36th Congress of International Union of Game Biologists

Quo vadis wildlife management?

The future of wildlife management in the evolving social and environmental realities

August 28–31, 2023 Warsaw, Poland

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The conference is held under the patronage
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Zdjęcia na okładce Mieczysław Hławiczka i Tomasz Różycki

Ladies and Gentlemen,

On behalf of the Organizing and Scientific Committee of the International Union of Game Biologists, I am pleased to welcome you to the 36th IUGB Congress hosted by the Warsaw University of Life Sciences, the oldest natural science university in Poland and one of the oldest offering education in agriculture, forestry and wildlife management in Central Europe. Therefore, the place of the congress is not accidental.

IUGB was founded in 1954 during the World Hunting Exhibition in Düsseldorf. Its founder was one of the most famous wildlife biologists of the time, prof. Fritz Nuβlein, for whom the most important thing was that hunting research and hunting practice should be an inseparable pair. They were an inspiration to each other and used their resources and experiences. So it happened, and for almost 70 years IUGB has been a forum for discussion and presentation of research related to wildlife management, nature conservation, agriculture, forestry and the coexistence of man and nature.

Currently, we are witnessing dynamic natural, demographic and social processes that have a significant impact on the surrounding nature and its resources. The landscape is changing dynamically before our eyes. The way societies around the world use nature are also changing. However, this does not happen without mutually exclusive situations. On the one hand, we would like to use natural resources and live comfortably surrounded by unpolluted nature. On the other hand, we do not allow ourselves to think that our existence, regardless of the trends of being "green", has a very large and usually negative impact on the natural environment. There is also an ongoing dispute as to whether pro-ecological activities are only passive protection of nature, or perhaps also activities consisting in controlling or regulating certain processes taking place in the landscape. Control conducted, among others, through conscious and sustainable management of wild animal populations. For this reason, the overarching goal of the IUGB is to continue the exchange of knowledge on the results of basic and applied research in the field of broadly protection of nature trough wise management.

Currently, wildlife management and hunting, which are an integral part of active nature protection, are in a clear crisis. Modern societies are unfavourable to hunting and uncompromisingly refer to wildlife management as a method of protecting and using renewable natural resources – wild animals. On the other hand, there are new conflict situations between wild animals and forestry, agriculture and epidemiological safety of farm animals or people. This situation requires scientists to both monitor the ongoing changes and constantly modify environmental management methods. Professionally prepared, also by game biologists, information and education campaigns addressed to societies are also necessary. The idea is to make the knowledge about sustainable management of natural resources more widely disseminated, understood and accepted.

Therefore, the title of the 36th IUGB Congress in Warsaw was formulated as the question: "Quo vadis Wildlife Management? The future of wildlife management in a changing social and environmental realities". I hope that, as in previous IUGB conferences, numerous oral and poster presentations will be, to paraphrase the words of prof. Fritz Nuβlein, "a good lesson for the young and an inspiration for the elderly" participants of our meeting in Warsaw.

Paweł Nasiadka
President of UIGB

Key speakers

Professor Marco Apollonio is full professor of Zoology at the University of Sassari from 2000 where he was director of the Department of Zoology and of the PhD School of Natural Resources for over 12 years. He was formerly assistant professor at the University of Pisa and researcher at the Italian Institute for Wildlife Management. He is presently director of the international course in Wildlife Management at the Department of Veterinary Medicine. Among his courses he taught vrtebrate zoology, ethology, conservation biology, wildlife management and wildlife management techniques. He was president of the Italian Mammalogical Society and Director of the Interuniversity Centre for Wildlife Research in Florence. He published 184 scientific papers on wildlife behavioural ecology, management, conservation, and ecological genetics of large mammals with special reference to ungulates and large carnivores. He edited 5 books on management of European ungulates, vertebrate conservation, and behavioural ecology. He participated to several European research initiatives like ENETWILD and the European Observatory of Wildlife, he worked with researchers form most European countries over the last 40 years. He was in the directive board of national parks for 15 years, participated to the CITES Italian Commission and was/is in the directive board of regional parks and protected areas.

Professor Luděk Bartoš established the Department of Ethology at the Institute of Animal Science in Prague, was its head for 30 years and still works there as a senior scientist. He has also been a full professor of ethology at the Czech University of Life Sciences in Prague, where he taught ethology, applied ethology and deer biology. In addition, he supervised nearly thirty PhD students from several local and also foreign universities. For several decades he was a member of the International Deer Biology Congress Steering Committee and was/is a member of several other scientific societies. Furthermore, he acts as an editor for two international scientific journals. According to WOS, he has published 212 papers in impacted journals and written over fifty book chapters and books. He works with captive as well as free-ranging animals. His research has

focused mainly on social, agonistic, reproductive and maternal behaviour, frequently related to physiology (e.g., antler physiology, reproduction, etc.). Among many topics, he also took part in the investigation of sika red deer hybridization. Species studied: deer (red, fallow, roe, white-tailed, pampas deer, reindeer, and pudu), horses, dogs, mice, owls, and other species.

Professor Tadeusz Kaleta, habilitated doctor, associate professor at the Warsaw University of Life Sciences. He works at the Department of Genetics and Animal Protection of the Warsaw University of Life Sciences. Prof. T. Kaleta focuses his professional activity on research work on animal behaviour, in particular wild predatory mammals and those accompanying humans. His scientific interests also include issues of human-animal relations, welfare of domestic animals and ethical aspects of animal use. The professor is the author of over one hundred and twenty scientific publications and over fifty reports at international and national conferences. He promoted four PhDs and supervised over a hundred master's and engineering theses. For many years, he has been teaching at the University of Life Sciences at the Institute of Animal Sciences, the Institute of Veterinary Medicine and the Institute of Agriculture. He is one of the founders of the Polish Ethological Society and a member of the Scientific Council of the Warsaw Zoo

Scientific Committee

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(Head of Scientific Committee) – Warsaw University of Life Sciences, Warsaw, Poland

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Warsaw University of Life Sciences, Warsaw, Poland

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Program

	Sunday 27.08.23
19:00–21:00	**Small refreshment with cold juice and small cake in Congress Hall**
	Monday 28.08.23
8:00–9:00	**Registration**
9:00–9:30	**Opening ceremony**
9:30–10:20	**Plenary lecture –** *prof. Marco Apollonio*
10:20–10:40	**Coffee break**
Theme:	**Ecology and environment**
10:40–11:00	**Phylogeography and distribution of moose (*Alces alces*) in Eurasia during the last 50 000 years –** *Magdalena Niedziałkowska, Danijela Popović, Marcin Górny, Piotr Chibowski, Krzysztof Stefaniak, Joanna Gornia, Maciej Sykut, Bogdan Ridush, Urszula Ratajczak-Skrzatek, Oleksandr Kovalchuk, Michał Ostrówka, Michał Golubiński, Paweł Mackiewicz, Małgorzata Suska-Malawska, Mateusz Baca*
11:00–11:20	**Effects of large carnivores, hunter harvest, and climate on the survival of calves in a partially migratory moose population –** *Giorgia Ausilio, Håkan Sand, Camilla Wikenros, Malin Aronsson, Cyril Milleret, Kristoffer Nordli, Petter Wabakken, Ane Eriksen, Jens Persson, Erling Maartmann, Barbara Zimmermann*
11:20–11:40	**Nocturnal activity of wild animals in response to a higher (Czech Republic) and lower (Japan) human presence during the COVID-19 pandemic 9 –** *Olejarz Astrid, Shigematsu Masafumi, Tsukada Hideharu, Podgórski Tomasz*
11:40–12:00	**Growth parameters as indicators of ecological change in a large herbivore –** *Nicolas Cybulska, Hendrik Edelhoff, Flurin Filli, Wibke Peters*
12:00–12:20	**Can wind farms impact roe deer population? –** *Daniel Klich*
12:20–12:40	**What drives wild boar density and population growth in Mediterranean environments? –** *Joana Colomer, Giovanna Massei, Deon Roos, Carme Rosell, Domingo Rodríguez-Teijeiro*

12:40–13:00 **Species on the move: connectivity modelling across unfragmented terrestrial habitats of Eastern Carpathians –** *Ancuta Fedorca, Marin Dracea, Georgeta Ionescu, Mihai Fedorca, Marin Dracea, Ovidiu Ionescu, Marin Dracea, Marius Popa, Ramon Jurj*

13:00–14:00 **Lunch**

14:00–14:20 **Adaptation of the ruminal bacterial microbiota of Bavarian chamois (*Rupicapra rupicapra*) to seasonal forage availability –** *Sarah-Alica Dahl, Jana Seifert, Amélia Camarinha-Silva, Angélica Hernández-Arriaga, Wilhelm Windisch, Andreas König*

14:20–14:40 **Aspects regarding the presence of mammals in riparian areas of Olt River basin , Romania –** *Georgeta Ionescu, Claudiu Pasca, AncutaFedorca, Alexandru Gridan, Popa Marius, Mihai Fedorca, Ramon Jurj, George Sarbu, Ovidiu Ionescu*

14:40–15:00 **Exploring wild boar rooting behaviour and wolf predation through DNA metabarcoding: unravelling ecological insights –** *Elena Bužan, Aja Bončina, Felicita Urzi, Luka Duniš, Hubert Potočnik, Ivan Kos, Boštjan Pokorny*

15:00–15:20 **Effects of human disturbance on red deer and subsequently on the natural succession from the pointed bulrush society (*Juncetum acutiflori*) to the Aurora willow srubs in Eifel National Park –** *Michael Petrak*

15:20–15:40 **Chemical screening of wild boar livers indicates contamination hotspots of per – and polyfluoroalkyl substances –** *Jana Rupp, Marc Guckert, Urs Berger, Wiebke Drost, Anneluise Mader, Karsten Nödler, Gudrun Nürenberg, Jona Schulze, Reiner Söhlmann, Thorsten Reemtsmann*

15:40–16:00 **The timing of mountain hare (*Lepus timidus*) coat colour change in Norway is determined by elevation, latitude, and local climate –** *Allan W Stokes, Tim R Hofmeester, Neri H Thorsen, John Odden, John D.C. Linnella, Simen Pedersen*

16:00–16:20 **Coffee break**

Theme: Welfare, pathology and diseases

16:20–16:40 **Impact of infectious viral diseases Covid-19 and African Swine Fever (ASF) on commercial hunting tourism in 2020–2022 in the Regional Directorate of State Forests in Poznań –** *Aubrun Brian, Andrzej Konieczny, Jarosław Kasprzyk, Tobiasz Szczesnowski*

16:40–17:00 **Investigating Pathogens in Wild Game by a Standardized Sampling Approach –** *Anneluise Mader, Denny Maaz, Rafael Mateus-Vargas, Jana Rupp, Julia Steinhoff-Wagner, Robert Pieper, Martin Richter*

17:00–17:20 **The use of hunters and Polish Hunting Association (PZŁ) structures in african swine fever (ASF) eradication program in Poland – resources, difficulties, wasted efforts and means for improvement of future taken actions** – *Maciej Perzyna, Bartosz Pawliński*

Theme: Benefits and costs of wildlife management – recreation, business, mitigation of conflicts ..... or all in one (?)

