastern part of the species' range.

Keywords

conservation genomics, reference genome, RAD-seq, genetic connectivity, phylogeography, hamster

Genomic approaches for the conservation the last Hungarian birch mouse (*Sicista trizona trizona*, Sminthidae) population

Gábor Sramkó¹, Sándor Jordán¹, Virág Nyíri²; Péter Balázs³; Tamás Cserkés⁴

1 - Evolutionary Genomics Research Group, Department of Botany, University of Debrecen, Debrecen, Hungary

2 - Department of Evolutionary Zoology, University of Debrecen, Debrecen, Hungary

3 - Bükk National Park Directorate, Hungary

4 - Hungarian Natural History Museum, Budapest, Hungary

Corresponding author: Gábor Sramkó (sramko.gabor@science.unideb.hu)

Abstract

The Hungarian birch mouse (*Sicista trizona trizona*) is among Europe's most threatened small mammals. Formerly distributed across the Pannonian Basin, at the western margin of the Eurasian Steppe, the taxon is now known from a single remaining population in Hungary. This population consists of several small subpopulations confined to isolated habitat patches within a protected grassland landscape. The severe range contraction, together with the species' elusive behaviour and low detectability, has made evidence-based conservation planning particularly challenging.

Here, we present the first comprehensive conservation genomic assessment of this endangered small mammal. We generated a highly contiguous, chromosome-level reference genome using PacBio HiFi long-read sequencing combined with Hi-C chromosome conformation data. We then complemented this genomic resource with high-coverage RAD-seq data from individuals sampled across all known habitat patches occupied by the remaining population.

Our results indicate that the extant Hungarian birch mouse population represents a single evolutionarily significant unit, as most subpopulations still form a largely cohesive cluster in genetic space. Nevertheless, subpopulation-specific genetic signatures are already detectable, suggesting recent fragmentation and restricted gene flow among habitat patches. Occasional dispersal may still occur, as shown by one individual whose genetic profile matched a neighbouring habitat patch rather than its capture site. However, some subpopulations appear to be genetically separated from the main cluster, most likely due to irrigation channels constructed in the 1970s, which now act as barriers to movement.

Despite reduced genetic diversity, genome-wide heterozygosity patterns provided no evidence for a recent severe bottleneck or pronounced inbreeding depression. Our findings highlight the urgent need to restore habitat connectivity within the last known site of the Hungarian birch mouse, especially by mitigating artificial barriers among habitat patches. More broadly, this study demonstrates how genome assembly and population-level genomic data can provide actionable information for the conservation management of rare and poorly detectable small mammals.

Keywords

Hungarian birch mouse, conservation genomics, reference genome, RAD-seq, habitat fragmentation, genetic connectivity

Small mammal declines and why they matter

Fiona Mathews^{1, 2}

1 - University of Sussex, UK

2 - Mammal Conservation Europe, The Netherlands

Corresponding author: Fiona Mathews (F.Mathews@sussex.ac.uk)

Abstract

Many of Europe's small mammals are in decline. Broad changes in land use — particularly woodland and grasslands — are primary drivers of population declines, but many small mammals are also affected by less-well recognised challenges. These include anti-migrant fences, the war in Ukraine, pesticides, plastics, traffic, and light pollution. This talk will review these issues, highlight key data gaps, and consider what mitigation steps might be possible.

For a few species such as the common hamster and souslik, significant investments are being made in their conservation. Yet, for many others, and particularly those that are not listed in the Bern Convention, little action is being taken. For many people, small mammals are simply vermin, regardless of their actual status. Therefore, changing opinions must be a key component of any conservation strategy, and this talk will draw on global research to highlight strategies for changing hearts and minds. It will conclude by reviewing the function of small mammals as both micro-ecosystem engineers and sentinels of declining ecosystem health and call for co-ordinated research that could shift the perception of small mammals from pest to problem-solver.

Keywords

population dynamics, conservation strategy, collaboration, pest

Rescuing ‘invisible mammals’: Conservation efforts for the blind mole rat species of Hungary

Attila Németh¹, Orsolya Moldován^{1,2}, Zsolt Hegyeli³, Viktor Schneider⁴, Gábor Csorba⁵

1 - Conservation Ecology Research Group, HUN-REN Centre for Ecological Research, Karolina Road 29, H-1113 Budapest, Hungary

2 - Department of Nature Conservation, Zoology and Game Management, University of Debrecen, Böszörményi str. 138, H-4032 Debrecen, Hungary

3 - University of Debrecen, Doctoral School of Animal Science, Böszörményi str. 138, H-4032 Debrecen, Hungary

4 - Kiskunság National Park Directorate, Liszt Ferenc str. 19, H-6000 Kecskemét, Hungary

5 - Hungarian National Museum Public Collection Centre, Hungarian Natural History Museum, Ludovika Square 2-6, H-1083 Budapest, Hungary

Corresponding author: Attila Németh (dr.attila.nemeth@gmail.com)

Abstract

Subterranean blind mole rats of Central Europe were once considered pests, but now face extinction. Recent studies have revealed that three distinct endemic species of blind mole rats belonging to the *Nannospalax* genus inhabit the Pannonian Basin. The Hungarian (*N. hungaricus*), Vojvodina (*N. montanosyrmiensis*) and Srem blind mole rats (*N. syrmensis*) are all highly endangered species. Information is currently available on the occurrence of the Vojvodina and Hungarian blind mole rats in Hungary. The blind mole rats in this region have long been persecuted, and much of their habitat has been lost, fragmented or degraded. The Pannonian endemic species of the group are threatened with extinction as they only exist in a few small and isolated populations. We have compiled all available data from the last 20 years relating to the distribution, threats, and conservation actions of these species. Based on this information, we have conducted national and global risk assessments of the species. Recent findings also suggest that blind mole rats play a key role in grassland ecosystems. Their digging creates mounds of bare soil surfaces that are available for plant colonisation and maintain soil structure. They also provide burrows for other animals. Practical conservation interventions, such as establishing new populations, offer hope in the fight to save these species. The conservation efforts made so far, the solutions implemented, and the lessons learned may contribute to the successful conservation management of other species or similarly sensitive situations.

Keywords

blind mole rat, *Nannospalax*, Hungary, grassland, Pannonian Biogeographic Region

Beyond the grassland: dispersal and colonisation of the European ground squirrel (*Spermophilus citellus*) in a fragmented landscape

Jan Matějů¹, Jitka Matoušová², Kateřina Poledníková³

1 - Museum Karlovy Vary, Czech Republic,

2 - Nature Conservation Agency of the Czech Republic

3 - ALKA Wildlife o.p.s., Lidéřovice 62, 380 01 Peč, Czech Republic

Corresponding author: Jan Matějů (honzamateju@seznam.cz)

Abstract

Dispersal is a key ecological process enabling gene flow and the colonisation of new habitats. Although long-distance movements have been documented in several ground squirrel species, information on the dispersal capabilities of the European ground squirrel (*Spermophilus citellus*) remains limited, particularly in the highly fragmented landscapes of Central Europe.

This study summarises opportunistic records of dispersing individuals and newly established colonies collected from several localities in the Czech Republic over the last 20 years. For each event, the minimum distance from the nearest presumed source population was estimated. Both direct observations of dispersing individuals and successful colonisation events were analysed.

A total of 33 events were recorded, including 18 dispersal events and 15 colonisation events. Dispersal distances ranged from approximately 400 to 7900 m, with a mean of 2217 m and a median of 1815 m. Repeated movements exceeding 2 km were documented, including several over 3 km and two over 5 km. The longest recorded movement involved an individual captured by a domestic cat and therefore represents only a minimum estimate. In contrast, successful colonisation occurred over considerably shorter distances, ranging from 190 to 1420 m (mean 775 m, median 800 m). Several observations indicate that dispersing individuals are capable of crossing forests, urban areas, rivers, and other potentially unsuitable landscape features

Our observations suggest that the dispersal capacity of the European ground squirrel is substantially greater than previously assumed from allometric predictions and available field data. At the same time, the pronounced difference between dispersal and colonisation distances indicates that long-distance movements do not necessarily result in the successful establishment of new colonies, highlighting a potential mismatch between movement capacity and effective range expansion.

Keywords

dispersal, colonisation, habitat fragmentation, range expansion, souslik

Awakening the Thracian dormice: An investigation into the ecology and conservation of *Myomimus roachi* and sympatric glirids.

Nikolaos Kiamos¹, Georgios Papamichail⁵, Despina Migli², Christos Astaras³, George P. Mitsainas⁴, Petros Lymberakis¹, Dionisios Youlatos²

1 - Natural History Museum of Crete, University of Crete, 71409 Heraklion, Greece,

2 - Department of Zoology, School of Biology, Aristotle University of Thessaloniki, 54124 Thessaloniki, Greece

3 - Forest Research Institute, Hellenic Agricultural Organisation "DEMETER", 57006 Vasilika, Greece

4 - Section of Animal Biology, Department of Biology, University of Patras, GR-26500 Patras, Greece

5 - Freelance researcher

Corresponding author: Nikolaos Kiamos (kiamosn@uoc.gr)

Abstract

Roach's mouse-tailed dormouse (*Myomimus roachi*) is one of the rarest mammals in Europe. It is classified as Vulnerable on the IUCN Red List, while it is listed as Critically Endangered on the Greek red list. In Greece, the species was first recorded in 2019 through the analysis of barn owl pellets at a single locality in western Evros prefecture. It was later confirmed by camera traps at two sites in the same broader area. More recently, the species was also recorded from barn owl pellets in the eastern part of Evros. We present the research effort undertaken to record *Myomimus roachi*, employing various survey methods including live traps, camera traps, pellet analysis, tunnel tracks and nest boxes. The research effort has also led to interesting observations of Gliridae species on individual trees, hedgerows and forest patches. In addition, we present landscape structure metrics to investigate dispersal in fragmented landscapes. Seasonal alternation in the use of nest boxes by different glirid species was observed, providing insights into sympatry.

Potential habitats of Roach's mouse-tailed dormice in Greece have undergone a transformation from heterogeneous agricultural landscapes with hedgerows and oak patches into monocultures of annual crops, accompanied by farmland consolidation and the removal of green elements that formerly served as field boundaries. We aim to highlight the importance of restoring ecological corridors to conserve the unique biodiversity of Thrace while promoting economic incentives for the declining local population through eco-friendly agricultural practices.