17:20–17:40 **Evaluation and patterns of damages produced by brown bear (*Ursus arctos*) population in Romania and identification of hot spots** – *Ioana Dutcă, Georgeta Ionescu, Marius Popa, Mihai Fedorca, Ramon Romulus Jurj, Ancuta Fedorca, Iulia Baciu*

17:40–18:00 **SOTKA-project to reverse the trend in declining waterfowl – costs and achievements during 2020–2022** – *Heidi Krüger, Mikko Alhainen, Kari Karhula, Veli-Matti Pekkarinen, Passila Petri, Helle Heikki, Mikko Toivola, Toni Laaksonen, Vesa Selonen, Andreas Lindén*

18:00–18:20 **The influence of the bear presence near local communities in Romania** – *Ramon Romulus Jurj, Mihai Fedorca, Constantina Jurj, Ancuta Fedorca, Georgeta Ionescu, Alexandru Gridan, Voda Flaviu, Iulia Baciu*

18:20–18:40 **The lack of mechanisms for collecting and sharing information about daring wolves and risky behaviours combined with biased event analysis may seriously increase the risk and frequency of severe conflict events** – *Maciej Perzyna, Krzysztof Klimaszewski*

Tuesday 29.08.23

8:00–9:00 **Registration**

9:00–9:40 **Plenary lecture** – *Prof. Ludek Bartos*

9:40–10:00 **Coffee break**

Theme: Biology of wildlife

10:00–10:20 **Potential of antlerogenic cells of red deer to differentiate with metalloproteinases' engagement** – *Anna Korzekwa, Anna Kononiuk, Julia Kaczmarczyk*

10:20–10:40 **Aliens vs. immigrants – Ground nesting in the landscapes of novel mammalian predators** – *Elmo Miettinen, Sari Holopainen, Heidi Krüger, Mervi Kunnasranta, Otso Huitu, Veli-Matti Väänänen*

10:40–11:00 **The influence of the environmental factor – electromagnetic field on the endometrium of European roe deer (*Capreolus capreolus*)** – *Marek Koziorowski, Natalia Gałka, Ewelina Bator, Bartłomiej Peret, Adam Orlewski, Anna Koziorowska*

11:00–11:20 **The electromagnetic field as a factor affecting the reproductive activity of the European roe deer male (*Capreolus capreolus*) –** *Anna Koziorowska, Camilla Adamska, Gabriela Betlej, Bartłomiej Peret, Adam Orlewski, Marek Koziorowski*

11:20–11:40 **Estimating the genetic diversity of Mediterranean wild boar as a tool for future management strategies –** *Andrea Rezić, Laura Iacolina, Toni Safner, Massimo Scandura, Elena Bužan, Alain Frantz, Alexandros Triantafyllidis, Nikica Šprem*

11:40–12:00 **Quick pair replacement of the monogamous golden jackal (*Canis aureus*) –** *Erika Csányi, Gyula Sándor*

12:00–12:20 **Population viability of red deer as a free-ranging population in the Obedska bara region of Vojvodina, Serbia –** *Srđan Stamenković, Đorđe P Božović, Dragan Gačić*

12:20–12:40 **To feed or not to feed – Energy untake of roe deer (*Capreolus capreolus*) in typical south German landscapes –** *Andreas König, Sarah-Alica Dahl, Martina Hudler, Wilhelm Windisch*

12:40–13:40 **Lunch**

13:40–14:00 **Wild boar biology in the northernmost edge of the distribution range –** *Kunnasranta Mervi, Miettinen Elmo, Ruha Leena, Iso-Touru Terhi, Melin Markus, Huitu Otso, Meller Anna, Väänänen Veli-Matti, Valtonen Mia, Holmala Katja*

14:00–14:20 **Age determination and setting times of Bavarian roe deer fawns (*Capreolus capreolus*) in the first days and weeks of life –** *Ferdinand Paul Stehr, Sophie Baur, Wibke Peters, Andreas König*

Theme: Monitoring the game species – knowing how many animals there is or knowing how many can be shot?

14:20–14:40 **Temperature and weather effects on faecal genotyping success in elusive mesocarnivores –** *Lukas G. Scholz, Manisha Bhardwaj, Henriette Tripke, Cornelia Ebert, Ilse Storch*

14:40–15:00 **Efficiency and disturbance effects of drone versus ground approaches to monitor moose –** *Martin Mayer, Erlend Furuhovde, Kristoffer Nordli, Giorgia Myriam Ausilio, Ane Eriksen, Alina Evans, Petter Wabakken, Barbara Zimmermann*

15:00–15:20 **How quick and effective is Popharvest for assessing the sustainability of migratory bird hunting in Europe? –** *Stanislas Sibille*

15:20–15:40 **Ungulate monitoring in German National Parks –** *Christian Fiderer, Marco Heurich*

15:40–16:00 Coffee break

16:00–16:20 **Evaluation of self-regulation by the shooting community. A case study on the voluntary restraint of woodcock *Scolopax rusticola* hunting –** *Catherine McNicol, Matt Ellis, Heather Warrender, Joah Madden*

16:20–16:40 **Results of the use of iMammalia and Agouti applications for game monitoring in Serbia –** *Dragan Gačić, Aleksandar Miletić*

16:40–17:00 **Estimation of Fallow deer (*Dama dama*) density using direct and indirect methods on the island of Rhodes, Greece –** *Bakaloudis E. Dimitrios, Kotsonas G. Evangelos, Papastergiou Konstantinia, Papaioannou Grigorios, Saxoni Stavroula, Koukouvinou Michaela, Theodoridis Nikolaos*

17:00–17:20 **Demographic trends in huntable waterbirds in the UK using hunter-collected wing samples: A focus on Eurasian wigeon (*Mareca penelope*) and Eurasian teal (*Anas crecca*) –** *Heather E. Warrender, Catherine McNicol, Matthew B. Ellis*

17:20–17:40 **National Field Techniques and Methods to develop homogenous Monitoring Plan for Mammal Species from Romania –** *Georgeta Ionescu, Iulia Baciu, Ramon Jurj, Elena Ciocirlan, Robert Egri, Ileana Ionescu, Maria Spataru*

18:40 **Gala dinner, departure from IUGB Conference hall**

Wednesday 30.08.23

8:00–9:00 **Registration**

9:00–9:40 **Plenary lecture –** *Prof. Tadeusz Kaleta*

9:40–10:00 Coffee break

Theme: Managing of wildlife populations

10:00–10:20 **Enhancements and farming adaptations to enable wild Grey Partridge to thrive on a modern arable farm –** *Doug Manzer, Phil Rose, Layne Sward, Dave Butler*

10:20–10:40 **Large scale recovery of beaver population in Poland requires adjustment of legal regulations and administrative procedures dedicated for this species management –** *Maciej Perzyna, Marcin Świątek*

10:40–11:00 **Maternal and neonatal behavioural components of roe deer bed-site selection in grassland habitats: implications for mowing activities –** *Sophie Baur, Johanna Kauffert, Mark Hewison, Sophie Reinermann, Andreas König, Annette Menzel, Wibke Peters*

11:00–11:20 **What is the future of the European bison population? –** *Daniel Klich, Wanda Olech, Kajetan Perzanowski*

11:20–11:40 **To what extent do released gamebirds contribute to fox diet in areas important to breeding waders? –** *Jodie Case, Nathan F Williams, Tom A Porteus, Mike J Short*

11:40–12:00 **Effect of wild boar (*Sus scrofa*) rooting on soil organic matter and total nitrogen contents in a protected grassland in Budapest, Hungary –** *Natalia Pitta-Osses, Csaba Centeri, Krisztián Katona*

12:00–12:20 **Studying the disturbance of coastal waterbirds within a Marine Protected Area: does human activities modify the behavior of birds? –** *Leprince Raphaël, Joyeux Emmanuel, Francesiaz Charlotte*

12:20–12:40 **Population size and demography in moose Alces alces in Poland –** *Bogusław Bobek, Leszek Drozd, Paweł Janiszewski, Paweł Nasiadka, Katarzyna Tajchman, Witold Frąckowiak, Jakub Furtek, Dorota Merta, Krzysztof Morow, Marta Wojciuch-Płoskonka, Bogdan Kasperczyk, Krzysztof Wyrobek*

12:40–13:40 **Lunch**

13:40–14:00 **Anthropogenic food resourcing of Red Foxes (*Vulpes vulpes*) and their impact on breeding wading birds in a busy National Park –** *Mike J. Short, Eleanor M. Rivers, Jodie Case, Nathan F. Williams*

14:00–14:20 **Eurasian lynx hunting bag structure and the effects of hunting on the effective population size in Finland –** *Annika Herrero, Cornelya Klütsch, Vandepitte Simon, Hagen Snorre, Katja Holmala*

14:20–14:40 **Spatio-temporal distribution pattern, population size and the aggressive behaviour of wolves towards humans in Poland –** *Bogusław Bobek, Jakub Furtek, Marta Wojciuch-Płoskonka*

Theme: Hunting and society

14:40–15:00 **Hunting practices, hunters and habitat restoration: a social issue –** *Alain Gigounoux*

15:00–15:20 **On the dog's tail: An insight into GPS telemetry –** *Nikica Šprem, Anesa Seferović, Hrvoje Kutnjak, Toni Safner*

15:20–15:40 **Kill site selection by wolf in an anthropogenic context –** *Francesca Brivio, Michele Zanni, Celeste Buelli, Silvia Piazzalunga, Marco Apollonio*

15:40–16:00 **Coffee break**

Theme:	**The role of urbanized areas for game and protected animals – benefits and threats for humans and animals**
16:00–16:20	**Behavioral adaptations of wolves and wild boars to human-dominated landscapes: different species, same story? –** *Rudy Brogi, Francesca Brivio, Michele Zanni, Stefano Grignolio, Enrico Merli, Marco Apollonio*
16:20–16:40	**Wildlife learning to cross the crowded infrastructure using existing underpasses –** *Mihai Fedorca, Lucian Toiu, Daniel Visan, Flaviu Voda*
Theme:	**Wildlife management in forestry and agricultural agrocenosis**
16:40–17:00	**Brown hare (*Lepus europaeus* Pallas) in forests: fable or truth? –** *Olgirda Belova*
17:00–17:20	**Assessment of migrating geese damage for winter wheat yield in Lithuania –** *Brazaitis Gediminas, Šimkevičius Kastytis, Kančauskaitė Dalia, Kazlauskaitė Sonata, Stankevičiūtė Jolanta, Brazaitytė Gailenė*
17:20–17:40	**Free-ranging cattle in the boreal forest: is their behavior affected by wolf presence? –** *Erik Versluijs, Barbara Zimmermann, Morten Tofastrud, Anna Hessle, Derek Scasta, Robert Serrouya, Genevieve Adamski, Petter Wabakken, Alina L. Evans*
17:40–18:00	**Contrasting management goals for a trans-boundary moose population in Scandinavia –** *Barbara Zimmermann, Karen Marie Mathisen, Paige Hellbaum, Giorgia Ausilio, Håkan Sand, Camilla Wikenros, Ane Eriksen, Kristoffer Nordli, Petter Wabakken, Malin Aronsson, Jens Persson, Jonas Sveum*
18:00–20:00	**Poster session / IUGB officers meeting**
	Thursdsay 31.08.23
8:00–9:00	**Registration**
9:00–9:40	**Closing ceremony. Invitation to 37th IUGB Congress**
10:40	**Post-conference tour. Departure from the Conference Hall**

36th Congress of International Union of Game Biologists

Abstracts

Effects of large carnivores, hunter harvest, and climate on the survival of calves in a partially migratory moose population

Giorgia Ausilio[1], Håkan Sand[2], Camilla Wikenros[2], Malin Aronsson[2], Cyril Milleret[3], Kristoffer Nordli[1], Petter Wabakken[1], Ane Eriksen[1], Jens Persson[2], Erling Maartmann[1], Barbara Zimmermann[1]

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Keywords: *Alces alces*, predation risk, *Canis lupus*, survival, ungulate, *Ursus arctos*

Survival of juvenile ungulates represents an important demographic parameter that influences population dynamics within ecosystems. In many ecological systems, the mortality of juvenile ungulates is influenced by various factors, including predation by large carnivores, human hunting activities, and climate-related variables. The relative importance of these mortality sources often exhibits spatial and temporal variation. While wolves (*Canis lupus*) are known to predate on moose (*Alces alces*) throughout all seasons, brown bears (*Ursus arctos*) primarily engage in predation during early summer, while human harvest activities primarily occur in autumn and early winter. Hence, understanding the impacts of predation, harvest, and climate on the survival of juvenile moose is crucial for adaptive population management and the determination of sustainable harvest rates. To investigate the summer and autumn-winter survival of moose calves in relation to carnivore occurrence (wolf presence and bear density), summer habitat productivity, winter severity, human harvest, and migratory strategy (migratory versus resident), we analysed data collected from 39 GPS-collared female moose in south-central Scandinavia. Cox proportional hazard models were used to examine the dataset, which included 77 observations of calf survival. Our findings revealed significant interannual variation in summer survival rates, which were negatively correlated with bear density. Specifically, areas with high bear density exhibited calf mortality rates twice as high as those in regions with low bear density. During the autumn-winter period, calf survival was lowest in the presence of wolves and deep snow, and it exhibited a negative correlation with the proportion of clearcuts and young forests within the mother's home range. Additionally, calf survival was negatively correlated with the risk

of human hunting, and calves of stationary females displayed ten times higher survival rates compared to migratory individuals. Our study provides valuable insights into the survival of moose calves coexisting with two large carnivores and humans. As wolf and bear populations continue to expand alongside declining moose populations, intensifying hunting pressure, and the potential threat of warming summers and winters, improving our understanding of the underlying mechanisms driving calf survival during both summer and winter seasons assumes increasing importance.

Estimation of Fallow deer (*Dama dama*) density using direct and indirect methods on the island of Rhodes, Greece

Dimitrios E. Bakaloudis, Evangelos G. Kotsonas, Konstantinia Papastergiou, Grigorios Papaioannou, Stavroula Saxoni, Michaela Koukouvinou, Nikolaos Theodoridis

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Keywords: Cervidae, distance sampling, Faecal Accumulation Rate, Faecal Standing Crop, population density

The Fallow deer (*Dama dama*) is the most widely distributed deer species on the planet. During the Neolithic period it was translocated to the island of Rhodes in Greece, the surviving population holds a unique ancestral genetic diversity. However, despite the plethora of studies on the island, no accurate estimation of the species population has been attempted. Thus, the aim of this study was to estimate the Fallow deer density on the island of Rhodes using direct and indirect methods to propose conservation and management measures for the species. We estimated the deer density (mean ± S.E.) into the three main habitat types (pine forest, scrubland and mixed areas, a mosaic of agricultural fields intervened with patches of natural vegetation) with Spotlight Distance Sampling (SDS), Faecal Standing Crop (FSC) and Faecal Accumulation Rate (FAR) methods. The three habitat types were surveyed with SDS, during the rut period of 2022 (September and October). Ten rectangular plots measured 2 m × 50 m were located randomly in each habitat for FSC method. Another ten plots (2 m × 50 m)

were located nearby, and all pellet groups were removed. These plots were revisited a second time during January 2023 in order to estimate FAR. The precision and accuracy of the FSC and FAR were evaluated with the index of Relative Net Precision (RNP). All methods showed that mixed habitats supported the highest Fallow deer density (SDS: 8.41 ± 3.39, FSC: 8.14, FAR: 10 ind./km^2). SDS and FAR methods showed that scrublands held lower densities (SDS: 2.56 ± 1.34, FAR: 2.64 ind./km^2) than mixed habitats, while forested areas was the habitat with lowest density (SDS: 1.21 ± 0.66, FAR: 2.04 ind./km^2). However, FSC method revealed opposite findings with forested areas (2.96 ind./km^2) held slightly higher density than scrublands (2.52 ind./km^2). The FSC was more accurate and precise (RNP = 8.37) than FAR (RNP = 4.15). According to the three methods the population of Fallow deer varies from 6,184 (SDS) to 7,146 (FAR) individuals. The SDS and FSC showed similar results in mixed and scrubland habitats, while the FAR seemed to overestimate the deer density. Our results highlight the importance of using and evaluating the accuracy of a combination of population estimation methods in order to implement proper conservation and management measures.

Maternal and neonatal behavioural components of roe deer bed-site selection in grassland habitats: implications for mowing activities

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Keywords: agricultural management, *Capreolus capreolus*, hider species, mowing death, human-wildlife conflicts, scale-dependency

In multi-use landscapes wildlife and human habitat use often overlap in space and time. Consequently, human-wildlife conflicts may arise especially if vulnerable times, like parturition and rearing, overlap with intense human land use. For

wildlife that inhabits grasslands during spring, e.g. fawns of roe deer (*Capreolus capreolus*), a hider species, agricultural practices like mowing pose a potentially severe threat. During their first weeks of life, mowing is one of the main causes of mortality among roe deer fawns in cultural landscapes. In this study, we aim to understand the driving factors of bed-site selection of roe deer fawns and the influence of their mothers simultaneously, by addressing two different scales of bed site selection. A coarser maternal scale, which reflects the selection between different meadows and a finer fawn scale which represents the selection of the bed-site within a meadow. We used a comprehensive dataset of more than 600 locations of fawns detected in springs 2020 to 2022 with drones across a wide environmental gradient in Bavaria, Germany. At the coarser scale we applied a GAMLSS model to test for the effect of environmental characteristics for both fawn presence and abundance in meadows. At the finer scale, we analysed fawn bed-site selection by comparing bed-sites with random sites using conditional logistic regression. Some selected environmental factors were the same for the coarser and the finer scale (maternal versus fawn scale), while others differed, allowing us to separate the influence of females and fawns on bed-site selection. The bed-site selection at the coarser scale was mainly driven by factors describing habitat diversity, suggestive for forage availability and cover simultaneously. Factors that characterized avoidance of predation risk dominated selection at the finer scale. Interestingly, the influence of human disturbances differed between the scales. Our findings can help wildlife managers and volunteers to prioritize areas potentially preferred by roe deer fawns and to intensify targeted searches prior to mowing.

Brown hare (*Lepus europaeus*) in forests: fable or truth?

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Keywords: Brown hare, monitoring, forest, ecotype, optimal habitat

The brown hare (*Lepus europaeus*) is an important component of native fauna in Lithuania. At the beginning of 20th century, the species has become widespread

in conjunction with an expansion of forest fragmentation while further the population, especially juveniles, have suffered dramatically from human disturbances (poaching) and predators including feral dogs and cats. The population has increased from 1957–1958 until its peak in 70s. Since that time, population experienced a substantial and continuous decline. Changes in landuse practice and further habitat alteration, and other human factors acted together with natural factors. The most studies emphasized hare attribution to typical farmland species, that occupied open habitats in agricultural landscapes throughout Europe. Only few studies showed the suitability of forest habitats. We aimed to reveal habitat preference of hares in Lithuania. We made the survey in the different natural regions in Lithuania in springtime within the long-term (2003–2023) monitoring network, using pellet count method (belt transect unit 4 × 100 m). We use MVA to examine all possible independent variables and their relationships. In agricultural lands, the habitat suitability increases in May-June while forests are less visiting (13.6%). However, the importance of managed forests and plantations increases from August (36.3%). I noted that brown hares reside in both, open lands and forests. Animals mostly prefer stands of 2–3 age class (50–70% cases) with moderate undergrowth cover along the forest block lines, forest roads and gaps. Felled areas of 8–10-year-old and plantations of 1 age-class are beneficial for hares. Forest management increase structural complexity and food supply for hares. As a highly adaptable and eurytopic species, brown hare can persist in various habitat types. Three species ecotypes were revealed like “field” (open habitats), forest and mixed ecotype “forest-field” depending on forest cover in the certain locality. In the mixed coniferous/deciduous forests, the relation between the density of brown hares and forest cover (%, x,) and soil fertility (x,) s is expressed as y = –17.61 + 0.20 lnx1 + 1.36 × 2 (R= 0.93). The optimal habitat for hares includes a combination of areas of sufficient foraging and shelter, forest – open land complex, mosaic landscape incl. coppices, shelterbelts, and tallgrass islands in regions of low forest cover. Reduction of threat related to planting/maintenance of shelterbelts, agroforests (where food supply reaches 200 kg/ha) and increase in forest-open land edge effect.

Spatio-temporal distribution pattern, population size and the aggressive behaviour of wolves towards humans in Poland

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Keywords: attacks, *Canis lupus*, density, humans, inventory grids, rate of increase, sampling plots

This study covered historical changes in the wolf range in Poland, estimating the population size of this species, and characterising wolf aggression towards humans. Survey data received from 429 forest districts and 23 national parks was used to present wolf distribution in the years when this species was persecuted (1970), had game-animal status (1990) and then protected species status (2022). Wolf presence was investigated in 511 inventory grids, each measuring 25 × 25 km, spread across Poland. Wolves were reported in 34 inventory grids in 1970. The number of grids with wolves increased to 173 (1990) and 319 in 2022. In the years 2019–2022, the wolf population density estimated using direct observation in 192 sampling plots (total area 767 km^2) averaged 0.553 ± 0.129 individuals/ 10 km^2 of forest (x ±SE) in 16 inventory units covering a total area of 12,378 km^2. This figure indicates that approximately 5,120 wolves may be living in Poland. Six different aggressive behaviours of wolves towards humans were recorded in 45 forest districts in 2022. Aggressive wolf behaviours interrupted forestry works in 21 forest districts, and were witnessed in house yards in 18 forest districts. In order to reduce such incidents and encourage the species to avoid contact with humans, culling is suggested as a suitable means to control the wolf population size.

Population size and demography in moose *Alces alces* in Poland

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Keywords: age structure, collective hunts, moose density, population census, sex ratio, wet forests

A study into the population size and demographics of moose, which is a game species under a year-round hunting ban, was conducted between 2018 and 2021 throughout locations in central and eastern Poland. The study covered 48 forest districts grouped into 10 research units containing 12,378 km^2 of forested areas overall. As many as 192 sampling plots covering a total of 767.7 km^2 were delineated in the study area, where teams of 30 watchers registered the number of encountered moose via direct observation in late February and early March. The average moose population density was 1.39 individuals/km^2. It significantly varied between research units within the range of 0.39–2.40 moose/km^2 of forest. A significant correlation ($r = 0.845$, $p = 0.001$, $n = 10$) was found between the percentage area of bog and hydric forest habitats and the population density. The number of moose observed per one driving plot during routine collective hunts for big game positively correlated with population densities ($r = 0.652$, $p = 0.041$, $n = 10$). Over three consecutive years, during September and October, 7 033 moose were recorded, including 2,728 cows, 2,295 bulls and 2,010 calves. Females were most numerous among adults (54.1%), and the mean number of calves per 100 cows was 74.0. The percentage of females among adults was diverse across the 10 research units, from 51.4 to 58.9%, and the number of calves per 100 females varied from 63.9 to 80.6. From this results obtained an overall estimation of 60.5 thousand ± 15.8% moose living in Poland. It is

more than twice as many as official hunting statistics suggest, the latter providing a guesstimate of 26.8 thousand (2020). Given the high population density of moose, which inflict considerable damage to forests and fields, and cause large numbers of traffic collisions, there is an urgent need to regulate the population of this species by the resumption of hunting.

Assessment of migrating geese damage for winter wheat yield in Lithuania

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High number of migratory geese by grazing pressure reduce yield of winter wheat. As the numbers of migrating geese are gradually increased during several decades the conflicts due to raising damage for agricultural are getting significant. It is important to determine the extent of yield reduction and develop compensatory mechanisms compromising biodiversity conservation and intensive agriculture. The aim of our study was to evaluate the level and characteristics of migrating geese damage for winter wheat yield. The study performed in two regions Lithuania: Žuvintas Biosphere reserve and Raseiniai region representing SW and Central parts of the country. We evaluated grazing pressure by counting droppings of migrating geese in 10 m^2 circle study plots during spring (March-April) migration. The census of droppings was conducted every 10–15 days from first appearance till leaving of migratory birds. Half of study plots (control plots) were protected against geese grazing by 1 × 1m nets. The yield of winter wheat was evaluated by sampling two rows, totalling 1m length, wheat ears in every study plot. In total, the study covered five wheat fields with at least 50 study plots in each. We analysed the total number of wheat ears and the total weight of grains in the sample, the weight of 1000 grains, the number of grains per ear and per a whole sample. We used ANOVA to compare the data between control and affected study plots. GLMM was applied eliminating the effects of microrelief and field. The average intensity of feeding pressure varied from 0.2 to 9.4

droppings/m^2 in studied winter wheat fields, reaching up to 15.8 droppings/m^2 in maximally grazed plots. The intensity of grazing differed even in intensively visited fields. In 9% of study plots we did not detected droppings, in 30% – we found 0–5 dropping/1 m^2 and in 67% of area 0–10 dropping/m^2. The loss of winter wheat yield might be up to 9.4% ($F = 4.29$; $p < 0.04$) in the fields with high grazing pressure (7.4–7.5 dropping/m^2). The effect mainly explained by decrease grain weight ($F = 8.2$; $p < 0.005$; by 6.1% comparing study plots with 0 and 10 droppings/m^2) and partly by the number of grains per ear ($F = 3.1$; $p < 0.08$). The compensatory mechanism should be developed avoiding conflicts among conservation, agriculture and hunting. Current practice of migrating geese scaring by extreme noise, lasers or strangers to avoid damage in particular field is effective to reduce problems locally but not regionally and shouldn't be promoted by agricultural support schemes.

Hunting practices, hunters and habitat restoration: a social issue

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Keywords: hunting practices; habitat restoration; hunters; traditional hunting; identity; management.

As part of the Green Pact, the European Commission has just adopted its biodiversity strategy for 2030 and has drawn up a proposal for a regulation on the conservation and restoration of habitats: the "Nature Restoration Act". Building on existing policies, the Commission is seeking to establish, in synergy with climate policies, restoration targets for habitats covered by the Habitats Directive (92/43 EC) and the Birds Directive (2009/147 EC). In the case of agro-ecosystems, the habitats most concerned by the conservation of bird populations, whose numbers have declined in recent decades, the role of farmers and other land managers, but also hunters in particular, is essential. The acceptance and support of local players are essential to the successful implementation of measures. This is an approach that the IUCN promotes in the sense that the sustainable use of natural resources can and must actively contribute to the sustainable

conservation of nature (Amann – Resolution 2.29). In France, as in Europe, hunters are involved in the management and restoration of natural environments and biodiversity. The presentation will document these aspects, for example: the planting of hedges, the creation of cover to improve trophic and reception capacities, the opening up of environments or the maintenance of floristic diversity, or in terms of the management, knowledge or protection of populations of game birds and mammals. These various positive actions for biodiversity, recognised in particular by French legislator, seem to be inseparable from hunting, but are by no means the final objective or motivation. Hunting is a highly socio-cultural activity, in which symbolism and passion are central, and which is the expression of hunting cultures that are often local or regional. It may be enough for a method of hunting or a game that is culturally and territorially part of local hunting practices to no longer be practised or hunted to demobilise the many players involved. It therefore seems that these hunting practices, understood as a "total social fact", could be the very condition for hunters' investment in conservation and restoration policies. We will examine these aspects through the example of regional hunting of the skylark (*Alauda arvensis*) and wood pigeon (*Columba palumbus*), two species of high heritage and socio-cultural value, hunted in the south-west of France under derogation orders. We will try to understand how the human dimension, if not sufficiently taken into account, can play a major role in the implementation of nature conservation policies in rural areas.