Keywords

Myomimus, *Muscardinus*, *Dryomys*, landscape, degradation, connectivity

How is the flow? – A view on landscape permeability for the common hamster

Pia Stein¹, Niels Hellwig¹, Christina Fischer¹

1 - Anhalt University of Applied Sciences, Department of Agriculture, Ecotrophology and Landscape Development, Germany

Corresponding author: Pia Stein (pia.stein@hs-anhalt.de)

Abstract

The common hamster (*Cricetus cricetus*) has experienced significant population declines globally over the past century. Agricultural intensification and habitat fragmentation are among the main drivers for this decline. However, it is unclear how spatiotemporal land-use patterns affect hamsters at the landscape scale. The agricultural landscape of Saxony-Anhalt contains one of the largest remaining hamster populations in Germany; thus, it is a good example to study hamster pathways across the landscape. This study aimed to reveal potential hamster pathway patterns depending on land use to understand how the connectivity of hamster populations can be supported across the agricultural landscape of Saxony-Anhalt. Therefore, we used the program Circuitscape to generate current maps. As a starting point, we used hamster surveys conducted on agricultural land between 2019 and 2024 and focused on three regions for which we developed resistance matrices based on hamsters' habitat preferences. For the resistance matrices, we used CORINE Land Cover data and the 20 dominant crops (based on administrative data) for each study year. We set hamster occurrences and eight edge points per region as focal nodes between which the pairwise currents were calculated. Generated current maps illustrate potential hamster pathways across the agricultural landscape and highlight how crops with high resistance, e.g. maize, sugar beet and winter rape, negatively affect hamster pathways. As a consequence, landscape permeability and connectivity change yearly due to crop rotations. Understanding these patterns is crucial to plan well-connected conservation measures aimed at mitigating the effects of intensive agriculture and habitat fragmentation, thereby promoting the survival and recovery of hamster populations.

Keywords

Cricetus cricetus, land-use patterns, agriculture, circuitscape

Current status of ground squirrel species (*Spermophilus citellus* and *Spermophilus suslicus*) in the Republic of Moldova

Victoria Nistoreanu¹, Alina Larion¹, Anatolia Savin¹

1 - Moldova State University, Institute of Zoology; Theriological Society of Moldova

Corresponding author: Victoria Nistoreanu (vicnistoreanu@gmail.com)

Abstract

On the territory of the Republic of Moldova, the European ground squirrel (*Spermophilus citellus*) has the eastern limit of its range, and the spotted ground squirrel (*Spermophilus suslicus*) has the western limit of its range. Both species are listed in the Red Book of Moldova as vulnerable [VU]. In recent years, the occurrence and distribution of both species have decreased drastically. The study aimed to assess the current status of both species and to emphasise the main limiting factors. From 2015 to 2025, field studies were performed all over the territory of the country.

During the last 10 years, the *Spermophilus citellus* population suffered a severe decline. Until 2015, about 20 locations of the species were known, which gradually disappeared over the years, and in 2023-2025, during population monitoring, only two locations of the species were found: near Japca locality (47,98 N and 28,72E, 30-80 m a.s.l.) and about 14 km in the northern direction, near Hrustovaia village. The surface occupied by the colonies is about 100 ha, with a mean density of 10-12 ind./ha.

Spermophilus suslicus has a larger distribution and occurrence. Before 2015, it was recorded in more than 30 sites all over the republic's territory. Colonies with a density of 20-25 ind./ha were registered in river valleys; other populations had lower densities of 4-6 ind./ha, many of them being at near extinction (0,5 – 2 ind./ha). In the last 10 years, about 20 colonies have become extinct, and in 2023-2025, the species was found only in 8 locations. The mean surface occupied by the colonies is 80-200 ha, with mean densities between 10-20 ind./ha.

The main limiting factors of population decrease are of anthropogenic origin, such as conversion of steppe and pastures to agricultural land, overgrazing or lack of it, and transformation of territories inhabited by ground squirrels for leisure, tourism, and fishing activities. The significant increase in the number of carnivorous predators (*Vulpes vulpes*, *Canis aureus*, *Felis sylvestris*) in recent years has also negatively affected the existence of species populations. Climate change over the last years, especially the droughts, has caused the loss of trophic sources and decreased reproductive success in both species.

Thus, in the Republic of Moldova, the current status of *Spermophilus citellus* is Critically Endangered [CR] and that of *Spermophilus suslicus* is Endangered [EN].

Keywords

Spermophilus citellus, *Spermophilus suslicus*, status, limiting factors, Republic of Moldova

Habitat use and population dynamics of European ground squirrels in a vineyard-dominated landscape

Franz Suchentrunk¹, Felix Knauer¹, Csongor István Gedeon²

1 - Research Institute of Wildlife Ecology, University of Veterinary Medicine Vienna, Austria

2 - Department of Soil Mapping and Environmental Informatics, Institute for Soil Sciences, HUN-REN Centre for Agricultural Research, Budapest, Hungary

Corresponding author: Franz Suchentrunk (franz.suchentrunk@vetmeduni.ac.at)

Abstract

Knowledge about potential local site-specific or habitat-specific effects on population dynamics is a prerequisite for planning appropriate regional conservation measures for European ground squirrels (EGS). In agricultural landscapes, habitat types that are differently exposed to anthropogenic disturbances may influence habitat choice and population density. We modelled long-term data on EGS burrow openings in a vineyard-dominated agricultural landscape in eastern Austria to identify potential effects of habitat type and local plot identity over eleven years of population decline, while accounting for general spatial density patterns and varying observability. Specifically, we counted active burrow openings in vineyards, meadows, orchards, and field margins, and expected particularly lower densities in vineyards, where almost year-round anthropogenic disturbance is assumed to be higher than in meadows, independent of overall population density. However, our results from information-theory-based multi-model inference indicated no difference between relative densities in vineyards and meadows across all years of population decline but revealed increased densities in field margins at high overall population densities. Densities in orchards were not affected by population decline, and no statistical effect of local plot characteristics was found despite some general spatial variation of densities. Detectability of openings varied due to different vegetation characteristics, but all our other modelling results were independent of that visibility-related effect, and there was no effect of different observers. Overall, our findings suggest that vineyards are equally suitable habitats for EGS in our study area and that field margins may play a key role in providing habitat connectivity. Moreover, the consistent spatial variation in opening densities may point to currently unidentified geographical or local factors, such as soil properties, unrecognised anthropogenic influences (e.g. road mortality), or other biotic or abiotic causes specifically related to health.

Keywords

European ground squirrel, habitat use, agricultural landscape, vineyards, population density, information theory-based modelling

Rapid urbanisation of the European hamster (*Cricetus cricetus*) in Ukraine

Mikhail Rusin ^{1,2,3}

1 – Kyiv Zoo, Kyiv, Ukraine

2 – Schmalhausen Institute of Zoology, Kyiv, Ukraine

3 – NGO Small Mammals Research and Conservation Center, Kyiv, Ukraine

Corresponding author: Mikhail Rusin (ellobius.talpinus@gmail.com)

Abstract

The European hamster (*Cricetus cricetus*) has been assessed as Critically Endangered on the IUCN Red List of Threatened Species since 2020. The population has undergone a severe decline in most countries across its range, including Ukraine. The European hamster mainly inhabits grasslands and agricultural landscapes; however, a few urban populations have been known for decades, including those in the cities of Vienna, Austria, and Simferopol, Ukraine.

Since 2024, we have been running the initiative "Hamster Rescue Center", aiming to minimise human–wildlife conflicts. We have collected evidence of the rapid urbanisation of the European hamster in Ukraine. Previously, hamsters were mainly reported from small private gardens on the outskirts of villages. We have recorded hamsters living next to human buildings not only in small villages but also in larger towns and cities. The most notable examples were found in the cities of Vinnytsia and Rivne, where hamsters occupied private and public lawns close to multi-storey buildings.

The highest densities of hamsters were observed near small cottages (often called dachas in Ukraine) in the Ivano-Frankivsk, Chernivtsi, Lviv, Chernihiv and Poltava regions. Population densities in such places exceeded 100 animals per hectare in 2025.

In both rural and urban areas, people reported the same story, describing hamsters as "appearing out of nowhere in the past 2–3 years". Most respondents admitted that they had never seen hamsters before and initially believed that their gardens were "infested with rats".

As hamster populations in human settlements continue to grow, with new populations emerging in previously unknown locations (for example, in the city of Horishni Plavni, which is surrounded by wetlands and forests, where hamster populations suddenly exploded over the past two years), the "traditional" non-urban populations continue to decline. Field surveys in the agricultural lands of Kyiv Region recorded the disappearance of most populations previously known during 2009–2019, while new populations emerged in the cities of Bila Tserkva and Vasylkiv in 2026.

The ongoing rapid urbanisation of the European hamster may represent a pathway for the species' survival. If this trend continues, the species should be reassessed from CR to a less threatened conservation status.

Keywords

Cricetus cricetus, synanthropisation, population density, outbreak, Ukraine, hamster

Why don't we do anything? The European hamster (*Cricetus cricetus*) as a conservation challenge in Croatia

Monika Petković¹, Dora Čuljak¹, Marko Augustinović¹, Jelena Mlinarec¹

1 - Oikon Ltd. – Institute of Applied Ecology, Croatia

Corresponding author: Monika Petković (mpetkovic@oikon.hr)

Abstract

The European hamster (*Cricetus cricetus*) is one of the most rapidly declining mammal species in Europe and is currently classified as Critically Endangered on the IUCN Red List. The species is strictly protected under the EU Habitats Directive, the Bern Convention, and Croatian national legislation. Nevertheless, population declines continue throughout much of its range.

In Croatia, the species occurs at the south-western edge of the Pannonian population. Between 2021 and 2023, the national project Development of Monitoring Programmes for Species and Habitat Types established the first systematic monitoring framework for the species, revised reference values for conservation status assessment, analysed pressures and threats, and proposed a set of conservation measures. The results revealed an alarming situation: the species was confirmed in only 13 occupied 10 × 10 km grid cells, indicating a highly restricted and fragmented distribution. Both population status and habitat status were assessed as unfavourable. Identified threats include habitat fragmentation, agricultural intensification, agrochemical use, loss of landscape heterogeneity, road mortality, and reduced ecological connectivity.

However, the Croatian case raises a broader question that extends beyond the conservation of a single species. While legal frameworks require monitoring, assessment, and reporting, they do not necessarily ensure the implementation and financing of active conservation measures or the research needed to understand the mechanisms driving population decline. As a result, a species may be legally protected, systematically monitored, and repeatedly reported as being in unfavourable conservation status, while continuing to decline.

We argue that reporting conservation status is not equivalent to conserving a species. Monitoring can identify decline, but it cannot reverse it without accompanying research, habitat management, population recovery measures, and long-term financial support. The case of *Cricetus cricetus* in Croatia highlights a critical gap between biodiversity reporting and biodiversity recovery and raises a fundamental question for conservation policy: who is responsible when a strictly protected species continues to disappear despite the existence of legal protection, monitoring programmes, and recognised conservation obligations?

Keywords

conservation status, population decline, conservation capacity, Habitat Directive, isolated populations

Insights into the current progress of the LIFE4HamsterSaxony project and the implementation of its first innovative measures

Ben Fleischer¹, Alexander Erdbeer¹

1 - Landesamt für Umwelt, Landwirtschaft und Geologie (LfULG), Pillnitzer Platz 3, 01326 Dresden, Germany

Corresponding author: Ben Fleischer (ben.fleischer@lfulg.sachsen.de)

Abstract

The common hamster (*Cricetus cricetus*) is one of the most endangered mammal species in Central Europe. In Saxony, due to years of population decline, the population has been virtually undetectable since 2020 and lies below the detection threshold.

Against this backdrop, our EU-co-funded LIFE4HamsterSaxony project, which launched in October 2025, aims to conserve the common hamster in Saxony in the long term and strengthen its population. This will be achieved through the implementation of innovative and best-practice-measures in agricultural production. The project is based on an area-management concept designed to establish a network of release sites, core areas, and connecting areas within the project area.

Although no long-term data on the effects of those agricultural measures are available yet, we would like to share our current state of the action. The project is supported by an external agricultural consulting company, together with which we are implementing the first innovative measures, such as the use of a stripper header (an attachment for a combine harvester).

Our presentation will provide a brief update on the current state of the project, the implementation of the area-management concept and the first insights into the experiences and lessons learned during the preparation and introduction of the stripper header.

Other tasks of the project, such as the breeding of common hamsters for release into the project area, will be presented by the Zoo Leipzig.

Keywords

common hamster, agriculture, LIFE-project, LIFE4HamsterSaxony, Germany/Saxony, conservation

An underestimated and overlooked threat: The hidden impact of roadkill on the European hamster (*Cricetus cricetus*)

Julianna Szulamit Szapu¹, Attila Németh^{2,3}

1 - Doctoral School of Biology, ELTE Eötvös Loránd University, Budapest, Hungary

2 - Department of Nature Conservation, Zoology and Game Management, University of Debrecen, Böszörményi út 138, Debrecen H-4032, Hungary

3 - BirdLife Hungary – Hungarian Ornithological and Nature Conservation Society, Költő u. 21, Budapest H-1121, Hungary

Corresponding author: Julianna Szulamit Szapu (szjuliannasz.felis.silvestris@gmail.com)

Abstract

The Central European populations of the Critically Endangered European hamster (*Cricetus cricetus*) play a key role in the global survival of the species amidst widespread declines. Although agricultural expansion and habitat degradation are well-known threats, the impact of wildlife-vehicle collisions is systematically overlooked, primarily due to low carcass persistence and detection rates. This study presents an incidental field observation from northwestern Hungary, where eight vehicle-killed hamster carcasses were documented along a localised road section within a 12-hour window in April 2026. The observed carcasses degraded almost completely within 4–5 hours, highlighting a severe persistence bias that distorts traditional mortality counts. To assess the scale of this event, we compared these findings with long-term monitoring data (2020–2025) from the Fertő-Hanság National Park Directorate. This contextualisation revealed that the casualties from this single night matched or surpassed the typical annual roadkill totals recorded for the entire region in non-outbreak years. Increased mobility during the breeding season (April–August) – especially by mate-searching males – elevates the risk of road mortality. Our results demonstrate that traditional biotic databases and relevant literature severely underestimate traffic-induced mortality, masking a potentially devastating additive threat to remaining populations. For effective conservation in key strongholds, we propose mitigation steps: establishing standardised, early-morning carcass monitoring protocols, seasonal speed restrictions during the breeding period, and constructing dedicated eco-passages designed with anti-predation features.

Keywords

roadkill, eco-passage, hamster, mortality, mobility

How golden eagles hunt sousliks: A review of hunting strategies

Ivaylo Danchev Angelov¹

1 - National Museum of Natural History - Bulgarian Academy of Sciences, Sofia, Bulgaria

Corresponding author: Ivaylo Danchev Angelov (ivaylo.angelov@nmnhs.com)

Abstract

Sousliks function as keystone species and ecosystem engineers, while golden eagles (*Aquila chrysaetos*) act as apex predators. To establish a global baseline of their trophic interactions and identify knowledge gaps, I reviewed approximately 200 studies on golden eagle diet and foraging behaviour across its range. Throughout Eurasia and North America, at least 16 souslik species (genera *Spermophilus*, *Urocitellus*, *Otospermophilus*, and *Callospermophilus*) are documented as prey. Across 19 specific studies from North America and Asia, eight souslik species (*S. fulvus*, *O. beecheyi*, *O. variegatus*, *U. columbianus*, *U. parryii*, *U. elegans*, *U. beldingi*, *U. mollis*) constituted between 10% and 84% of individual prey items in the eagles' diet. To capture sousliks, golden eagles are known to employ five distinct hunting behaviours. The most prevalent is the 'low-contour flight with a short glide attack', which utilises topographic features for surprise attacks and requires high manoeuvrability during the final strike phase. Two acoustically cryptic strategies, the 'slow descent attack' and the 'parachute stoop', target unsuspecting sousliks by minimising aerodynamic noise during approach. A third general strategy involves still-hunting from elevated perches (trees or cliffs) within grasslands, where eagles ambush selected prey. The 'walk-and-grab attack', a behaviour more characteristic of other *Aquila* species, is likely the least frequent tactic. Finally, golden eagles occasionally acquire sousliks through kleptoparasitism, executing swift attacks on smaller raptors after prolonged high soaring or diving from distant high perches.

Keywords

golden eagle, hunting behaviour, ground squirrel

Prey composition of the saker falcon (*Falco cherrug*) based on two different methods

Benedek Juhász¹, Márton Herényi², Márton Horváth¹

1 - Birdlife Hungary, Hungarian University of Agriculture and Life Sciences, Budapest, Hungary

2 - Hungarian University of Agriculture and Life Sciences, Budapest, Hungary

Corresponding author: Benedek Juhász (juhasz.benedek@mme.hu)

Abstract

The diet of the saker falcon (*Falco cherrug*) is highly diverse. In Hungary, researchers identified 112 prey species between 1992 and 2006, including birds, mammals, two reptile, four insect, and two gastropod species. This study aimed to provide a comprehensive assessment of the saker falcon's diet and to compare the effectiveness of two dietary assessment methods—prey remains collection and camera-based prey identification—in the Northern Great Plain region of Hungary. We hypothesised that prey remains analysis provides an accurate representation of prey species with larger body sizes, but the method may underestimate the occurrence of smaller prey items. Small-bodied prey species are often consumed entirely by the falcons, leaving few identifiable remains and thus reducing the likelihood of their detection through conventional prey remains collection. In some cases, evidence of such prey may only be recovered from pellets. In 2025, within the LIFE SakerRoads project, in the North-Hungarian Plain 15 wildlife cameras were installed at Saker Falcon nests (located both on high-voltage electricity pylons and on trees) while prey remains were collected simultaneously. Altogether, 802 prey items were identified during the study. Camera-based analyses revealed that more than half of all recorded prey items (51%) belonged to the order Rodentia, mainly comprising *Microtus* species, whereas rodents represented only slightly more than 2% of the prey remains sample. The European ground squirrel (*Spermophilus citellus*), formerly considered a common prey species, was recorded only once during the study. Based on prey remains, pigeons (*Columba* sp.) accounted for 50% of all identified prey items, whereas this proportion was only 14% based on camera-trap observations. The substantial differences observed among the various prey categories can be attributed to differences between the two methods, as well as to the Saker Falcon's feeding behaviour. Overall, it can be concluded that, in the prey remains collection method, prey types with larger body sizes are found in higher proportions in the samples, as they leave considerably more feathers, bones, or other identifiable structures that can be used for species identification. In this presentation, I would like to compare the results obtained using these two methods and consider their characteristics in the assessment of the Saker Falcon's diet.

Keywords

saker falcon, diet composition, prey remains analysis, camera-based prey identification

Reintroduced saker falcons (*Falco cherrug* Gray, 1834) are dependent on European ground squirrels during the breeding period in Bulgaria

Yana Andonova¹, Dilian Georgiev^{2,3}, Rusko Petrov^{1,2}, Yana Andonova¹, Ivaylo Klisurov¹, Ivaylo Angelov^{4,5}, Anton Stamenov⁴, Dimitar Gradinarov⁴, Volen Arkumarev⁴

1 - Green Balkans - Stara Zagora NGO, 26 Konstantin Irechek Str., 6000 Stara Zagora, Bulgaria

2 - Trakia University, Student town, 6000 Stara Zagora, Bulgaria

3 - University of Plovdiv 'Paisii Hilendarski', 24 Tsar Assen Str., Plovdiv, Bulgaria

4 - Bulgarian Society for the Protection of Birds/BirdLife Bulgaria, Yavorov quarter, Bl. 71, Entr. 4, app. 1, 1111 Sofia, Bulgaria

5 - National Museum of Natural History, Bulgarian Academy of Sciences, Sofia, Bulgaria

Corresponding author: Yana Andonova (yandonova@greenbalkans.org)

Abstract

This study examines the diet of the reintroduced saker falcon (*Falco cherrug*) population in Bulgaria. By combining food-remain analysis, visual observations, and camera-trap monitoring, we documented 144 prey items taken by saker falcons during the 2020, 2024, and 2025 breeding seasons. The analysis revealed the species composition and frequency of occurrence of their prey. Direct observations documented 58 prey deliveries, camera-trap monitoring recorded an additional 17 deliveries, and 69 prey items were identified from food remains collected in or near the nests. The diet composition clearly indicated that the breeding saker falcons in Bulgaria rely predominantly on mammals, with small rodents comprising 88.9% of all identified prey items, while birds accounted for 10.4% and reptiles for 0.69%. The most frequently occurring prey species was the European ground squirrel (*Spermophilus citellus*), which accounted for an overwhelming majority of the diet with 116 occurrences, representing 80.56% of the total identified individuals. The frequency of other identified mammals was low, including *Mus* sp. (0.69%), *Apodemus* sp. (0.69%), *Microtus* sp. (1.39%), and *Glis glis* (0.69%). Unidentified rodents contributed an additional 7 occurrences (4.86%), further confirming the high preference of this group. Birds represented a secondary prey category. Feral pigeons (*Columba livia f. domestica*) were the most significant avian prey, found in 6 occurrences (4.17%). Other bird species recorded in the diet were *Sturnus vulgaris* (1.39%), *Pica pica* (0.69%), *Cuculus canorus* (0.69%), *Turdus merula* (0.69%), and *Turdus visvicorus* (0.69%). Only one occurrence of a large lizard, *Lacerta* sp. (0.69%), was recorded, indicating that reptiles are an opportunistic or negligible component of the diet in this specific area and period. The pronounced dependence on *S. citellus* underscores its essential role in the diet of the falcons. Consequently, conservation efforts should prioritise the protection and restoration of pasture systems and the recovery of declining ground squirrel populations in Bulgaria.

Keywords

reintroduction, birds, diet, ground squirrel, pastures, saker falcon

Foraging and parental behaviour of a saker falcon pair raising five fledglings: implications for territory quality and prey demand

Anton Stamenov¹, Ivaylo Angelov², Yana Andonova³, Dimitar Gradinarov¹, Ivaylo Klisurov³, Volen Arkumarev¹

1 - Bulgarian Society for the Protection of Birds/BirdLife Bulgaria, Yavorov complex, bl. 71, vh. 4, PO box 50, 1111 Sofia, Bulgaria

2 - National Museum of Natural History, Bulgarian Academy of Sciences, 1 Tsar Osvoboditel Blvd., 1000 Sofia, Bulgaria

3 - Green Balkans – Stara Zagora NGO, 26 Konstantin Irechek Str., 6000 Stara Zagora, Bulgaria

Corresponding author: Anton Stamenov (anton.stamenov@bspb.org)

Abstract

The population restoration of regionally extinct raptors is often challenging, especially during initial establishment. The endangered saker falcon (*Falco cherrug*) became extinct as a breeding species in Bulgaria but has recently been reintroduced. The first breeding occurred in 2017, and six breeding territories are currently occupied. We investigated the parental behaviour of a breeding pair that successfully raised five fledglings, aiming to quantify parental provisioning by sex, describe prey handling and food-transfer behaviour, and estimate prey demand. During 90.7 h of observation, 56 prey deliveries were recorded. European ground squirrels (*Spermophilus citellus*) were the primary prey, accounting for 85% of male and 92% of female provisioning. In 46 provisioning events where the hunting individual could be identified, the male captured 72% of prey and the female 28%. Male-to-female food transfers occurred 15 times, both in the air and at the nest. Nearly all prey items were brought to the nest decapitated, suggesting that adults consumed the heads. The female fed the chicks in 85% of cases and the male in 15%, with feedings lasting an average of 14 ± 3.84 min. Based on provisioning rates, we estimated that the pair and their offspring consumed approximately 600 prey individuals during the breeding season. Future research should focus on winter residency, hunting behaviour outside the breeding season, and the effects of kleptoparasitism on souslik availability.