Behavioral adaptations of wolves and wild boars to human-dominated landscapes: different species, same story?

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Keywords: the conservation and management of European large mammals in urban areas, *Canis lupus*, city, mammal, management, *Sus scrofa*, urban areas

Wolves (*Canis lupus*) and wild boars (*Sus scrofa*) have shared most of their history of coexistence with humans, from the successful domestication of their

ancestors to their increasing presence in human-dominated landscapes. Both species were subjected to intense persecution leading to their extinction in most of their European range. After that phase, they experienced a fast and successful recovery, becoming major sources of conflict with human activities and even occupying urban and suburban areas. However, it remains unclear whether the expansion of wolves and wild boars to urbanized areas has been facilitated by behavioral adaptations or solely driven by the range expansion of the two species. We investigated the occurrence of possible behavioral adaptations of wolves and wild boars to human-dominated landscapes by studying the recolonization process of a wolf population analyzing the distribution of 110 home-sites, as well as the inter – and intra-individual variability of wild boar movements using GPS data from 43 individuals belonging to two distinct Italian populations. Focusing on an Italian region hosting a high-density wolf population monitored from 1974 to 2016, we showed that wolves started to recolonize mountains and hills, occupying the human-dominated plains only recently while still showing avoidance of human settlement proximity. Despite this avoidance, 70% of packs included at least one urban settlement within the expected home range in 2016 due to the decreasing availability of remote territories. This suggests a likely increase in tolerance for human proximity in the near future. Compared to wolves, wild boars' behavior appeared to be more flexibly adjusted to human proximity. In a population inhabiting a mountainous area in Central Italy, we detected different strategies to balance food resource acquisition and avoidance of human-induced mortality. Specifically, some individuals approached human infrastructures to take advantage of anthropogenic food, compensating for the higher human-induced risks by moving less and selecting covered habitats during active periods. Moreover, wild boars inhabiting a touristic resort in insular Italy adjusted their resource selection patterns according to the seasonality of the touristic flow, demonstrating strong intra-individual plasticity. This is likely the key factor allowing populations to successfully occupy human-dominated landscapes. Behavioral adaptations to human-dominated landscapes are already present in wild boars and are likely to emerge soon in wolves. These findings shed light on the ongoing and upcoming scenarios for wildlife management in the urban area.

Kill site selection by wolf in an anthropogenic context

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Keywords: *Canis lupus*, cluster, predation, resource selection function, telemetry

Wolves (*Canis lupus*) are increasingly expanding into human-dominated landscapes in many European regions. This proximity to humans increases the challenges and threats faced by wolves inducing changes in their behaviour that can affect the prey population too, if predatory patterns are modified. Understanding the behavioural responses to anthropogenic features can shed light on the ability of wolves to thrive in anthropised contexts and can improve the management and conservation of both predator and prey populations. From September 2020 to January 2022, we investigated the kill-site selection of an Italian wolf pack in a multi-prey context characterized by different anthropogenic activities (livestock farming, tourism, hunting) and different levels of anthropogenic disturbance throughout the year (North-Eastern Italy). By taking advantage of the presence of 3 wolves monitored with GPS collars, we identified clusters which were attentively checked by means of direct field surveys to identify wolf predation events. For each kill site, we recorded prey species and environmental features. To investigate the environmental characteristics of kill sites and the influence of human-related features on the probability of selection by wolves, we adopted the resource selection function on 192 kill sites identified as wolf predator events on both domestic animals and wildlife. The kill sites used by the monitored wolves showed a specific clustered spatial pattern: wolves selected specific areas where they periodically returned to prey. Human-related features (infrastructures, roads, and trails) significantly affected the probability of selection of kill sites by wolves. Contrary to our expectations, these features were not avoided by wolves, as wolves preferentially killed animals close to roads and human infrastructures. Interestingly, the presence of cover increased the probability that wolves selected kill sites close to human features, regardless of the species killed. Other environmental characteristics differently affected the probability of selection of kill sites depending on the prey species. This study confirms the plasticity of wolves in adapting to anthropised landscapes, revealing that its effect on prey populations can change on account

of human influences. These results suggested a weak effect of the human shield, which seems not effective in protecting prey species from predation risk. These findings suggest further investigation of the drivers influencing prey populations' expansion towards human-dominated landscapes (e.g., food resources, hunting avoidance).

Exploring wild boar rooting behaviour and wolf predation through DNA metabarcoding: unravelling ecological insights

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Keywords: *Canis lupus, Sus scrofa*, snapshot diet profile, DNA barcoding

Wild boar rooting and wolf predation are two distinct ecological processes that can have a significant impact on other species as well as entire ecosystems. Therefore, understanding the diets of wild boar and wolves is important as it provides crucial insights into their ecological roles, trophic interactions, and enable effective conservation and management strategies for both these and other species. Metabarcoding, a potent DNA-based identification method, provides a non-invasive approach to study the dietary habits of several species, including wild boar and wolf. By analysing DNA isolated from faecal/scat samples and prey remains, we can identify species composition of their diets. Moreover, metabarcoding enables the identification of rare or elusive prey species, improving our understanding of the trophic dynamics associated with these two key species in temperate forest ecosystems. Recently, we started metabarcoding wolf scats and wild boar droppings collected in different areas of Slovenia (central Europe) to better understand wolf feeding habits and their impact in the contact zone between the Alps and the Dinaric Mountains. We found that wolves primarily preyed upon red deer, European roe deer and wild boar. Wild boar diet at rooting

sites includes plant matter, invertebrates (earthworms, beetles) and vertebrates (rodents, birds, reptiles). Our research sheds new light on the ecological interdependencies between the two targeted species and their ecological roles, i.e., dietary preferences and predation pressure of wolves on wild ungulates, and the effects of wild boar on soil invertebrates, including species that cause losses in agroecosystems. We highlighted the efficacy of DNA metabarcoding as a valuable and non-invasive technique to study the diet of taxa with different feeding ecologies, i.e. omnivores (wild boar) and carnivores (wolf). In this respect, metabarcoding offers numerous advantages, including its non-invasive nature, the ability to achieve high throughput, and the ability to detect multiple species simultaneously in the diet. These features make DNA metabarcoding a powerful tool for studying complex ecological interactions and provide valuable insights into the diets of both, game and protected species.

To what extent do released gamebirds contribute to fox diet in areas important to breeding waders?

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Keywords: breeding waders, diet, gamebird releasing, *Vulpes vulpes*

In the UK, an estimated 57 million non-native gamebirds are bred and released for sport shooting each year, and an excess of unshot birds remain in the landscape. The Game and Wildlife Conservation Trust (GWCT) provides guidance on sustainable gamebird releasing to minimise ecological impacts of this practice, however, gamebird releasing and the presence and distance of dispersal of unshot gamebirds, continues to be a contentious subject within the UK's wildlife conservation sector. Concerns are raised that this additional 'un-natural' food resource in the UK countryside is driving an increase in generalist predators and predation pressure on vulnerable breeding waders; particularly, by the native Red Fox (*Vulpes vulpes*). We explored if released gamebirds are a significant food resource and key-driver of rural fox populations in two

adjoining areas in Southern England. One site is a privately owned Estate managed for forestry, dairy farming, arable crop production, and game and wildlife, and the other site forms part of a National Park with open access and various European designations to protect habitat and wildlife. Both study sites are important areas for breeding waders and wildlife managers carry out strategic fox culling programmes, but the private Estate also releases gamebirds following GWCT's sustainable gamebird releasing guidance. We analysed fox diet in these areas during the wader breeding period by collecting stomach samples from foxes culled to protect ground nesting birds. We categorised items found within each stomach and evaluated the food item's frequency of occurrence and volume of the contents. Gamebirds were found to be an important food resource for foxes on the private shooting Estate where sustainable gamebird releasing was taking place, and additionally, where breeding wader productivity is high. However, on the adjoining site, also important for breeding waders, gamebirds were found to be a considerably less important resource for foxes. It is reasonable to conclude from our study, that if local game managers follow sustainable gamebird releasing guidelines, and undertake a strategic fox culling programme, gamebird dispersal is so low to the extent that they do not substantially subsidise foxes in adjoining areas important for breeding waders.

What drives wild boar density and population growth in Mediterranean environments?

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Keywords: population dynamics, ecology, environmental effects

Accurate prediction of wild boar (*Sus scrofa*), population dynamics is crucial for making informed decisions on management decisions to prevent or mitigate negative impacts. Climate, habitat, food availability, and density dependence are the main factors influencing mammalian population dynamics. For wild boar, precipitation, temperature, and especially summer conditions have been described to be the most likely limiting factors in southern Europe. However, there is uncertainty regarding the role of these factors and the mechanisms driving population variations. This study utilized long-term data from wild boar populations in Catalonia, Spain to analyse the effects of weather conditions, landscape characteristics, and density-dependent processes on two population indicators (density and population growth rate) using Generalized Additive Models (GAM). Both models showed a high percentage of variability explained; 94 for the density model and 65% for the growth rate model. Higher spring precipitation in both the current and previous year, increased female weight (indicating greater food availability), and higher forest cover (particularly above 60%) were associated with higher wild boar densities and population growth rates. The interaction between crop cover and total annual precipitation also played a significant role in determining population density. Furthermore, higher density was linked to lower population growth in the following year, suggesting a density-dependent process that is still not well-described in wild boar populations. These results suggest that the expected decrease in rainfall may limit the availability

of natural resources and potentially slow wild boar population growth. However, the adaptable nature of this species may lead them to seek alternative resources in humanized areas, mitigating the impact of climatic conditions variability. This could also forecast an increase of wild boar-human conflicts on the following years. Therefore, management policies should focus measures to limit wild boar access to human food sources, such as enhancing crop protection and strictly controlling their presence on urban areas. Additionally, landscape management measures, such as reducing dense forest cover, can help reduce refuge availability in areas with high wild boar impacts.

Quick pair replacement of the monogamous golden jackal (*Canis aureus*)

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Keywords: golden jackal, alpha pair, flexible social system, movement ecology, mate substitution

The latest example of the mesopredators' population growth in Europe is the golden jackal (*Canis aureus*); since the early 1990s, the golden jackal has become a successful predator in Central and Eastern Europe. Despite the species' intensive spread, the golden jackal's movement ecology must be better explored in Europe. We conducted extensive research in the Pannonian biogeographical region of southwestern Hungary between 2020–2023; 91 golden jackals were captured and fitted with GPS collars (Vectronic) to obtain more information on the movement ecology of the species. Our study detected a unique interaction between an alpha pair (F1 female and M1 male) with offspring and a neighbor female (F2 female). Based on a genetic test, we proved that the three individuals were not relatives. F1 and M1 raised at least three pups, and the alphas' home ranges (MCP95, 6–7 km^2). The home range (MCP 95%) of the F1 and M1 had almost complete (96%) overlap and a high (70%) overlap of their core areas (KHR50%). The single female, F2, which lived in a separate territory close to the alpha pair as part of a family group, quickly entered and occupied the territory of the alpha pair (F1, M1) after the death of the F1 (the F1 was shot). F2 did not return to her

former home range and remained with the alpha male (M1). We demonstrated that an unrelated, single female immediately replaced the deceased alpha female within a day outside of the breeding season. This previously undocumented phenomenon indicates an evolutionarily advantageous strategy. The monogamous golden jackal's ability to instantly replace his lost pair may explain the intensive population growth of the species.

Growth parameters as indicators of ecological change in a large herbivore

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Keywords: Constitutional parameters, growth pattern, environmental variation, climate change, chamois

Understanding how environmental variation influences life history traits, and therefore population dynamics, of ungulates is important for wildlife management and conservation. This topic has gained even more relevance with an increased interest in anticipating the potential effects of climate change and other human caused environmental alterations. Here, we test for the effects of different factors on growth patterns of the lower jaw and the hind foot of harvested Alpine chamois (*Rupicapra rupicapra*) in two study areas in the Bavarian Alps, Germany, with different environmental conditions and varying degrees of human impact. We fitted non-linear monomolecular, Gompertz and logistic growth models to 615 observations from both study areas. We compared model fit using Bayesian information criterion (BIC) and chose the best baseline model to subsequently test for population, sex and environmental effects in the model residuals. Next, we correlated the lower jaw and hind food lengths with another important constitution parameter of chamois; the first two segments (i.e., annulus L2) of the horn. The results of the growth models indicated a marginal sex-specific difference in both, the lower jaw and hind foot length, which can be explained by the small morphological difference in skeletal size in chamois. Importantly, we found significant differences in the growth patterns between study areas, but not in the asymptotic size achieved by animals in both

study areas as adults. These differences can be attributed to varying proportions of forest cover and climatic conditions. Similarly, the horn length of chamois showed the same significant patterns as the growth models. We discuss potential reasons for these sex-specific differences. Finally, we compare our results from the two study areas in Bavaria to data from the Swiss National Park and evaluate the suitability of the lower jaw and the hind foot length as indicators for monitoring ecological changes in chamois.