Keywords

raptors, behaviour, food provisioning, food preparation, European ground squirrel



Poster abstracts



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Co-funded by
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Pilot activities for breeding and studying the behaviour of the European ground squirrel *Spermophilus citellus*, Linnaeus 1766, in zoo conditions

Katerina Zareva-Simeonova¹, Yordan Koshev², Maria Kachamakova², Venislava Spasova³, Daniela Simeonovska-Nikolova³, Krastio Dimitrov³

1 - Sofia Zoo, 1 Srebarna Street, 1407 Sofia, Bulgaria

2 - Institute of Biodiversity and Ecosystem Research at Bulgarian Academy of Sciences, 2 Gagarin Street, 1113 Sofia, Bulgaria

3 - Faculty of Biology, Sofia University, 'St. Kliment Ohridski', 8 Dragan Tsankov Blvd., 1164 Sofia, Bulgaria

Presenting author: Katerina Zareva-Simeonova (upupa1904@abv.bg)

Corresponding author: Yordan Koshev (bgsouslik@gmail.com)

Abstract

The European ground squirrel/souslik *Spermophilus citellus* is listed as 'Endangered' in the IUCN Red List. Around the world, the species is bred in zoos to improve its conservation status. Until now, sousliks have not been bred in zoos in Bulgaria, despite this goal being included in the National Species Conservation Plan (2023–2031).

We present the pilot activities for souslik husbandry at Sofia Zoo. Seven individuals were captured during a rescue operation in the area of Pazardzhik, within the Natura 2000 site "Reka Maritsa" (BG0000578). The animals were initially placed in the quarantine facility of the Zoo. During the first week, their behaviour was recorded with video cameras and then analysed. Next, two behavioural tests – "Open Field" and 'Novel object exploration' – were used to assess locomotor and exploratory behaviour, as well as risk-taking in response to novelty. Based on their behaviour, two female sousliks were kept in the Zoo's exhibition area, while the others were released into a suitable habitat.

The initial results show that the sousliks built nests from the provided hay and spent more time inside them. All animals produced the characteristic alarm calls, especially after the first day. In the 'Open Field' test, the sousliks spent significantly more time in the peripheral zone of the experimental arena than in the centre. In the 'Novel object exploration' test, only one female and one male approached the object and made contact with it. The two individuals that remained in the exhibition enclosure showed an afternoon peak in activity during August, which corresponds to observations from other regions in Bulgaria.

In conclusion, for the first time, two classical tests – 'Open Field' and 'Novel object exploration' – were conducted on *S. citellus*, and sousliks were successfully bred and displayed to the public in Bulgaria, representing an important step toward establishing captive breeding for conservation purposes.

Keywords

'Open Field' test, 'Novel object' exploration test, souslik, conservation

Protected — but not where it matters: spatial mismatch between conservation areas and core habitats of the Persian squirrel

Yiannis G. Zevgolis¹, Alexandros D. Kouris², Apostolos Christopoulos³, Christina Valeta¹, George P. Mitsainas⁴, Petros Lymberakis⁵, Dionisios Youlatos^{6,7}, Panayiotis G. Dimitrakopoulos¹

1 - Biodiversity Conservation Laboratory, Department of Environment, University of the Aegean, Greece

2 - Department of Sustainable Agriculture, University of Patras, Patras, Greece

3 - Department of Zoology and Marine Biology, Faculty of Biology, National and Kapodistrian, University of Athens, Athens, Greece

4 - Section of Animal Biology, Department of Biology, University of Patras, Patras, Greece

5 - Natural History Museum of Crete, School of Sciences and Engineering, University of Crete, Irakleio, Greece

6 - Laboratory of Marine and Terrestrial Animal Diversity, Department of Zoology, School of Biology, Aristotle University of Thessaloniki, Thessaloniki, Greece

7 - International Center for Biodiversity and Primate Conservation, Dali University, 671003 Dali, Yunnan, China

Corresponding author: Yiannis G. Zevgolis (zevgolis@env.aegean.gr)

Abstract

Conservation frameworks implicitly assume that protected areas spatially coincide with the core of species distributions. This assumption is rarely tested using high-resolution occurrence data, particularly for insular, range-edge populations. Here, we quantify the spatial congruence between formal protection and realised habitat use in a peripheral population of the Persian squirrel (*Sciurus anomalus*), a species classified as ‘Vulnerable’ in Greece, on Lesvos Island. Using multi-year field surveys, we delineated core-use areas through kernel density estimation and spatial statistics and explicitly compared these with the spatial extent of Natura 2000 sites. Contrary to expectations, core distributional nodes are largely decoupled from the existing protection network, with only a minor fraction of occurrences falling within designated areas. High-density clusters are instead embedded within traditional olive-grove mosaics, a land-use type that is systematically underrepresented in conservation zoning. This spatial decoupling indicates that current protection schemes fail to capture the population's functional habitat space. Rather than reflecting ecological requirements, conservation boundaries appear aligned with coarse habitat classifications that overlook structurally suitable, but anthropogenically maintained, environments. We argue that this mismatch is not incidental but symptomatic of a broader limitation in conservation planning: the reliance on static habitat typologies as proxies for ecological function. These results demonstrate the necessity of integrating species-specific spatial data into conservation design and highlight the role of traditional agroecosystems as unrecognised yet critical components of effective biodiversity conservation in the Anthropocene.

Keywords

Sciurus anomalus, range-edge populations, Natura 2000 sites

Behavioural assessment and foraging decision-making of Persian squirrels across acorn quality gradients in Mediterranean agroecosystems

Yiannis G. Zevgolis¹

1 - Biodiversity Conservation Laboratory, Department of Environment, University of the Aegean, Greece

Corresponding author: Yiannis G. Zevgolis (zevgolis@env.aegean.gr)

Abstract

Pre-consumption assessment of food resources constitutes a fundamental component of foraging theory, particularly in scatter-hoarding rodents, where inaccurate resource selection may impose substantial energetic costs. Within this framework, behavioural discrimination among resources differing in quality may represent a critical mechanism underlying energetic optimisation and adaptive foraging decisions. Despite the ecological importance of the Persian squirrel (*Sciurus anomalus*), especially in insular populations occurring at the westernmost edge of the species' distribution, the behavioural processes governing resource evaluation remain poorly understood. This study investigated fine-scale ethological responses of Persian squirrels to experimentally differentiated acorn quality gradients within traditional Mediterranean agroecosystems on Lesbos. Camera traps were deployed across five olive-dominated agroecosystem mosaics associated with *Quercus coccifera* formations. Experimental feeding stations included intact acorns, structurally hollow acorns, and partially decomposed acorns representing contrasting resource conditions. Video sequences were analysed to construct a behavioural ethogram describing sequential responses associated with resource assessment and consumption decisions, including inspection intensity, manipulation sequences, handling duration, rejection probability, and vigilance behaviour during resource handling. Preliminary observations revealed marked behavioural divergence among acorn categories, although responses did not follow a strictly linear quality gradient. Intact acorns were rapidly accepted, whereas hollow acorns were frequently rejected shortly after inspection. In contrast, partially degraded acorns elicited prolonged manipulative and inspection behaviours, suggesting intensified assessment effort under conditions of ambiguous resource profitability. These findings indicate that Persian squirrels may allocate assessment effort according to uncertainty rather than resource quality alone, revealing complex pre-ingestive decision-making processes that potentially optimise energetic efficiency under heterogeneous environmental conditions.

Keywords

Sciurus anomalus, Persian squirrel, pre-ingestive assessment, behavioural ecology

Behavioural negotiation at the threshold of capture: pre-entrapment decision dynamics in the broad-toothed field mouse in a Mediterranean forest ecosystem

Yiannis G. Zevgolis¹, Fragkiskos Darmis²

1 - Conservation Laboratory, Department of Environment, University of the Aegean, 81132 Mytilene, Greece

2 - Research group Behavioural Ecology of Individual Differences, Max Planck Institute for Evolutionary Biology, Germany

Corresponding author: Fragkiskos Darmis (darmis@evolbio.mpg.de)

Abstract

Live trapping remains one of the most widely employed techniques in small mammal ecology, yet the behavioural processes preceding trap entry remain largely unexplored. Here, we investigated the pre-entrapment behavioural dynamics of the broad-toothed field mouse, *Apodemus mystacinus*, within a Mediterranean forest ecosystem on the island of Lesbos through the integration of live traps and infrared video surveillance. Sherman traps baited with peanut butter and peanuts functioned simultaneously as concentrated food sources, novel structural objects, and potential risk stimuli, enabling the examination of behavioural decision-making immediately preceding capture events. Infrared video recordings revealed that trap entry was rarely immediate and instead emerged through sequential behavioural negotiation processes characterised by investigatory and hesitation behaviours. Individuals frequently exhibited prolonged latency to entry, repeated approach–withdrawal sequences, olfactory inspection of trap surfaces and entrances, stationary vigilance postures near trap apertures, and partial body insertions without full commitment to entry. Several individuals repeatedly investigated bait-associated cues surrounding the trap while avoiding entrapment entirely, whereas others entered rapidly following minimal inspection, indicating substantial variability in trap acceptance dynamics and apparent risk appraisal thresholds. Importantly, trap-directed behaviour was not exclusively solitary. Multiple recording events documented the simultaneous presence of two or three conspecifics around single trap stations, creating transient social contexts in which investigatory behaviour, spatial positioning, hesitation, and entry decisions unfolded under immediate conspecific influence. In several cases, behavioural responses appeared temporally associated with the movements and proximity of nearby individuals, suggesting that trap acceptance may be partially shaped by socially mediated exploratory dynamics in addition to individual risk assessment. Our findings suggest that live traps should not be regarded solely as passive sampling devices, but rather as behaviourally active stimuli capable of generating complex pre-entrapment decision sequences. Integrating camera-trap video with live trapping can therefore provide valuable ethological insight into trap wariness, decision latency, and socially mediated responses in nocturnal rodents, improving both the interpretation of trapping data and the design of small mammal surveys.

Keywords

Apodemus mystacinus, live trapping, entry latency, social facilitation, neophobia

Maternal care and early behavioural development in the forest dormouse (*Dryomys nitedula*, Pallas 1779), revealed by nest-box camera monitoring

Dionisios Youlatos¹, Artemis Papafoti¹, Konstantina Tzisiou¹, Styliani Nouvaki¹, Dimitrios Garelidis¹, Christos Astaras²

1 - Aristotle University of Thessaloniki, School of Biology, Greece

2 - ELGO-Dimitra, Forest Research Institute

Presenting author: Dionisios Youlatos (dyoul@bio.auth.gr)

Corresponding author: Artemis Papafoti (apapafob@bio.auth.gr)

Abstract

The ecology of arboreal nocturnal rodents remains poorly understood due to the difficulty of observing these cryptic species. Maternal care and early development in the forest dormouse (*Dryomys nitedula*), have received limited scientific attention. This study investigates maternal care and cub development through non-invasive nest-box camera monitoring of a wild-born breeding female and her litter maintained under captive laboratory conditions. Observations were obtained from 3,690 video recordings of 20 s duration each, representing approximately 20.5 h of footage. To systematically quantify activity patterns, a detailed ethogram was developed for both maternal and juvenile individuals. Ethogram categories included locomotion, resting, maternal interaction, self-care, interaction with the nest box, nest-related activities, feeding, and exploration movements, which were further subdivided into more specific actions for detailed analysis. Videos were analysed using instantaneous scan sampling at 0, 10, and 20 s intervals to quantify activity occurrence and temporal variation, resulting in approximately 42,000 observations. Due to developmental changes in visibility and mobility, coding followed a two-stage approach. During early developmental stages, cubs were recorded at the litter level when individual identification was not possible. Once cubs became visually distinguishable, observations were recorded separately for each of the three offspring, enabling individual-level comparisons of developmental trajectories and mother–offspring interactions. Preliminary analyses focus on quantifying maternal investment through nursing, grooming, nest maintenance, and protective actions, while simultaneously assessing developmental shifts in cub activity, social association, and independence. This work provides novel insights into the ecology of *D. nitedula* during a rarely observed life stage and highlights the value of camera-based nest monitoring for studying parental care and early ontogenetic development in elusive small mammal species.

Keywords

ethology, behavioural ontogeny, behavioural development, Gliridae, camera trapping

Daily activity patterns of predators and their prey: a comparison between two model areas

Atidzhe Ahmed¹, Sirma Zidarova¹, Milena Gospodinova¹, Eli Mincheva², Venislava Spasova², Lyubomir Andreev²

1 - Institute of Biodiversity and Ecosystem Research, Bulgarian Academy of Sciences, 1 Tsar Osvoboditel Blvd., 1000 Sofia, Bulgaria

2 - Faculty of Biology, Sofia University St. Kliment Ohridski, 8 Dragan Tsankov Blvd., 1164 Sofia, Bulgaria

Corresponding author: Atidzhe Ahmed (atidje_dj@abv.bg)

Abstract

Wood mice are among the small mammals that serve as major food sources for many predator species. Their dominance in many small mammal communities determines the important role they play in ecosystems. Nevertheless, research on the diel activity of the wood mouse in situ, as well as on the predator-prey relationship and human impact on it, is almost lacking in Bulgaria. This study aims to investigate the diel activity of *Apodemus sylvaticus/flavicollis* in situ and the degree of overlap of its temporal niche with those of three species of widespread predatory mammals – golden jackal (*Canis aureus*), red fox (*Vulpes vulpes*) and beech marten (*Martes foina*). Data were collected using camera traps in two areas with different degrees of anthropogenic disturbance across all seasons. The activity of the wood mouse was predominantly nocturnal and showed no significant difference between the two study areas and between the warmer and the colder periods of the year. On the contrary, an increase in activity during daylight hours in the warmer part of the year was observed in the three predators in the area with less anthropogenic disturbance. This shift is most pronounced in the jackal and least pronounced in the beech marten. The overlap of predator/prey temporal niches is strongest with the beech marten and weakest with the jackal. Our data indicate that the wood mouse exhibits circadian activity that is not influenced by external factors such as temperature, daylight hours, and human presence. The results suggest that human presence has an impact on predator activity. The extent of this impact depends on the species' specific degree of human persecution and its capability to avoid this threat.

Keywords

wood mouse, golden jackal, red fox, beech marten, temporal activity, Bulgaria

Shelter-boxes combined with footprint traps and camera trapping: an innovative methodology for monitoring the least weasel (*Mustela nivalis*) in agricultural landscapes

Paula González Simón¹, Miriam Báscones-Reina¹, Lorena Hernández-Garavís¹, Fernando Blanca-Chana¹, José Fernando Garcés-Toledano¹, Carlos Cuéllar¹, Beatriz Rodríguez-Moreno¹

1 - Grupo de Rehabilitación de la Fauna Autóctona y su Hábitat (GREFA), Monte del Pilar S/N, 28220, Majadahonda, Madrid, Spain

Corresponding author: González-Simón (paulagonzalez@grefa.org)

Abstract

The least weasel (*Mustela nivalis*) is a specialist predator of small mammals whose low detectability has historically hindered its study and monitoring, despite recent evidence suggesting a possible decline in Spain and its relevance for biological control in agricultural ecosystems.

To improve its monitoring, a methodology based on shelter-boxes combined with footprint traps and camera trapping was developed. Footprint traps were installed inside the shelter-boxes to detect shelter use and in double-entry footprint tunnels placed outside to record the presence of individuals in the surrounding area, while camera trapping was used to document behaviours associated with shelter use.

The study was conducted between 2023 and 2025 in three agricultural areas with different landscape structures, coinciding with the common vole (*Microtus arvalis*) outbreak recorded in 2024. The methodology enabled the detection of weasel presence, the recording of behavioural patterns such as scat marking, scent marking and prey caching, the identification of temporal changes in shelter use associated with variations in prey availability, and the detection of a female with offspring using a shelter-box.

The results highlight the potential of this combination of techniques as a non-invasive tool for monitoring a species that is difficult to detect and suggest its application in least weasel conservation programmes and biological control strategies in agricultural ecosystems.

Keywords

Mustela nivalis, shelter-boxes, footprint traps, camera trapping, *Microtus arvalis*, biological control

Conservation implications of the distribution and ecological niche models for the European ground squirrel (*Spermophilus citellus*) in Bulgaria

Yordan Koshev¹, Maria Kachmakova¹, Natália Martínková², Jordan Tzvetkov³

1 - Institute of Biodiversity and Ecosystem Research at the Bulgarian Academy of Sciences (IBER-BAS), Bulgaria

2 - Institute of Vertebrate Biology, Czech Academy of Sciences, Květná 8, Brno 60300, Czech Republic

3 - Space Research and Technology Institute, Bulgarian Academy of Sciences, Acad. Georgy Bonchev str. bl. 1, Sofia 1113, Bulgaria

Corresponding author: Yordan Koshev (bgsouslik@gmail.com)

Abstract

The European ground squirrel (*Spermophilus citellus*) is classified as “Endangered” on the IUCN Red List and is a protected species under the EU Habitats Directive. In Bulgaria, the species is listed as “Vulnerable” in the Red Data Book of Bulgaria, but it is not protected under the National Biodiversity Act. Only its habitats within the Natura 2000 network receive legal protection.

All studies to date indicate a sharp population decline and extensive habitat loss of the species in Bulgaria. Habitat destruction is occurring along several pathways. Preventive conservation of the species is carried out through Appropriate Assessments evaluating the compatibility of plans and projects with the conservation objectives of Natura 2000 sites. A key element in these assessments is the estimation of the area of habitats suitable for the ground squirrel. Until now, these assessments relied on CORINE and other land-cover layers.

The need to develop a high-resolution species distribution and ecological niche model for the European ground squirrel was urgent. Based on 3,328 presence records and using climate, geology, soil, topography, and land-cover variables to characterise the environment, the model revealed that only a very small proportion - around 5-6% of the optimal and suboptimal habitats fall within nationally protected areas. Coverage is higher within the Natura 2000 network, with the highest proportion of optimal habitats in the Alpine biogeographical region (80.7%). The lowest number of suitable habitats protected in the Natura 2000 network is in the Continental region (28.8%), which is also the most extensive region and the most threatened by habitat destruction. Since 2007, pastures and meadows have been ploughed to receive agricultural subsidies; now, habitats are being destroyed to build photovoltaic parks. At the same time, the continental region holds the core population of the species in Bulgaria. As a result of the conflict between immediate human interests and long-term biodiversity conservation, the main Bulgarian population of the European ground squirrel is exposed to substantial risk.

Keywords

European souslik, Natura 2000, habitat destruction, land-use change

First in the world release of Romanian hamsters (*Mesocricetus newtoni*)

Yordan Koshev¹, Maria Kachamakova¹

1 - Institute of Biodiversity and Ecosystem Research at the Bulgarian Academy of Sciences (IBER-BAS), Bulgaria

Corresponding author: Yordan Koshev (bgsouslik@gmail.com)

Abstract

Within the LIFE20 NAT/BG/001162 project, Romanian hamsters were bred for conservation purposes for the first time by a team from the Institute of Biodiversity and Ecosystem Research at the Bulgarian Academy of Sciences (IBER-BAS).

The release site is maintained by Agrotime Ltd., Isperih. The company manages the area using no-till agriculture, resulting in a diverse understory of broadleaf grasses and insects beneath the sunflower crops. Using a motor auger with a 6-cm drill bit, artificial burrows were made at a 45-degree angle. Mesh cylinders were placed over the burrow entrances, providing a single access point. Inside, food was supplied: a seed mixture of maize, sunflower, and wheat. Fresh vegetables - cucumbers, peppers, and carrots - were also provided.

On 09 June 2025, the twelve captive-bred hamsters were released in the Natura 2000 site BG0002062 – Ludogorie (SPA), near the village of Sveshtari, Isperih Municipality, Razgrad District, Bulgaria. Six males and six females were released, with a body weight ranging from 78 to 121 grams. After two days, the mesh cylinders were opened so that the hamsters could freely enter and exit the enclosures.

Camera traps were installed near some of the enclosures. The recordings showed the presence of wild boar and foxes, but these wild animals did not show interest in the hamsters.

Monitoring was conducted twice, searching for characteristic hamster burrows to place live traps. No burrows were found. Based on our experience, even with wild hamsters, we rarely obtain recaptures. We suppose that the hamsters likely make larger movements across the terrain.

Keywords

conservation, reintroduction, Dobrudzha hamster, Bulgaria

Establishment of a new European ground squirrel colony under predation pressure – the Božice case

Lukáš Poledník¹, Jindřich Poledník¹, Ondřej Poledník¹, Kateřina Poledníková¹

1 - ALKA Wildlife o.p.s., Lidéřovice 62, 380 01 Peč, Czech Republic

Corresponding author: Lukáš Poledník (lukas.polednik@alkawildlife.eu)

Abstract

The European ground squirrel (EGS) (*Spermophilus citellus*) is a critically endangered species in the Czech Republic. Today, only about 40 isolated colonies remain. Therefore, various conservation measures, including the establishment of new colonies, are being implemented to support the species' long-term survival.

A new EGS colony was established in South Moravia, near the villages of Božice and Borotice. The release site was selected within the area of a former grass-covered airport. Currently, the site consists of permanent grassland maintained through regular mowing by both municipalities. Due to the dry climate and the absence of fertilisation, the vegetation has a steppe-like character. Several predators have been recorded in the area, including multiple raptor species (e.g. *Aquila heliaca*) as well as the steppe polecat (*Mustela eversmanii*).