Adaptation of the ruminal bacterial microbiota of Bavarian chamois (*Rupicapra rupicapra*) to seasonal forage availability

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Keywords: chamois, microbiota, nutrients, rumen, season

The status of German chamois populations has been discussed intensively for years. However, much data on how the populations are really doing is not available. This discussion has triggered several new research projects in recent years. In this study, we want to clarify what forage is available to the animals, how they use it, what seasonal fluctuations they are confronted with and how they successfully adapt to them. An adaptable microbiome is essential for this. It enables ruminants to utilise plant food and convert it into absorbable essential fatty acids. The aim of the study is to map microbial (bacterial) and nutrient profiles in the rumen of Bavarian chamois and to show how they specifically adapt to seasonal fluctuations. For this, rumen microbiota from 48 chamois of different age classes and gender were examined by 16S rRNA gene amplicon sequencing. In addition, condition and age data were collected for each individual and

the crude nutrient content and content of fermentation products of the rumen content was determined. Amounts of ingested plants were determined by the botanical rumen content analysis. The data originated from the sample years 2017–2020. A significant seasonal effect ($p < 0.001$) is reflected in the composition of the ruminal microbiota. The decisive differences are mostly defined by only a few genera. Due to the current state of research, many of the genera could not be determined. This also often makes it difficult to assign the exact functions. However, a "core microbiome" could be identified. But this comprises considerably more genera than in some other wild ruminant species, such as the roe deer. The seasonal effects are also reflected in the distribution of crude nutrients. The highest fibre content (Neutral-detergent-fibre: 55.7%, Lignin 13.8%) is found in the rumen in winter. Antagonistically, the highest proportions of crude protein (20.1%) and non-fibre-carbohydrates (11.5%) are found in the rumen content in summer. Even if the functional relationships can only be partially assessed due to the many unclassified genera, individual clear connections can be recognised. The microbiome adapts flexibly to seasonal fluctuations and enables the animals to make optimal use of the given forage. Furthermore, the study provides information on the seasonal use of the chamois' given forage.

Title: Evaluation and patterns of damages produced by brown bear (*Ursus arctos*) population in Romania and identification of hot spots

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Keywords: claims and compensations of brown bear damages, evaluation of damages, human-bear conflict, Romania, *Ursus arctos*

Human-bear conflicts in Romania have escalated in the past years, resulting in high compensation costs paid by the State, through the Ministry of Environment, Waters and Forests. Declining tolerance and negative attitudes towards brown bear species is becoming one of the main threats to its long-term

conservation. In this context, an extensive analysis of the types of damages produced, their geographical localization, their total cost, is highly needed, in order to propose management preventive measures, that would increase tolerance. With this view in mind, all data on damages produced by brown bear (*Ursus arctos*) in the period 2015–2021 were analyzed, in order to identify patterns and hot spots. For this purpose, we used the Ministry of of Environment, Waters and Forests published website database (2016–2021) and data collected through LIFE FOR BEAR Project-Conservation of brown bear population in Romania (2015). The highest number of claims were for livestock (cattle, sheep, beehives, pigs, equidae, chicken, goats, other domestic animals, dogs, rabbit)-60,7 %, followed by agricultural crops, orchards, vineyard (corn, orchards, beetroot, sunflower, wheat, oat, potatoes, vineyards) – 19,2 % and other categories or multiple damages-20,1 %. Considering the cumulated value of claims throughout the analyzed period, the highest paid amounts were for livestock (71.6%), followed by agricultural crops, orchards, vineyard (25.8%) and a small proportion of 2.7 % for other categories or multiple damages. The number of claims ranges from a minimum of 58 claims in 2016 (13,000 RON) to a maximum of 2,449 claims in 2021 (5,734,385 RON), with hot spots identified in the counties of Harghita, Covasna, Mureș and Brașov, where bear densities are the highest. The spatial analysis has highlighted a spread of damages from a minimum of 5 counties in 2016 to 23 counties in 2021 (also outside of the bear distribution in Romania). Instead of reacting to problems, investing in prevention should be the norm, in order to mitigate the financial costs that at the moment, result in a high burden in the form of compensations paid by the State to the damaged parties. To find the optimum management measures, it is of upmost importance to know the distribution of damages, their frequency, costs per damage event, correlation to variables like proximity to village, proximity to forest, densities of species, availability of prey species.

Species on the move: connectivity modelling across unfragmented terrestrial habitats of Eastern Carpathians

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Keywords: connectivity conservation, carnivores, herbivores, movement patterns

Carpathians are currently one of the best-connected landscapes, with high-quality habitats and a high density of carnivores and less densities for herbivores. However, the nation need is to ensure economic growth, and without responsible government actions, these could pose a threat to brown bear connectivity, a vital pillar of the entire Carpathian region. The study's main goals was to develop species-specific distribution and connectivity models, to assess the differences between season's movement patterns, and to identify high-quality areas to be secured for multispecies connectivity conservation. We collected approximately 5000 GPS locations over four years for three carnivores and five herbivores' species, and we applied circuit-theoretic approaches (Circuitscape) to identify the potential movement corridors, high-priority areas and seasonality preference. The results provided new evidence on the uneven movement patterns, and pathways species use in different seasons in the study region. Movement preferences of carnivores were related to river shores and dense forest coverage areas, avoiding urban areas, while herbivores were predicted to move across forested and open areas and were more tolerant to human-modified areas. Three high-quality areas were delineated for most species, while connectivity conservation efforts are needed due to the vicinity of anthropic pressures. The spatial models generated for multi species and on multi seasons could lead to applicable management and conservation measures and setting connectivity targets within environmental and impact assessments, all contributing to biodiversity conservation.

Wildlife learning to cross the crowded infrastructure using existing underpasses

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Keywords: monitoring, connectivity, wildlife passages, green solutions, protected species

With the human population rapidly growing, wildlife faces more and more challenges in moving around habitat patches. Habitat loss is one of the main threats to wildlife, combined with car accidents involving wildlife species. The cost of damages is very high, and people and wildlife are injured, and sometimes, individuals pay with their life. Reducing these interactions between humans and wildlife is crucial, but more importantly, we must understand the mechanism driving wildlife species to use the crowded infrastructure to mitigate these problems. Road ecology is an effective and essential tool for designing crossing solutions. Our study occurred in the Romanian county Brasov, on 3 major roads (DN1, DN1A, DN13), DN1 being one of the busiest roads in Romania. We used surveillance cameras to monitor the crossing of wildlife species under 15 bridges. The experiment started in March 2022, and as of January 2023, we have registered 650 wildlife crossings from different species, which can be translated into the same number of avoided car accidents. It seems that the species registered in the experiment have learned in time from their mothers that these structures are safe to use. The witness of these hypotheses is the images of mothers with cubs, especially brown bears (*Ursus arctos*) and pine martens (*Martes martes*), which used the structures multiple times.

Ungulate monitoring in German National Parks

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Keywords: adaptive management, camera-trap-distance sampling, national parks, ungulate monitoring, ungulates

National parks are required not to intervene in natural processes in a large part of their area and to reduce management to a necessary level in order to preserve biodiversity. However, due to a long and intensive history of settlement and land use, in Central Europe national parks cover only small areas and therefore are closely intertwined with infrastructure and economically oriented areas in their surroundings. This leads to sharp boundaries and emerging conflicting goals when it comes to ungulate management and game damage in the national park's surroundings. As a result, national parks undertake massive interventions in ungulate populations by wildlife regulation. These measures should be limited to what is necessary, clear, well justified as well as precisely documented and effective. Monitoring ungulate populations and their effect on vegetation therefore is a crucial part of the adaptive management process in protected areas as it serves as an important basis, justification and control of success for wildlife regulation. Within the large-scale research and development project "Ungulate Monitoring in German National Parks", funded by the Federal Agency of Nature Conservation, we developed a standardized ungulate monitoring system and run it from 2019 to 2020 in 10 large protected areas. In this talk we present the developed monitoring system and show first results of red deer (*Cervus elaphus*), wild boar (*Sus scrofa*) and roe deer (*Capreolus capreolus*) relative abundance, population density via Camera Trap Distance Sampling and activity pattern in 10 German large protected areas. In order to derive population indicators, we randomly deployed 643 camera traps by putting a 1-kilometer grid over the entire areas and installing camera traps in the center of randomly selected grid cells. Our findings revealed the highest red deer relative abundance and density in Königsbrücker Heide and the highest wild boar and roe deer relative abundance and density in Hainich National Park. Furthermore, our findings suggest a spatial distribution of all three ungulate species towards the zones without wildlife regulation as well as a higher diurnal behaviour of wild boar and red deer in these areas, while the latter was not be observed in roe deer.

Our monitoring allows tracking the development of ungulate populations and their effects on vegetation in a standardized and comparative way and therefore represents an important tool for future sustainable and adaptive wildlife management in protected areas and beyond.

Results of the use of iMammalia and Agouti applications for game monitoring in Serbia

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Keywords: monitoring, wildlife, population, hunting ground, camera trap, Serbia

In Serbia, there is an abundance of diverse game thanks to favourable natural habitat conditions. However, the current system of game population monitoring and their habitats in Serbia has numerous shortcomings and is lagging behind modern and the best monitoring systems (e.g. in Slovenia, Hungary). This paper analyses the main problems in the use of iMammalia and Agouti applications by citizens and hunters in Serbia, as well as the results on game obtained using these applications. These implemented activities were an integral part of two major international initiatives (MAMMALNET and EOW), funded by EFSA (European Food and Safety Authority) through the scientific project ENETWILD (www.enetwild.com). A total of 1,012 records on mammals were collected on the entire territory of Serbia using the iMammalia application (period from 8 May 2016 to 12 May 2023), of which the largest number of records were accepted as valid (n = 938 or 92.7%). The dominant game species are roe deer (n = 334), wild boar (n = 165), brown hare (n = 155), badger (n = 83), fox (n = 73) and jackal (n = 72), followed by red deer, squirrel, hedgehog, brown bear, wolf, marten, fallow deer and wildcat. The Agouti application was applied in the analysis of a large number of collected images (n = 25,000) using 12 camera traps installed in the period July-October 2022 at 36 randomly selected locations in the part of the hunting ground "Studenica" with an area of about 6,000 ha. This forest-mountain hunting ground is located in central Serbia near the town of Kraljevo and is managed by a hunting association. Various species of game have been recorded, the most common being roe deer, wild boar, marten, fox, dormouse and squirrel. It is estimated that the density of the wild boar population in the studied part of the hunting

ground "Studenica" is 2.2 ind/km^2, while for roe deer a much higher density of 14.0 ind/km^2 was estimated. It is concluded that both applications can help to obtain important new data and significantly improve the system of game populations monitoring in Serbia, so their use by citizens and hunters should be continued in the coming period, particularly in a much larger number of hunting grounds throughout Serbia.

Eurasian lynx hunting bag structure and the effects of hunting on the effective population size in Finland

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Keywords: effective population size, game management, hunting, lynx, large carnivore

The lynx population in Finland slowly increased since the end of the 1960's when lynx were partially protected. In early 2000's, there were approximately a hundred family groups in the whole country. Ten years later the number had almost quadrupled. Between years 2011–2017, about 20 % of the population was hunted yearly. The overall high hunting pressure caused the population to crash by 21% in 2017–2018. With a lowered hunting pressure, the population has slowly been increasing since. We assessed the demographic structure of the lynx hunting bag and found it to be slightly male-biased. Age-wise it consisted mainly of kittens, but not significantly more than yearling males and adult females. Females with dependent young are generally protected. The probability of shooting a reproducing female was rather equal when tracking an individual lynx vs. a family group. When tracking a family group, the probability of shooting the adult female was high. The results will be discussed with lynx ecology, population management goals and hunting ethics in mind. We also evaluated the effective population size for the lynx with the Sliding windows approach, over a study area of four game management districts for 15 time windows (between 2003–2020).

The effective size followed the estimated population size until the heavy hunting began but started declining from there on in a relatively deeper manner than the population.

National field techniques and methods to develop homogenous monitoring plan for mammal species from Romania

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Keywords: conservation status, large mammals, national scale, semi-aquativ mammals, wildlife monitoring

The wildlife monitoring plan is a vital tool for the species conservation and sustainable development of the populations. This strategy aims to establish the population size and the conservation status that are important parameters for the population's survival. In this case we compare monitoring efforts conducted to determine the national population size of 10 mammal species of European importance: *Ursus arctos, Canis lupus, Canis aureus, Lynx lynx, Felis sylvestris, Lutra lutra, Mustela lutreola, Bison bonasus*, and *Rupicapra rupicapra*. The monitoring methodologies of these species of community interest in Romania were developed to apply an uniform system for wildlife monitoring from a methodological and organizational point of view at the national level, which succeeds to ensure a common standard record of the data necessary for the evaluation of their conservation status, and allow the feeding of the database, according to the article 17 of the Habitats Directive. The survey is conducted every 6 years, and the sampling design to estimate population size is carried out by comprehensive or partial inventory of the species habitat, usually using: the transect method, presence signs, direct observations, females and cubs method, and photo trap cameras. The particularities and impediments when implementing the methods specific to each evaluated species and their habitat are documented in the current study. While some beaver population living areas can be

fully surveyed, it is impossible to do the same for the bear or the wolf population of which home ranges are more widespread and possess different biological requirements. The monitoring units are usually 10 × 10 km, some of the species, like the brown bear needs adjustments of subunits sampling of 3 km. If the area of the species' range is very extensive, the collection of information is carried out for about 10% of the total sample areas, 20% being the case for the beaver population. Many other interesting particularities and recommendations are addressed in this paper. Most of the outcomes revealed a favorable conservation status for the assessed species which actually points back to a properly applied hunting management that succeeds to be sustainable and adaptive.

Aspects regarding the presence of mammals in riparian areas of Olt River basin, Romania

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Keywords: game species, biodiversity, riparian zone, forest

The study was carried out over two years on a 450 km river sector of the main course of the Olt River in Romania. Twenty-one species of mammals were identified by using direct observations; each GPS point (749 in total), the habitat conditions and anthropogenic influence were characterized by employing 12 variables, and the species were identified using 22 variables. However, most species identified were beavers, foxes, deers, moles, otters and mice (92–247 individuals), while the rare ones identified were the wolf, badger, jackal and wild cat (1–2 individuals). The correlation matrix, the correlation coefficient (r), and transgression probabilities α = 5%, α = 1%, respectively α = 0.1%, have been used to assess the relationship between species and habitat conditions. Somewhat predictably, the fox (best represented) shows no predilection for a specific habitat type; on the same note, the otter mainly uses areas with rich food and is not concerned with settling in terrestrial habitats in particular cases. On

the other hand, the beaver prefers riparian areas with rich vegetation, depending on the presence of woody vegetation during the winter. Other species, such as deer, wild boar, wolves and brown bears, are using riparian areas mostly covered by forest, and some of them (bears and wild boars), showed trophic opportunism (photo captures and observations), possibly influenced by the excessive densities in certain natural areas.

The influence of the bear presence near local communities in Romania

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Keywords: wildlife management; mitigation of conflicts; bear relocation; habituated bears; human-bear interactions.

In 2023, in Romania, there are approximately 71,850 km² of natural habitats suitable for brown bears, representing approximately 30% of Romania's territory with a population size estimated at 7,410–8,590 individuals. Over the last 20 years, socio-economic development has increased in various sectors: transport, construction, tourism, and agriculture, which inevitably generated a series of direct conflicts between species and humans, such as the presence of bears in areas with permanent anthropogenic activities, road accidents and road kills, agricultural damages, bear attacks, human deaths caused by bears. This research aimed to analyse: i) the phenomenon of captured habituated bears (bears near anthropogenic infrastructures: roads, tourist areas, inhabited areas, etc.) and relocated in natural habitats, monitored by GPS systems (under the project LIFE SAVE CROSSING) in the period 2018–2023; ii) human-bear interactions, by using social methods (interviews, focus groups, social documents), and techniques for analysis of communication content. Thus we established a typology of conflicts and their frequency, location, determinants, and measures adopted by local communities (project LIFE FOR BEAR) in 2014–2022. Our results showed that the relocation success of habituated bears tends to be zero, most of the individuals

are returning to the initial point of capture (less than 100 km), or they find first localities near the place where they have been relocated, into direct conflict with the community that was not used to the presence of bears (over 100 km), so in these areas, the locals are looking for methods, often illegal to get rid of them and negative impact of these bears. With this method, the problem is transferred from one side to another, or even the problem multiplies at the national level, gradually decreasing human acceptance towards the species. In areas where bear presence near human settlements has been a historical custom, communities tend to have greater acceptance of bear species than communities where bear presence is new. The results of these analyses will be a valuable perspective for central, regional and local authorities and entities to establish prevention measures to reduce human-bear conflicts at the national level.

Can wind farms impact roe deer population?

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Keywords: roe deer, wind farm, population, impact

Wind power is one of the fastest-growing renewable energy sources. This technology characterizes with a low environmental impact, but a negative effect on the local biodiversity of wildlife has been reported. Usually, this influence was indicated in case of birds and bats, mainly by a direct collision with the rotors. Wind farms may however also affect terrestrial non-flying species, including mammals, but this influence is species-dependent. Roe deer occupying agricultural landscape is a convenient model for studying large herbivores response to wind farms. A tendency to avoid wind farm interiors and direct proximity to turbines was exhibited by this species. Moreover, individuals occupying large terrestrial wind farms presented higher fecal cortisol concentration. The above indicates the possible impact of wind farms on roe deer. For this reason, an attempt was made to assess this impact in a new research project. The assumptions of the project and the expected effects will be presented.

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What is the future of the European bison population?

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Keywords: European bison, conservation, Europe

European bison, which was close to extinction 100 years ago, has now reached a population of over 10,000 individuals. Nevertheless, a number of problems related to the species' future remain unresolved. This applies above all to a narrow gene pool and health threats but also limited living space, isolation, poaching and insufficient habitat for reintroduction. New problems are also emerging, mainly related to the management of this species, i.e. damage to crops and forest or increasing mortality on roads and railways, resulting in Human – European bison conflict. These problems are the result of the overcrowding of some large European bison populations, which also increases the risk of pathogen transmission. Unexpectedly, a new problem appeared in the form of an armed conflict, i.e. Russia's attack on Ukraine. These and other problems mean that the future of the European bison is still uncertain and conservation actions aimed at this species are still necessary. We present our proposal for the future of this species in Poland and some other countries.

Impact of infectious viral diseases Covid-19 and African Swine Fever (ASF) on commercial hunting tourism in 2020–2022 in the Regional Directorate of State Forests in Poznań

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Keywords: commercial hunting tourism, impact of Covid-19 and African Swine Fever (ASF), state hunting areas

Viruses that cause human and animal diseases affect all areas of the economy to varying degrees. In December 2019, the first outbreak of African Swine Fever (ASF) was discovered in Wolsztyn (Wielkopolska) and the first official case of Covid-19 infection in Poland appeared on 4 March 2020 in a hospital in Zielona Góra. Both of these situations, related to infectious viral diseases, correlate with each other both temporally and locally and undoubtedly influenced people's travel decisions. Tourism is very sensitive to any changes in human and animal health conditions, and as a result, to changes in legal restrictions and orders. According to United Nations World Tourism Organization data, tourism before the Covid-19 pandemic generated over 10 percent of the global GDP and gave work to over 12 percent of all employees. The pandemic has caused a huge impact on tourism. The World Travel Council forecasts show that millions of people lost their jobs in tourism around the world. The decrease in rates could be as much as 2.7 billion USD. In order to combat common and cross-border viral diseases, numerous countries (including Poland) in 2020–2022 introduced restrictions related to the border crossing, mandatory vaccination, and quarantine in the case of Covid-19, and in the case of ASF, restrictions related to the transport of products of animal origin and recommendations, e.g. some German lands not to travel to Poland for hunting purposes – to places where ASF was found. On the example of commercial hunting tourism operating in the Regional Directorate of State Forests in Poznań, I will present the economic consequences of caused by introducing additional sanitary and geopolitical requirements. The object of the analysis will be eight state hunting areas of the State Forests managed by forest inspectorates grouped in the RDSF in Poznań. In these places, conducting safe tourism through the organization of hunting was associated

with additional costs, while reducing revenues due to less interest from customers caused by the fear of the epidemic. The study will present an analysis of the economic effects, lost benefits, and actions taken, together with implemented solutions which helped to limit the spreading of infectious diseases, it helped as well as saved good financial results. The existing situation forced the organizers of hunting tourism to raise the standards of accommodation and sanitary conditions during hunting. The organizers pay more attention to safety, appropriate equipment, selection of people, and current legal conditions.

To feed or not to feed – Energy intake of roe deer (*Capreolus capreolus*) in typical south German landscapes

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Keywords: roe deer, rumen, habitat, crude nutrient, fiber fraction, metabolizable energy

Irrespective of the fact that the European roe deer (*Capreolus capreolus*) occurs from the Mediterranean to above the Arctic Circle and is one of the most successful species, roe deer are fed in winter in Germany and Austria. Hunters justify the supplementing feeding with the argument that roe deer do not find sufficient high-quality food in our cultural and natural landscape and cannot utilize the high fibre content in the available diet.

Our aim was to measure the quality and energy content of the roe deer diet (in terms of metabolizable energy (ME)) and the daily energy intake by roe deer.

Between 2011 and 2014 and 2017 to 2019, 534 roe deer rumen were collected from typical forest habitats such as beech, oak, mixed spruce-beech, and mixed mountain stands, as well as from typical grassland and arable land. Samples were examined by standard methods of dietary analysis, as in vitro ruminal fermentation, crude nutrient analysis and the analysis of neutral/acid detergent fibre and acid detergent lignin. In addition, condition and age data were collected for each roe deer. Key results: The diet consumed by roe deer has an energy density of 5.5 MJ / kg dry matter (DM) on average. Agricultural landscapes

provide significantly ($p < 0.001$) more energy with an energy density of 6.4 MJ/kg DM. Higher energy densities can be attributed to higher carbohydrate (NfE) ratios in the diet. Crude fibre contents in the diet varied between 20% and 38% DM. Lower energy densities in vegetation are compensated for by roe deer consuming more food. Across all habitats, roe deer consume an annual mean of between 8 ME MJ/day and 11 ME MJ/day.

Roe deer find sufficient high-energy food in all landscape types. They consume and can utilise raw fibre to the same extent as red deer or mouflon. Differences in energy density between habitats result from carbohydrate content and are compensated by more food intake. Energetic undersupply of roe deer could not be detected in any habitat and any time.

Roe deer do not need supplemental feeding because they can obtain sufficient energy from vegetation anywhere during all seasons. Supplemental feeding leads to browsing damage from lack of raw fibre in the feed. The lack of raw fibre in feed causes rumen acidosis in roe deer, which is the cause of death in 30% of fallen roe deer in Austria.

Potential of antlerogenic cells of red deer to differentiate with metalloproteinases` engagement

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Keywords: stem cells, metalloproteinases, red deer, antler, pluripotency

Antlerogenic cells can serve as a model for studying cellular processes during cancer stem cell carcinogenesis involving metalloproteinases (MMP)s. Metalloproteinases degrade components of the extracellular matrix, facilitating cell migration and regulating the activity of signalling factors in the extracellular matrix. These proteinases regulate developmental processes, control angiogenesis and wound healing, participate in the formation of immune receptors, and are expressed in stem cells. The aim was to characterize the pluripotency of antler cells and determine MMPs' action in antler stem cells (ASCs) before and after differentiation into adipo-, osteo-, and chondrocytes. Antler tissue was collected approximately 40 days after observed antler growth above the skin of the skull

post mortem (about 20 min after the shot) from healthy breeding five year old males (N = 7). The cells were isolated from the pedicle layer of the scutellum after skin separation and cultured. The pluripotency of the ASCs was evaluated by mRNA expression for NANOG, SOX2, and OCT4. ASCs were differentiated for 14 days. The MMP (1–3) and TIMP (1–3) mRNA expression was determined in the ASCs, their concentrations in the ASCs and the medium as well as profiles of mRNA expression for MMPs: 1–3 and TIMPs: 1–3 during differentiation of ASCs to osteocytes, adipocytes and chondrocytes. We showed antlerogenic cells` pluripotency. Depending on differentiation of the ASCs to osteocytes, adipocytes or chondrocytes, MMPs` and TIMPs` expression profile fluctuates for all studied proteases and its inhibitors. The studies demand continuation considering the role of proteases in stem cell physiology and differentiation. The results may be relevant for prognostic results of therapies with the ASCs treatment as an extract for wound healing acceleration or as a cell transplant.