The first 147 ground squirrels were translocated in 2023 from Slovakia, where the animals had been rescued from an area designated for new construction near Bratislava Airport. In 2024, an additional 18 individuals from the rescue breeding station at Brno Zoo and 14 individuals from a nearby wild colony at Miroslav were released at the site.

Based on previous experience, the animals were released using the soft-release method into pre-prepared mesh enclosures. Artificial burrows were drilled both inside and around the enclosures. The ground squirrels were provided with sunflower seeds, apples, and a water source.

Annual burrow mapping has shown continuous population growth since the establishment of the colony, and reproduction was confirmed as early as the second year. The health status, physical condition, and genetic variability of randomly captured individuals indicate that the population is well established and viable. The colony is thriving and showing a positive trend in both population size and area of occurrence. This development has occurred despite the presence of several important EGS predators and ongoing predation pressure. These findings suggest that habitat quality may be the key factor influencing the successful establishment of new colonies.

Keywords

European ground squirrel, reintroduction, predation

Does the vegetation of release sites provide a suitable food base for captive-bred European hamsters?

Urszula Eichert¹, Patrycja Jerzyńska¹, Urszula Sajda²

1 - Forest Biology Center, Adam Mickiewicz University, Poland

2 - Small Mammal Section, Poznań Zoo, Poland

Corresponding author: Urszula Eichert (urszula.eichert@gmail.com)

Abstract

The success of captive breeding programmes depends largely on how well animals born in captivity adapt to natural conditions after release. Diet — particularly the availability of herbaceous plant species encountered in the wild — has not been considered so far.

At the Poznań Zoo breeding center, herbaceous plants have been a permanent component of the European hamster diet since 2018. In the wild, approximately 58% of the diet consists of herbaceous vegetation (Tissier *et al.* 2018). In captivity, hamsters receive plants considered safe for rodents, such as dandelion (*Taraxacum officinale*), red clover (*Trifolium pratense*), white clover (*Trifolium repens*), broadleaf plantain (*Plantago major*), ribwort plantain (*Plantago lanceolata*), alfalfa (*Medicago sativa*), common chickweed (*Stellaria media*), shepherd's purse (*Capsella bursa-pastoris*), yarrow (*Achillea millefolium*), and common knotgrass (*Polygonum aviculare*).

Crops and soil type have been treated as key criteria when selecting release sites, while plant communities have largely been overlooked. Therefore, in spring 2026, we investigated plant communities at two planned release sites to determine whether hamsters would encounter familiar food plants and whether the sites could provide a safe food base.

Site 1 was located in a barley field, whereas Site 2 was situated in an alfalfa field with a well-developed herbaceous layer. At Site 1, dominant species included white campion (*Silene latifolia*), common lamb's quarters (*Chenopodium album*), and corn poppy (*Papaver rhoeas*). None of the plants regularly provided in captivity were recorded there. Although poppy and lamb's quarters are reported as food plants of wild hamsters (Tissier *et al.* 2018), they are excluded from the captive diet due to potentially harmful compounds.

Site 2 was dominated by *Medicago sativa* and *Holcus lanatus*. Seven of the ten plant species routinely fed at the zoo were present: alfalfa, yarrow, ribwort plantain, white clover, dandelion, red clover, and broadleaf plantain.

In summary, one site was rich in plants familiar to captive-bred hamsters, whereas the other was dominated by unfamiliar species, including plants containing compounds not recommended in rodent diets. When selecting release areas in spring and early summer, before cereal ears become available, herbaceous vegetation should be assessed, as food availability may influence post-release survival.

Keywords

plant communities, restitution, European hamster

LIFE Cricetus: Catalysing the conservation of the Critically Endangered common hamster through an innovative species and agricultural management approach

Ferre Smekens¹, Hans Cornelissen¹, Sarah Descamps¹

1 - PXL Bio Research, Belgium

Corresponding author: Hans Cornelissen (hans.cornelissen@pxl.be)

Abstract

LIFE Cricetus is a demonstrative project that aims to reach a more favourable conservation status for the European hamster (*Cricetus cricetus*) in the project area through an integrated management approach in which farmers, scientists and policymakers closely cooperate and implement innovations in management. Following the EU Biodiversity Strategy 2030, this project will make an important contribution to improving the conservation status of a species that depends on and is affected by agriculture. Therefore, the project wants to demonstrate that it is possible to bridge productive farming and rural biodiversity through innovation while having an impact on policy. In this project, the region of the BNN genetic lineage of the European Common hamster is used to demonstrate this integrated approach. The BNN-region comprises the South of Limburg (Belgium), Limburg (The Netherlands) and the state of North Rhine-Westphalia (Germany).

LIFE Cricetus builds upon the following objectives:

1. Prevent the extinction of *Cricetus cricetus* in the project area of Belgium, The Netherlands and Germany/North Rhine-Westphalia;
2. Ensure long-term survival and fitness of the European hamster;
3. Establishment of experimental and demonstration farms where the feasibility and effectiveness of new agricultural management measures for the European hamster will be tested and deployed;
4. Establishment of agricultural hamster cooperatives that support the protection of the hamster as well as other farmland biodiversity;
5. Increase the area of land managed with hamster & wildlife-friendly measures in intensive farmland;
6. Provide recommendations for the CAP and implement new measures for the European hamster;
7. Raise awareness and enhance support for the hamster and biodiversity-friendly agricultural management;
8. Dissemination of the findings, actions, and management structure to other areas where other European genetic lineages of the European hamster are present and declining.

Keywords

European hamster, sustainable agriculture, farmland biodiversity

Rodents as food resources for threatened mustelid species in Bulgaria

Sirma A. Zidarova¹, Romyana D. Kostova², Albena Y. Vlasheva¹

1 - Institute of Biodiversity and Ecosystem Research, Bulgarian Academy of Sciences, 2 Gagarin Street, 1113 Sofia, Bulgaria

2 - Department of Zoology and Anthropology, Faculty of Biology, Sofia University "St. Kliment Ohridski", 8 Dragan Tsankov Blvd., 1164 Sofia, Bulgaria

Corresponding author: Sirma Zidarova (s.zidarova@gmail.com)

Abstract

The abundance of rodents is a key factor that determines the distribution, density, and successful reproduction of predators. Open habitats in Bulgaria provide food resources for two rare mustelid species, the vulnerable marbled polecat (*Vormela peregusna*) and the endangered steppe polecat (*Mustela eversmanii*). Dynamic changes in these habitats, as a result of human activity and climate change, could lead to the disruption of food chains. This study aims to assess the current status of the main prey of these predators by abundance estimates of rodents typical of grassland habitats in Bulgaria: European ground squirrel (optimal prey), lesser blind mole-rat, and mouselike rodents. A total of 159 sampling sites in 9 regions were investigated by a simple and inexpensive transect method. The analyses conducted reveal differences between regions. The share of sites characterised by a high abundance of the European ground squirrel is highest in the hilly areas and low mountains of Central Bulgaria, as well as in the Rhodopes and the Danube plain. Considered optimal prey of the open habitat mustelids, this rodent is extinct or in critically low numbers in a significant portion of the studied sites. The degradation and the abandonment of pastures, as well as local climate events, are supposed to be the most likely reasons for the observed negative trend. The lesser blind mole-rat and the mouselike rodents are most abundant in Dobrudzha and West Central Bulgaria – regions where the marbled polecat is most common. According to our data, the southwestern part of the country is characterised by the poorest food resources. The methodology of the field survey is applicable for national and regional monitoring of the quality of the habitats of the marbled and steppe polecats. The assessment of food resources provides a good basis for taking timely conservation measures to ensure mustelids' long-term survival.

Keywords: Mustelidae, prey, *Spermophilus citellus*, *Nannospalax leucodon*, *Microtus*, *Mus*

Coccidia (*Eimeria spp.*) infections and body condition of European ground squirrels - preliminary data

Franz Suchentrunk¹, Jonas Kahlen¹

1 - Research Institute of Wildlife Ecology, University of Veterinary Medicine Vienna, Austria

Corresponding author: Franz Suchentrunk franz.suchentrunk@vetmeduni.ac.at

Abstract

We tested whether intestinal coccidia, *Eimeria spp.*, influenced the body condition of European ground squirrels, whose hibernation and population development likely depend heavily on fat reserves. We quantified parasite abundance by a modified McMaster approach using 63 road-killed individuals from a large population in eastern Austria and assessed body condition via their retroperitoneal fat index (RFI), validated against total body fat determined by Soxhlet fat extraction. Our statistical modelling showed that *Eimeria* abundance had no meaningful negative effect on body condition, while sex, age, and seasonal timing were the primary determinants of fat accretion. Females exhibited low body condition early in the active season due to reproduction but surpassed males before hibernation, and juveniles consistently showed lower fat reserves. Our findings suggest that the currently detected level of *Eimeria* infections does not impair body condition before hibernation, though an improved sample size should evaluate our limited conclusions because of the relatively high model uncertainty.

Keywords

European ground squirrel, coccidia, *Eimeria*, body condition, fat deposit

Intestinal helminth infections of European ground squirrels in an agricultural landscape of eastern Austria: does exposure duration affect abundance?

Franz Suchentrunk¹, Linda Kotlowski¹, Annika Posautz¹, Felix Knauer¹, Verena Strauss¹, Sarah Kugler¹, Anna Kübber-Heiss¹, Helmut Sattmann²

1 - Research Institute of Wildlife Ecology, University of Veterinary Medicine Vienna, Austria

2 - 3rd Zoological Department, The Natural History Museum Vienna, Austria

Corresponding author: Franz Suchentrunk (franz.suchentrunk@vetmeduni.ac.at)

Abstract

Parasitic infestations may reduce the biological performance of individuals and eventually their chance of survival. We studied intestinal macroparasites in a large, continuous population in northeastern Austria, with a particular focus on differences between juvenile and adult individuals. Specifically, we tested two principally contradictory hypotheses: 1) the Immunocompetence hypothesis, i.e., higher infestation level in juveniles due to not fully developed immunocompetence, and 2) the Exposure duration hypothesis, i.e., lower infestation level in juveniles due to a shorter period of exposure to infectious stages. We examined 133 gastrointestinal tracts using standardised washing techniques, followed by microscopic quantification and morphological identification of helminths. Our statistical analyses included multi-level modelling approaches (mixed-effects models, GAMs, and multimodel inference) incorporating month, age class, sex, and year as predictors. We detected four helminth taxa: three nematodes (*Trichostrongylus sp.*, *Aonchotheca sp.*, *Ascaris cf. laevis*) and one cestode (*Hymenolepis sp.*). Overall helminth prevalence was 55.6%. Juveniles generally exhibited lower helminth abundances in early summer, particularly for *Trichostrongylus sp.*, supporting the hypothesis that shorter exposure times rather than immunological immaturity drive age-related differences. Strong seasonal patterns and significant interactions between month and sex were observed, including increasing parasite loads in juvenile males toward late summer and decreasing loads in adult females over the same period. In adults, helminth abundances — especially *Trichostrongylus sp.* — declined across the study years, suggesting potential density-dependent or environmental influences. *Aonchotheca sp.* showed a clear age effect, with markedly lower abundances in juveniles, while cestode prevalence varied mainly with month and year. Our findings highlight complex host–parasite dynamics shaped by age, season, sex, and temporal trends.

Keywords

European ground squirrel, intestinal helminths, infestations, immunocompetence hypothesis, exposure duration hypothesis, multimodel inference

When rodent management becomes conservation: Lessons from a nest box programme in agricultural landscapes

Lorena Hernández Garavís¹, Miriam Báscones-Reina¹, Paula González-Simón¹, Fernando Blanca-Chana¹; Beatriz Rodríguez-Moreno¹, José Fernando Garcés-Toledano¹

1 - Grupo de Rehabilitación de la Fauna Autóctona y su Hábitat (GREFA), Spain

Corresponding author: Lorena Hernández Garavís (garavis@grefa.org)

Abstract

Population outbreaks of small rodents represent one of the main challenges for the sustainability of many European farming systems. To promote the presence of natural predators as a complementary tool for managing these species, an extensive nest-box network has been established across cereal-growing landscapes in north-western Spain since the late 2000s.

Assessing the population-level effects of such interventions remains a major scientific challenge. Demonstrating a direct effect of predators on rodent population dynamics, as well as quantifying the contribution of nest boxes to raptor population trends, requires long-term approaches and complex monitoring systems due to the high spatial and temporal variability that characterises agricultural ecosystems.

Nevertheless, the long-term monitoring of this infrastructure has revealed an additional outcome of considerable conservation interest. The network, currently comprising approximately 2,000 nest boxes, has been consistently occupied by several raptor species associated with farmland habitats, providing breeding opportunities in landscapes where suitable nesting sites are often limited.

After nearly two decades of operation, this infrastructure has evolved from a tool originally designed to help manage agricultural conflicts into a large-scale biodiversity conservation resource. This contribution presents the development of the programme, the main beneficiary species, and the lessons learned from its implementation, highlighting how a measure initially aimed at managing small mammal populations can generate significant conservation benefits for predators in European agroecosystems.

Keywords

small mammals, biological control, farmland biodiversity, nature-based solutions, conservation management

Detecting a rare mammal in a changing landscape: camera-trap monitoring of the garden dormouse (*Eliomys quercinus*) in the Upper Harz Mountains

Julia-Marie Battermann¹, Jakob Malte Ahrenberg², Jan-Eric Strauch², Andreas Kinser¹, Klaus Hackländer^{1,3}

1 - Deutsche Wildtier Stiftung (German Wildlife Foundation), Lucy-Borchardt-Str. 2, 20457 Hamburg, Germany

2 - University of Göttingen, Department of Conservation, Wilhelmsplatz 1, 37073 Göttingen, Germany

3 - BOKU University, Institute of Wildlife Biology and Game Management, Gregor-Mendel Str. 33, 1180 Vienna, Austria

Corresponding author: Julia-Marie Battermann (j.battermann@deutschewildtierstiftung.de)

Abstract

The garden dormouse (*Eliomys quercinus*) is listed as critically endangered on the German Red List of mammals, having lost over 50% of its former range within the past 30 years. In Germany, the Harz Mountains in the federal state of Saxony-Anhalt represent the species' northern distribution limit, but no large-scale systematic survey has yet assessed its current distribution there. We aimed to assess the occurrence of garden dormice in the Upper Harz Mountains. Since 2023, the German Wildlife Foundation has implemented a monitoring programme for the garden dormouse in Saxony-Anhalt, following its designation as Germany's Animal of the Year. The present study reports exclusively data from the 2025 field season, as results from previous years have already been published.

The study area covered circa 260 km² and is characterised by extensive deforestation of former coniferous forests. Storm events, extreme drought, and bark beetle infestation have caused large-scale dieback of spruce stands in recent years. The landscape is now dominated by early successional habitats with scattered forest remnants. Rocky structures such as cliffs and boulder fields occur locally. We used baited camera trapping to detect the species. Cameras were deployed at 89 sites, baited with pumpkin seed oil applied to cloth lures, and checked every 7–16 days. Sites were selected based on known habitat requirements and relocated after detections or repeated absences. In addition, we collected sighting reports through public outreach.

Garden dormice were recorded at 24 camera sites, with two additional records (one live sighting and one dead individual), resulting in 26 confirmed occurrences in 2025. Sites were, on average, 1.2 km apart. Individuals were detected on 101 camera nights, with a maximum of 12 nights per site. Activity peaked in July and declined sharply after August; no records were obtained in October. The highest relative detection density occurred in May. Occupied sites showed high structural diversity, including ecotones between remnant conifer stands and successional habitats. Key features included deadwood, shrub layers, open ground and refuge structures. More than half of the sites also contained vertical elements such as scree slopes, cliffs, or boulder fields with crevices. Important food plants included bramble, raspberry, blueberry, hawthorn, elderberry, and rowan.

Based on these findings, habitat enhancement measures were implemented, including species-rich forest edge plantings to improve food availability and habitat connectivity. Ongoing habitat loss may increase the isolation of local populations. Due to limited data, a precise spatial delineation and population assessment are currently not possible.

Keywords

garden dormouse, *Eliomys quercinus*, small mammal, monitoring, camera trap

Pre-baiting enhances trappability and reduces trap-shyness in live-trapping of European ground squirrels (*Spermophilus citellus*)

Katalin Amri^{1,2,3}, Julianna Szulamit Szapu⁴, Dávid Czabán⁵, Ida Altbacker⁶, Vilmos Altbacker²

1 - Hungarian University of Agriculture and Life Sciences, Doctoral School of Agricultural and Food Sciences, Animal Science Program, Wildlife Biology Subprogram, Gödöllő, Hungary

2 - Hungarian University of Agriculture and Life Sciences, Institute for Wildlife Management and Nature Conservation, Gödöllő, Hungary

3 - Hungarian National Museum Public Collection Centre, Budapest - Hungarian Natural History Museum, Department of Zoology, Budapest, Hungary

4 - Eötvös Loránd University, Doctoral School of Biology, Budapest, Hungary

5 - Independent Researcher, Tárnok, Hungary

6 - Department of Zoology, University of Bristol, UK

Corresponding author: Katalin Amri (amri.katalin@phd.uni-mate.hu)

Abstract

Live trapping is the principal method used for monitoring and translocating the endangered European ground squirrels (*Spermophilus citellus*). We have found that colonies vary markedly in trap-shyness, particularly where prior human presence has been limited. This reduces trapping efficiency and undermines the comparability of capture data across sites. We tested whether pre-baiting — scattering bait items over a site before trapping begins — reduces initial avoidance of baited traps and increases trapping success. A field experiment was conducted in three consecutive steps on matched plots with equal ground squirrel density and trap number:

a/ trapping success was compared between pre-baited and untreated control plots;

b/ capture rates were compared between baited and empty traps within a pre-baited area, and

c/ capture preferences were compared between plots pre-baited with carrot versus apple.

We have found that a/ pre-baiting doubled the trapping success compared to untreated controls, and b/ animals were significantly more likely to enter traps baited with the pre-familiarised food than empty ones. When offered a choice in c/ between carrot- and apple-baited traps, ground squirrels consistently favoured the trap baited with the food type used during the pre-baiting session, with either bait type proving equally effective. Thus, pre-baiting substantially improves live-trapping efficiency in European ground squirrels by reducing trap-shyness and increasing the probability of trap entry, regardless of the bait type. This low-cost methodological refinement can shorten fieldwork duration, reduce animal disturbance, and improve the comparability of trapping data among populations differing in baseline shyness.

Keywords

Spermophilus citellus, pre-baiting, trap-shyness, live-trapping, trappability, conservation monitoring

Ectoparasite screening of *Mesocricetus newtoni*: An ex-situ laboratory investigation

Mihail Vasilev¹, Spas Spasov², Ivaylo Raykov³, Veselina Raykova³, Nedko Nedyalkov⁴

1 - Varna Zoo, Saltanat 5, 9000 Varna, Bulgaria

2 - United Veterinary Clinic – Varna, Bulgaria

3 - Department of Natural History, Varna Regional Museum of History — Varna, 41 Maria Luiza Blvd., 9000 Varna, Bulgaria

4 - National Museum of Natural History, Bulgarian Academy of Sciences, Tsar Osvoboditel 1 Blvd., 1000, Sofia, Bulgaria

Corresponding author: Mihail Vasilev (mihail_hr.vasilev@abv.bg)

Abstract

The Romanian hamster (*Mesocricetus newtoni*) is endemic to Europe, occurring within a small territory of the lower Danube plain in Bulgaria and Romania (Nedyalkov & Vohralík, 2026). A drastic decline in its population has been reported due to habitat loss and fragmentation (Nedyalkov & Rusin, 2024). Although widespread across the Balkans during the Middle and Late Pleistocene, its highly fragmented population is now restricted to a small area of approximately 40,000 km² (Nedyalkov & Vohralík, 2026).

Due to the species' rarity, its zoonotic and parasitological status remains almost entirely unstudied. Here, we provide the first data on ectoparasites — specifically two mite taxa (*Arachnida*) — from a captive colony recently established (autumn 2025) at the Varna Zoo. Out of ten examined individuals, two mites were identified from the skin of two hamsters (one adult and one juvenile female): *Demodex criceti* (eggs) and *Listrophorus* spp. (adult forms). All individuals were in good general condition. No skin lesions or alopecia were observed, except for limited erythematous spots around the mammary papillae of the two females. All animals were treated with topical ivermectin following a standard regimen for domestic hamsters. Six months post-treatment, all animals remain in good health, and no further mites have been detected.

Keywords

Mesocricetus newtoni, mite infestation, *Demodex criceti*, *Listrophorus*, ex-situ conservation

Updated distribution of the Balkan snow vole (*Dinaromys bogdanovi*) in Montenegro

Belma Šestović¹, Marina Radonjić², Stefan Ralević², Teodora Tanjević², Nedko Nedyalkov³

1 - Public Enterprise for National Parks of Montenegro, Trg vojvode Bećir-bega Osmanagića 16, 81000, Podgorica, Montenegro

2 - NGO Wildlife Montenegro, Vidikovac bb, 85330 Kotor, Montenegro

3 - National Museum of Natural History, Bulgarian Academy of Sciences, Tsar Osvoboditel 1 Blvd., 1000, Sofia, Bulgaria

Corresponding author: Belma Šestović (sestovicbelma@gmail.com)

Abstract

The Balkan snow vole (*Dinaromys bogdanovi*) is a paleoendemic species and the sole living representative of the ancient arvicolid *Pliomys* lineage (tribe *Pliomyini*). It occurs across the mountain ranges of the western Balkans, spanning Croatia, Bosnia and Herzegovina, Montenegro, Serbia, North Macedonia, and Albania. As a habitat specialist, it is strictly associated with rocky terrains within the karstic landscapes of the Dinaric mountain system. It has been suggested that sympatry with another rock-dwelling species, the European snow vole (*Chionomys nivalis*), could result in the competitive exclusion of the relatively K-selected Balkan snow vole. The species is currently listed as Vulnerable (VU) with a declining population trend in the latest IUCN Red List assessment (Kryštufek & Shenbrot, 2024).

Here, we present new data regarding the distribution and status of the Balkan snow vole, collected between 2017 and 2026 from various localities in Montenegro. Field surveys were conducted using live-traps (Sherman and Longworth traps) and camera traps (Bush Bandit®).