The electromagnetic field as a factor affecting the reproductive activity of the European roe deer male (*Capreolus capreolus*)

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Keywords: male roe deer, testicles, reproductive steroids, 3β-HSD, aromatase, electromagnetic field

The process of spermatogenesis in roe deer male testes is strictly regulated by the action of steroid hormones, especially oestrogens and androgens. Their synthesis takes place in the testes under the strict control of steroidogenesis enzymes, e.g. 3β-HSD, which catalyses the formation of testosterone (T2)

and dehydrotestosterone (DHT3) in Leydig cells, and aromatase, which catalyses the formation of oestrogens from androgens. The presence of aromatase in the cells of the male gonad is necessary to maintain a high level of oestradiol needed for the proper course of the spermatogenesis process and sperm maturation. 3β-HSD and aromatase are key enzymes in the steroidogenesis pathway. Disturbances leading to a decrease or increase in their amount can cause many unfavourable changes in the reproductive system, such as a decrease in hormone production, and thus impairment of the main steroidogenesis or spermatogenesis pathways, determining the fertility of animals. In the agricultural and forest environment, there are more and more sources of electromagnetic fields that can affect animals living in their surroundings. In order to test the resistance of male roe deer testicle tissues to the extremely low-frequency electromagnetic field, testicular tissue material collected during planned hunting in the area of the Kolbuszowa Forestry Inspectorate was exposed to electromagnetic field for 2 and 4 hours during in vitro culture. The immunohistochemical reaction showed the presence of the 3β-HSD enzyme and aromatase in the testis cells of male roe deer in all study groups, i.e. testicular tissues treated with a 50 Hz field for 2 and 4 hours, as well as control samples not treated with a field, collected during the pre-rut, rut and post-rut. Analysis of the immunohistochemical reaction for 3β-HSD showed a decrease in the amount of this enzyme in testicular tissue treated for 2 hours in all analysed periods compared to the control group. A decrease was also observed in testicular tissues collected during the rut period treated for 4 hours, as opposed to the post-rut period when an increase was noted. The analysis of the immunohistochemical reaction for aromatase showed an increase in the amount of this enzyme in testicular tissue treated for 4 hours in all analysed periods compared to controls. An increase was also observed in tissues treated for 2 hours during the rut, in contrast to the post-rut period where a decrease in the amount of this enzyme was seen. The obtained results indicate that the extremely low-frequency electromagnetic field may be an environmental factor negatively influencing the process of spermatogenesis in male roe deer.

The influence of the environmental factor – electromagnetic field on the endometrium of European roe deer (*Capreolus capreolus*)

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Keywords: roe deer, uterus endometrium, oestrogen receptors, androgen receptors, electromagnetic field

Every year, the number of sources of artificial electromagnetic fields (EMF) in the environment increases due to the development of technology. Emitters of extremely low-frequency fields include power lines, distribution stations, and devices powered from the power grid. All these devices can be sources of EMF impact on animals. European roe deer adapt very well to the environment in which they live. Roe deer reproduce only once per year. The endometrium consists of two layers – basal and functional. The first one connects the endometrium with the myometrium (outer layer), while the functional layer, changes under the influence of hormones during the rutting season. Aromatase is an enzyme involved in the formation of oestrogens by aromatizing androgens. The enzyme substrates are, for example, testosterone and androstenedione. The function of aromatase is to regulate the synthesis of oestrogens from testosterone in many tissues – including the endometrium, ovaries and placenta. Oestrogens are key enzymes in preparing the uterine endometrium for a future pregnancy. Oestrogens bind to their receptors, which are divided into two types: oestrogen receptors α and β. The first are found mainly in the uterus, kidneys, heart or liver, while the second are found in the ovaries, lungs and nervous system. The aim of the presented research is to check the effect of the 50 Hz EMF on the presence of aromatase in the endometrium of the European roe deer uterus. The collected tissues were treated with a 50 Hz EMF for 2 or 4 hours.

Then, an immunohistochemical reaction was performed. The reaction results were subjected to a semi-quantitative analysis, i.e. the calculation of the relative optical density (ROD) of post-reaction preparations, on the basis of the tissue images. Then, the average ROD of the individual preparations were compared with the control group (tissues not treated) and a statistical analysis was performed to find out if there are differences between the tested groups. Based on the obtained results, it can be seen that the effect of EMF has a statistically significant effect on the production of aromatase after more than 2 hours. The 4-hour exposure causes a significant increase in enzyme production. A high amount of aromatase can lead to increased oestrogen production. The results of the conducted research indicate the effect of EMF with a frequency of 50 Hz as a factor causing an increase in the production of this enzyme by the tissue of the endometrium of the roe's uterus.

SOTKA-project to reverse the trend in declining waterfowl – costs and achievements during 2020–2022

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Keywords: biodiversity loss, waterfowl, wetlands, restoration, invasive alien predator

Finland is responsible for the breeding success of many European waterfowl species and, through this, for their population trends that have been rapidly declining. Main reasons for this are considered to be the decline in habitats, along with the increasing predation by the two invasive alien predators, the American mink (*Neovison vison*) and the Raccoon dog (*Nyctereutes procyonoides*), that

pose a major threat to ground nesting bird communities. SOTKA-project led by the Ministry of Agriculture and Forestry, Finland, is part of a bigger national HELMI-program that aims to halt biodiversity loss on several habitats. During 2020–2022 the SOTKA-project has funded the work on wetlands with altogether ca. 5 million €, supplemented by private funding and voluntary work by landowners, hunters and local people. The costs and results per sub-project are 1. Sotka-Wetlands, building and restoring wetlands 1.9 million €, with 43 sites (635 ha) finished, 2. Sotka-Staging areas 225,000 €, creating a network of staging areas for autumn migration, with 20 agreements made, 3. Control of invasive alien predators on 73 Natura SPA wetlands, 2.1 million € (+1.4 million other funding), 4. Control of invasive alien predators in the archipelago and on the inland lakes 250 000 €, 5. Research on the restoration effects and the IAS control, and their cost efficiency 700 000 e. All subprojects in the SOTKA-project are run by different organizations in close co-operation with each other as well as with the local people and landowners. All actions are monitored carefully and documented enabling a scientific evaluation on the effectiveness of the methods. With these measures, aimed to be continued until 2030, the Government of Finland aims to halt and reverse the declining trend of waterfowl. HELMI-program is a joint program of the Finnish Ministry of Agriculture and Forestry, and the Ministry of the Environment: https://ym.fi/en/helmi-habitats-programme. SOTKA-project: https://mmm.fi/en/sotka-project.

Wild boar biology in the northernmost edge of the distribution range

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Keywords: abundance, ASF, border zone, genetics, GPS, spatial ecology, *Sus scrofa*

Rapidly increasing wild boar (*Sus scrofa*) populations in Europe promote disease risks and cause damages in agriculture and natural habitats. Therefore, there is a critical need for more knowledge on wild boar biology, especially at

the edge areas of the species range. The wild boar population in Finland represents the northernmost edge of the current distribution. This population originates mainly from Russia and is densest in the southeastern part of the country. Due to mild winters, the population has grown recently, increasing the concern for damages for crops and introduction of African Swine Fever (ASF). The latter is a risk especially induced by the transboundary movements of wild boars. In our national wild boar monitoring program, we have assessed the Finnish wild boar population size since 2016 with a Bayesian population dynamics model based mainly on hunting data and literature. In addition, using GPS collars, we studied the movement patterns of wild boars in border region. Finally, we are using genome-wide SNP panel (Illumina PorcineSNP80v1) to understand the population structure and diversity of the current population. Our estimates (medians) of annual population sizes vary from 2500–3000 individuals during the last seven years. A key factor in controlling the growth of the Finnish wild boar population has been hunting. We found that all GPS-collared wild boars (N = 17) showed continuous transboundary movements, with the core areas of the home ranges predominantly on the Russian border zone. Total home ranges were up to five times the size of those in southern latitudes. Our genomic results revealed the Finnish wild boar population is relatively homogenous with no clear spatial patterns. Our study shows that the movement capacity of the species and large northern home ranges increase the risk of spread of diseases. Our results emphasize the importance of transboundary collaboration in the monitoring and management of common wild boar populations. In addition, we predict that changing climate will increase wild boar population growth regardless of active hunting. This highlights the need for accurate monitoring and research of the northernmost population.

Studying the disturbance of coastal waterbirds within a Marine Protected Area: does human activities modify the behavior of birds?

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Keywords: anatidae, human activities, management, marine natural park, shorebirds, space competition

The French coasts are of major importance for staging and wintering waterbirds. However, these areas are also highly used and visited, with multiple recreational or professional human activities taking place. Therefore, humans compete for space with birds and can cause disturbances. The presence of people can either generate behaviour changes, resulting in additional energy expenditure, or entirely deprive these birds of access to their habitat. As a result, their body conditions may be affected, which may decrease their ability to migrate or survive. The Gironde Estuary and Pertuis Sea Marine Natural Park, located on the French Atlantic coast, aims to reconcile the development of human activities and the conservation of its biodiversity. By hosting regularly more than 300 000 waterbirds in winter, the responsibility of the Marine Natural Park for the conservation of shorebirds and waterfowl is important. In this context, the French Biodiversity Agency has set up a protocol to monitor disturbance and its effect on waterbirds in nine sectors with different protection statuses, habitats, and functions for birds. The goal is to monitor throughout the year how human activities generate changes in behaviour and the number of birds. This monitoring, which started in 2020, benefits now from more than three years of data. The analyses allow first of all to describe the evolution of the human activities on the study sites along the year and according to tidal hours. Their effects on waterbirds' behaviour will then be evaluated and their implication in terms of species conservation and management measures will be discussed.

Investigating pathogens in wild game by a standardized sampling approach

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Keywords: monitoring, zoonosis, pathogen, hunting, game meat

Wild game animals may host pathogens with significant economic relevance for domestic livestock as well as pathogens of veterinary and public health relevance. Pathogens may be transferred via food of animal origin. Research on the occurrence and distribution of these agents in wildlife poses multiple challenges. One major challenge is the acquisition of sufficient number of samples and efficient use of manpower and time needed to conduct this kind of investigation. In addition, for food safety research, as well as for various other scientific purposes, the provision of a sufficient number of samples without unnecessary disturbance or killing of animals is a major limitation.

Here we present an approach to obtain samples from game animals killed as part of standard ungulate management practice. The methodology and output of a sampling approach for game animals was implemented at drive hunts in Germany. Since 2017/18 about 4,000 samples were obtained from red deer, fallow deer, roe deer and wild boar (about 1,000 individual animals) and used for various studies regarding agents associated with food consumption in game animals. Depending on the species and the scientific questions in focus, following samples were acquired: heart, liver, spleen, blood (scooped from the chest cavity), faeces, nasal swabs, caecum, tongue, tonsils, larynx, abdominal fat as well as foreleg, abdominal or diaphragm musculature.

The standardized sampling approach for wild game animals proved to be representative for the hunted game animal population and effective for obtaining a large number and variety of samples of different organs, tissues and other matrices. Sampling reflected the proportional distribution of ungulate species in the hunting district. Hunting district and hunting season strongly influenced hunting bag and hence sampling success.

This sampling approach was demonstrated to be a suitable basis for long-term monitoring of animal and public health threats associated with wildlife and is adaptable to other regions and research fields.

Enhancements and farming adaptations to enable wild grey partridge to thrive on a modern arable farm

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Keywords: grey partridge, farming, habitat enhancement, wetland, partridge pair density, pheasant, chick success

Enchant Farm lies within the heart of Alberta's highly modernized cropland, and it stands out among the surrounding landscape with its newfound wealth of wildlife present. We began more than 10 years ago to increase the density of grey partridge and pheasants, while also enabling a local seed producer who leases the farming rights to remain profitable. The farm is 5.8 km^2 and uses irrigation to enhance yield on eight arable fields ranging in size from 6.9 to 81 ha. Four primary enhancements have been integrated across the farm to benefit gamebirds. First, shrub rows were planted to surround the edge of all arable fields for nearly 20 linear kilometres of vertical structure. Second, narrow headlands of forbs were seeded to separate the shrub rows from seeded crop on the inside, along with a 2m dirt buffer strip. Third, the area on the outside perimeter of the shrub rows were seeded with a blend of forbs and tussocky grasses for nest and additional brood rearing habitat. And fourth, we increased the number of ephemeral wetlands dispersed across the farm from 7 in 2013 to more than 30 today. These mesic areas are rich in plant and wildlife diversity and provide a haven for gamebirds seeking escape cover, particularly pheasants. We have tracked a marked difference in partridge pair densities at control sites compared to those at the farm which are commonly 8 to 10 times greater. Pair counts at control sites range from 1–3 pairs/km^2 while densities on the farm now range from 9.1 to a high of 35 pairs/km^2 several years ago. Counts on the farm in spring 2023 were 17 pairs/km^2. Spring partridge pairs show selection for areas with shrub rows present. Naturalized pheasants are uncommon on this landscape so we are attempting to establish a self-sustaining huntable population. Poults are released using several soft-release methods, although our initial attempts were unsuccessful in retaining females that survived and reared

broods. However, soft releases over the past 2 years have been more effective with over 40 breeding aged hens living wild on the farm this past spring, and evidence of broods in 2022 and 2023. The approach taken at Enchant Farm has been purposeful to benefit gamebirds, with continual adaptation to change what is not working while holding on to those applications that are effective.

Efficiency and disturbance effects of drone versus ground approaches to monitor moose

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Keywords: *Alces alces*, behavior, GPS, Norway, unmanned aerial vehicle, wildlife

Efficient wildlife management requires precise monitoring methods, e.g., to estimate population density, reproductive success, and survival. Here, we evaluated the efficiency of drone and ground approaches to detect and monitor GPS-collared free-ranging female moose (*Alces alces*) and their calves. Moreover, we quantified how drone and ground approaches affected moose behaviour and space use. The average time used for drone approaches was 17 min compared to 97 min for ground approaches, with drone detection rate being higher (detected 95% of adult female moose and 88% of moose calves known to be present) compared to ground approaches (78% of adult females and 82% of calves detected). Drone detection success increased at lower drone altitudes (50–70 m). Adult female moose left the site in 33% of drone approaches (with > 40% of fleeing moose becoming disturbed once the drone hovered < 50 m above ground) compared to 56% of ground approaches. We failed to find short-term effects (3-h after approaches) of drone approaches on moose space use, but moose moved > 4-fold greater distances and used larger areas after ground approaches. Similarly, longer-term (24-h before and after approaches) space use did not differ between drone approaches compared to days without known disturbance, but moose moved comparatively greater distances during days of ground approaches. In conclusion, we could show that drone approaches

were highly efficient to detect adult moose and their calves, being faster and less disturbing than ground approaches, potentially making them a useful tool to monitor and study wildlife.