The presence of the Balkan snow vole was confirmed across 24 localities within the following mountain ranges: Volujak, Orjen, Lovćen, Durmitor, Morača, Komovi, Prokletije, and Korita. Documented records range in elevation from 820 m to 2,342 m a.s.l. (Bobotov Kuk, Mt. Durmitor), with approximately 90% of the records occurring above 1,000 m. In several of these locations, the species had not been confirmed for more than 60 years. Alongside the Balkan snow vole, we recorded *Dryomys nitedula*, *Glis glis*, *Clethrionomys glareolus* and *Apodemus flavicollis*. Furthermore, the Balkan snow vole and the European snow vole (*Chionomys nivalis*) were found to be sympatric in the Morača and Durmitor mountains.

Keywords

Dinaromys bogdanovi, distribution, Montenegro, field techniques, Bush Bandit®, trapping, camera trap

Cross-habitat transferability of segmentation models for Albanian mole-rat mound detection using UAV imagery and open-source GIS tools

János Mészáros¹, Ferdinand Bego², Csongor Gedeon^{3,4}

1 - Institute for Soil Sciences, HUN-REN Centre for Agricultural Research, Hungary

2 - Department of Biology, Faculty of Natural Sciences, University of Tirana, Albania

3 - Institute for Soil Sciences, HUN-REN Centre for Agricultural Research, Hungary

4 - Department of CitellusLIFE, Herman Ottó Institute Non-Profit Ltd., Hungary

Corresponding author: János Mészáros (meszaros.janos@atk.hun-ren.hu)

Abstract

In our study, we evaluated the transferability of a deep learning-based image segmentation model and quantified the amount of fine-tuning data required across two habitats of the lesser blind mole-rat in Albania. The first study site (Cajupi) is located in a small basin within Zagoria Nature Park. The second study site (Trebesina) is located in the Trebesina Mountain. Both habitats were surveyed using a quadcopter producing true-colour orthomosaics with a mean spatial resolution of 0.02 m/pixel.

The Cajupi site was used as the primary training area to develop an optimised model for detecting mole-rat mounds. A total of 925 mound polygons were delineated within a 100 × 100 m sample area. Using this training dataset, a deep learning model was trained to segment mole-rat mounds.

The resulting base model and its fine-tuned versions were subsequently evaluated at the Trebesina site. Both the independent test area and the area used for collecting fine-tuning data had the same extent as in Cajupi. Owing to the lower mound density in Trebesina, fewer polygons were available for fine-tuning and testing (258 and 241, respectively). The fine-tuning dataset was divided into five subsets containing increasing numbers of polygons, from 50 to 258 in increments of 50. Polygons for each subset were selected using spatially stratified sampling. Finally, the first base model was evaluated on the independent Trebesina test datasets. In addition, the base model was also fine-tuned using each of the five subsets to assess how the amount of fine-tuning data affects segmentation accuracy.

Classification performance was evaluated using recall and precision. The base model achieved the lowest performance ($R = 0.101$, $P = 0.044$), reflecting its optimisation for the Cajupi site. The performance of the fine-tuned models improved consistently with the increasing number of polygons, from $R = 0.095$, $P = 0.885$ to $R = 0.728$, $P = 0.863$. Increasing the training dataset to total of 258 polygons resulted in only a slight improvement ($R = 0.798$, $P = 0.888$). The increase in recall indicates a higher number of correctly detected mounds, while the consistently high precision suggests that only a small number of false positives were introduced.

Our results demonstrate that transferring a deep learning segmentation model between habitats is feasible, even when differences exist in mound colour.

Keywords

mole-rat, habitat mapping, image segmentation, UAV imaging, U-Net++, Albania

Diversity of gut microbiota in populations of the European ground squirrel from Vojvodina, Serbia

Miloš Vratarić¹, Ana Đorđević¹, Jelena Ćorivić², Tijana Nikolić Lugonja³, Maja Knežević³, Duško Ćirović⁴, Nada Ćosić²

1 - Department of Biochemistry, Institute for Biological Research 'Siniša Stanković', National Institute of the Republic of Serbia, University of Belgrade, 11108 Belgrade, Serbia

2 - Department of Evolutionary Biology, Institute for Biological Research 'Siniša Stanković', National Institute of the Republic of Serbia, University of Belgrade, Belgrade, Serbia

3 - BioSense-Institute for Research and Development of Information Technology in Biosystems, University of Novi Sad, Novi Sad, Serbia

4 - Faculty of Biology, University of Belgrade, Belgrade, Serbia

Corresponding author: Nada Ćosić (nada.cosic@ibiss.bg.ac.rs)

Abstract

Already depleted populations of the European ground squirrel (*Spermophilus citellus*; EGS) are under increasing pressure from rapid environmental change. Despite extensive research, important knowledge gaps remain, including the role of the gut microbiota in EGS health and physiology. This study investigated gut microbiota diversity and composition across eight populations in three regions of Vojvodina (Bačka, Banat and Srem) and assessed the effects of region and locality on bacterial community structure.

The faecal microbiota was analysed by sequencing the V3–V4 region of the 16S rRNA gene using the Illumina platform. Sequence data were processed using QIIME2, and statistical analyses were performed using R. Alpha diversity, beta diversity, taxonomic composition and differential abundance of bacterial genera were assessed using the ANCOM-BC2 method.

Alpha diversity analysis revealed significant differences in bacterial richness among geographical regions, with EGS populations from Banat exhibiting significantly lower gut microbiota richness than populations from Bačka and Srem. Within regions, the population from Titel showed the highest richness within the Bačka region. No significant differences were detected among localities in Banat, whereas the Neradin population exhibited higher richness than the Donji Petrovci population in Srem. Beta diversity analysis demonstrated a significant effect of geographical region on gut microbiota composition, which was supported by PERMANOVA across multiple distance metrics. Differential abundance analysis identified several bacterial genera with significantly different relative abundances among geographical regions and among localities within each region.

The results provide new insights into the factors influencing the gut microbiomes of wild European ground squirrel populations and establish a foundation for future studies on their ecology, adaptation, and health.

This research was funded by the Ministry of Science, Technological Development and Innovation of the Republic of Serbia, grant number 451-03-33/2026-03/ 200007.

Keywords

gut microbiota, metagenomic sequencing, European ground squirrel, Vojvodina

How to breed a hamster? 22 Years of conservation breeding at Heidelberg Zoo

Sophie Luczak¹, Marco Sander¹, Selene Weidenkopf¹, Ulrich Weinhold¹

1 - Institut für Faunistik, 69253 Heiligkreuzsteinach, Germany

Presenting author: Sophie Luczak (luczak@institut-faunistik.net)

Corresponding author: Ulrich Weinhold (weinhold@institut-faunistik.net)

Abstract

In 2004, the first conservation breeding centre for the Common hamster was established at Heidelberg Zoo in Germany. Starting with a capacity of 100 individuals until 2016, we can now house up to 250 hamsters. The housing is constantly improved to meet the demands of animal welfare. To manage the keeping of so many individuals, a modular cage system has been created to offer more space and enrichment according to the minimum standards for keeping mammals in Germany. Hamsters are kept under natural light and temperature conditions. Feeding takes place three times a week, with water offered ad lib. Hamsters are fed all kinds of vegetables, seeds and animal protein in the form of boiled eggs. Since 2004, a total of 3.900 hamsters have been bred, 2.744 of which have been released. Diseases are monitored and examined by the Veterinary Investigation Office. Especially pups at the age of 2 – 4 weeks are susceptible to bacterial or viral infections. The average litter size is 6.5 pups per litter (min. 1 – max. 12). The reproductive success rate is 50 % (min. 0,25 – max. 0,73). The breeding stock is managed with the help of the breeding software FHPro and every 3 to 4 years a genetic examination is carried out by the Senckenberg Institute for Wildlife Genetics. So far, we have managed to keep genetic diversity continuously high and inbreeding low.

Keywords

conservation breeding, genetics, litter size, reproduction rate

Surface thermal footprints of subterranean architecture: multi-scale patterns in the warrens of the European rabbit

Christina Valeta¹, George P. Mitsainas², Yiannis G. Zevgolis¹

1 - Biodiversity Conservation Laboratory, Department of Environment, University of the Aegean, Greece

2 - Section of Animal Biology, Department of Biology, University of Patras, Patras, Greece

Presenting author: Christina Valeta (xristinavaleta@gmail.com)

Corresponding author: Yiannis G. Zevgolis (zevgolis@env.aegean.gr)

Abstract

Burrow systems of fossorial and semi-fossorial mammals constitute a form of biological architecture capable of modifying physical conditions at the land surface. However, the extent to which such subsurface structures are expressed as spatially organised thermal patterns above ground remains unresolved. In the European rabbit (*Oryctolagus cuniculus*), warrens represent complex subterranean systems whose ecological role is typically inferred from visible entrances alone, despite the possibility that surface temperature may capture an additional, functionally relevant dimension of their expression. Here, we use infrared thermography to investigate rabbit warrens as multi-scale thermal systems, linking entrance-level thermal anomalies with whole-warren surface patterning. Thermal imagery was acquired from multiple independent warrens, and temperature-based descriptors were quantified for individual entrances and adjacent substrate. In parallel, the warren structure was characterised using entrance number and spatial configuration, enabling an explicit evaluation of how fine-scale thermal variation relates to system-level organisation. We show that rabbit warrens exhibit distinct and spatially structured thermal signatures at the surface. Individual entrances consistently form localised thermal anomalies relative to the surrounding substrate. However, these anomalies are not isolated features but are embedded within broader, heterogeneous thermal fields that vary among warrens. Moreover, warrens with higher entrance density and more structured spatial configuration display increasingly complex thermal patterning, indicating that surface heterogeneity reflects, at least in part, the organisation of the underlying burrow system. These results demonstrate that rabbit warrens generate non-random, multi-scale thermal mosaics at the surface, extending their ecological influence beyond the subsurface domain. Infrared thermography therefore provides a robust, non-invasive framework for quantifying the surface expression of subterranean architecture, offering new opportunities to link visible burrow features with spatially explicit microclimatic patterns and to better understand how burrowing mammals contribute to fine-scale environmental heterogeneity in terrestrial ecosystems.

Keywords

Oryctolagus cuniculus, infrared thermography, burrow systems



The Small Mammal Conservation Conference 2026 was a joint event with the 33rd Hamster Working Group meeting & the VIIIth European Ground Squirrel meeting.

The conference took place in Sofia, Bulgaria, in 2026, and was organised by The Habitat Foundation, the Institute of Biodiversity and Ecosystem Research of the Bulgarian Academy of Sciences, Mammal Research Netherlands and Mammal Conservation Europe.



The Habitat Foundation

Boomkikkerlaan 9
4105 SB Culemborg
The Netherlands16
info@thehabitatfoundation.org



Institute of Biodiversity and Ecosystem Research

2 Gagarin Street
1113 Sofia
Bulgaria
office@iber.bas.bg



Mammal Research Netherlands

Toernooiveld 1
6525 ED Nijmegen
The Netherlands



Mammal Conservation Europe

Toernooiveld 1
6525 ED Nijmegen
The Netherlands

The 2026 conference was sponsored by the European Mammal Foundation, Pensoft Publishers and the LIFE project 'Securing the recovery of the endangered Saker Falcon in Bulgaria and Southern Romania (LIFE20 NAT/BG/1162)'



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