Aliens vs. immigrants – Ground nesting in the landscapes of novel mammalian predators

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Keywords: agriculture, camera trap, nest predation, raccoon dog, wild boar

Many ground-nesting birds have experienced population declines in recent decades. These species include waterfowl, waders, and grouses, many of which are also considered important game species. The declines are mainly attributed to changes in breeding habitats and, partly, to changes in predator abundances. In this study we focused on two novel mammals in Finland, the raccoon dog (*Nyctereutes procyonoides*) and the wild boar (*Sus scrofa*). Both species are restricted by climate, dispersed from Russia, and benefit from mixed agriculture – forest landscape. The raccoon dog, an introduced alien, has spread earlier and wider in Finland, whereas the wild boar, an immigrant dispersing on its own, is relatively recent and mostly restricted to the south-eastern part of the country, near the Russian border. To assess the roles of these new nest predators, we conducted nest experiments with 426 artificial nests using pheasant eggs and game camera monitoring in 2015–2021. Cameras also monitored scent posts to estimate the site-specific predator abundances as visitation indices. The study was carried out in 35 sites within the core areas of the Finnish wild boar population, and 29 control sites outside of the established wild boar distribution. Control sites were also more agricultural as they are predominantly further from the eastern border in more temperate and eutrophic habitats. Corvids were responsible for 61% of all nest predation. The raccoon dog was the most common mammalian predator in both areas (13% of predation). However, in wild boar areas raccoon dog abundance was lower. Wild boars themselves predated only five nests (6% of total predation in the wild boar area). Our results indicate

that, with current wild boar densities, the species' nest predation pressure is low. Active transboundary movement and abundance of supplementary feeding may also divert wild boar movement and time allocation from searching other food sources on the Finnish side of the border. Current differences in predator communities between areas seem to even out differences in predation pressure. The future will show if increasing wild boar numbers deter smaller predators like raccoon dogs, or if the increasing predation by wild boars is solely additive. Such an increase could be highlighted in the more agricultural areas as wild boars prefer similar environmental conditions as raccoon dogs.

Evaluation of self-regulation by the shooting community: A case study on the voluntary restraint of woodcock *Scolopax rusticola* hunting

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The self-regulation of hunting activity in the United Kingdom is a vital part of improving the sustainability of wild bird harvest. In recent years, there have been calls to voluntarily shorten the open season for shooting woodcock, a popular wild quarry species, to reduce any potential impact on resident breeding birds. This call for voluntary behaviour change offers an opportunity to assess bag data and understand if hunters are adhering to these self-imposed regulations. Due to a lack of standardised bag recording in the UK, this study uses 'messy datasets' in the form of large membership surveys, game bag censuses, game card records from shoot days, game dealer records and wings submitted by hunters. Collectively, these data sources allow the authors to document game bag trends and behaviour change in hunters from a range of qualitative and quantitative sources. This work addresses the state of voluntary compliance to recommended hunting dates in the UK, and the impact of appropriate messaging. We discuss the possibility that with a collective effort to conserve wild quarry, legislation changes may not be necessary to achieve sustainable harvest rates.

Phylogeography and distribution of moose (*Alces alces*) in Eurasia during the last 50 000 years

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Keywords: expansion, extinction, genetic diversity, mitochondrial DNA, recolonization, stable isotopes, cold-adapted species

We analysed the range, habitat and mitochondrial DNA variability of moose (*Alces alces*) in relation to environmental changes in Eurasia since the Late Pleistocene. In our study, we analysed both contemporary and radiocarbon-dated moose samples, their whole mitochondrial DNA (mtDNA) genomes as well as stable carbon (δ13C) and nitrogen (δ15N) isotope composition in bone collagen extracted from selected samples. The range of moose and their genetic diversity were larger in the Late Pleistocene and the Early Holocene than today, and they have changed as a result of climatic oscillations and human impact. After surviving in several refugia during the Last Glacial Maximum (LGM), moose rapidly recolonised more northerly located areas that were released by the glacier. By the Early Holocene, moose was found almost everywhere in Europe, except the southernmost areas. Then the moose's range began to decline. The most dramatic contraction occurred in the last few hundred years, probably due to intensive over-hunting by humans. Some of the genetic variants of the species have not survived to modern times. Today we have three mtDNA clades of moose in Europe. Two of them, the Western and the Central ones, have suffered the most because of range contraction during the Holocene.

Nocturnal activity of wild animals in response to a higher (Czech Republic) and lower (Japan) human presence during the COVID-19 pandemic

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Keywords: anthropulse, camera trap data, day-night activity, human-wildlife interaction

The COVID-19 pandemic modified human presence in recreational, urban and rural areas. As a result, it provided a unique opportunity to measure the effects of varying human presence on wild animals and their activity. We analysed wildlife activity patterns from camera trap data in Japan and the Czech Republic during the COVID-19 pandemic, when restrictions on human leisure activities were introduced but not always followed. In the study area of the Czech Republic (suburban forest area "Kostelec nad Černými lesy" near Prague), human visits during the COVID-19 pandemic increased in 2020 by 53% from 2019, while in Japan (forest-farm area "Kouzu" in the Gunma prefecture) an 18% decrease of human visitors was observed in 2020 compared to 2019. Those two areas represented opposite sides of the change in human activity (anthropulse) induced by COVID-19 restrictions. In the Czech Republic, we expected to observe a higher night activity across animal species triggered by increased human presence, compared to Japan, where higher day activity of wildlife was expected due to decreased human presence. We observed 17 different bird and mammal species in the Czech Republic and 13 in Japan. We focused the analysis on the taxonomic groups present in both study areas. Hourly activity data showed a peak of wild animal activity at dawn and dusk of the day in both study areas. The number of human observations peaked between 11 am and 3 pm. Model calculations show that human presence affects the nocturnal activity of wild animals. Both areas showed an increase in nocturnal activity in relation to human presence. The response of wild animals to humans was more pronounced in the Czech Republic ($\beta = 0.009$, $p < 0.02$) than in Japan ($\beta = 0.008$, $p < 0.07$). We suspect that the stronger response to nocturnal behaviour in the Czech Republic is related

to the increased human presence forced by the COVID-19 pandemic in 2020. Camera traps effectively show how human presence affected the activity pattern of wild animals during the COVID-19 pandemic in the year 2020.

Effects of human disturbance on red deer and subsequently on the natural succession from the pointed bulrush society (*Juncetum acutiflori*) to the Aurora willow srubs in Eifel National Park

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Keywords: long term study, red deer, touristic influence, vegetation survey

The study analyses the effects of increasing human activities on the natural succession in the “Wüstebach-Valley” in Eifel National Park. In this highland valley since the middle ages the original plant communities of beech forest and alder forest along the brooks developed by extensive forms of cattle grazing and mowing to substitute associations of anthropogenic and zoogenic grasslands. Since the 1970s these valleys are nature reserves. Besides they are important feeding grounds for red deer. For the *Juncetum acutiflori* the effect of an increasing number of visitors since the Eifel national park is founded on the impact of red deer is studied by vegetational surveys. The Eifel National Park is a 110 km^2 woodland reserve in the German low mountain range (altitude 200–624 m) founded in January 2004. The number of visitors increased from 450,000 in 2007 to more than 870,000 in 2015 and 1 016,000 in 2022. Consequently open valleys are less available for red deer: The effects on the natural succession are studied.

The succession for the period from 1983 to 2021 is analysed by means of vegetational surveys on sample areas from 2 × 2 m, created according phytosociological criteria in 1983. Vegetational surveys focused on the estimation of the cover of all plant-species. Cover is defined as the vertical projection of above-ground parts on to the ground. The empirical material is presented as plant sociological table. For each species, the degree of coverage was given according to a percentage scale from 0 = 0%, 1 – up to 5% and then in 25% steps up to 5 = 75–100%.

The changes in the degree of coverage of plant species indicates the development from the *Juncetum acutiflori* to the ear willow bushes. A forest road following the valley can be found in a map of 1938 – up to the 1980tees this trail was only used by hikers during the weekend. With the beginning discussion for an Eifel National Park the numbers of hiker and bikers increase during even during the week. With the increasing numbers of people the plant community changed from *Juncetum acutiflori* to willow brushes, mainly beginning in the year 2000. Even small sample areas according phytosociological criteria indicate the vegetation development and the effects of the disturbance of wildlife on the natural succession. A long term monitoring is needed and the visitor management has to be improved.

The use of hunters and Polish Hunting Association (PZŁ) structures in African swine fever (ASF) eradication program in Poland – resources, difficulties, wasted efforts and means for improvement of future taken actions

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Keywords: African swine feaver, ASF, eradication, hunters, wild boar

ASF control and eradication process depends on cooperation of three parties: veterinary officials (Veterinary Inspection – IW), pig farmers/pork producers and hunters responsible for management and control of wild boars. Although the strong necessity for joint actions is obvious, the implementation of this cooperation in Poland seems to leave a lot of space for improvement. Specifics of so called Polish hunting policy/model may not be fully understand by officials from government or IW. Motivations, scope of competence and actual skills of hunter community seem to be either largely unknown or not considered by policy makers when working on strategic plans or legislation about ASF issues. The nine year observation of fight with disease, from the perspective of country veterinarians, scientists, hunters, academic teachers and policy consultants

in comparison with large set of administrative decisions, local law acts, national law and formal strategies for ASF control – shows that lack of communication and mutual understanding may be the leading reason for low effectiveness of taken actions. This work is set on showing basic mechanisms of official actions taken in course of fighting with disease and focused on either use of hunters or regulation hunting activities for the purpose of fighting animal diseases. On real life examples authors aim for explaining how ill constructed procedures or not enough holistic attitude may disprove effectiveness of actions against ASF. Proposals for ways of improvement the cooperation with hunters and making their input more effective are shown.

The lack of mechanisms for collecting and sharing information about daring wolves and risky behaviors combined with biased event analysis may seriously increase the risk and frequency of severe conflict events

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Keywords: attack, conflicts, fearless wolves, predation on human, wolf aggression

Authors performed analysis of chosen cases of fearless behavior, attacks on humans and events in wich wolves may be considered as a possible predator or scavenger in relation to a man from last 5 years in Poland. The possible reasons and sequence of events that eventually leads to this kind of interactions were previously described by other researchers. Authors of this work recognized, that theory about wolf as shy and harmless for human animal should be revised, at least in Polish reality. There is a substantial probability , that rapid growth in frequency of serious conflict records is not only an effect of improvement in information sharing (largely by social media), but it is a reflection of actual changes in wolves behavior toward people. Basing on information obtained from

Regional Directorates for Environmental Conservation (RDOŚ), General Directorate for Environmental Conservation (GDOŚ) and Forest Inspectorates the lack of organized gathering and analysis of information about risky and otherwise problematic wolf behavior may be observed. Officials seems to lack administrative tools and procedures for coping with problematic animals or packs. Information about dangerous animals may be disbelieved and citizens applying for mitigation of the problem may be discouraged by some of officials as well as by wolf protectionists. Lack of scientific publications in Polish language about those kind of problem may be observed. Interpretations of dangerous events provided by researchers seems to be biased in favor of wolves, and trough and objective analysis of particular cases are often not performed. Lack of official taken actions may induce increased frequency of illegal killing what was repeatedly described for wolves and other large carnivores in many countries and by multiple authors. The actual efficiency of illegal killing in mitigation of human-wolf conflicts may be low or opposite to expectations.

Large scale recovery of beaver population in Poland requires adjustment of legal regulations and administrative procedures dedicated for this species management

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Keywords: beaver, control, population management, wildlife conflicts

On the example of standard administrative decision for culling eight individuals of beaver *Castor fiber* in particular fish production unit in northern Masovia , authors discuss out of date regulation for this species management in Poland. Law regulation combined with decision making process influenced by somehow reserved and protectionist mind set of officials from regional departments of environment conservation (RDOŚ) is likely the major reason for extremely low efficiency of control actions. Although careful actions with even local reductions

of beaver numbers may be beneficial for this species as for other that wetland or water dependent, the same time it is highly ineffective with mitigation of problems secondary to large growth of beaver population and its range. Financial and infrastructural losses together with public safety problems and whole spectrum of difficulties secondary to bever activity requires effective, not expensive and possibly easy for performing ways of control and management of populations. In many ways current legislation make removing problematic animals either ineffective or extremely expensive. Authors discuss mechanisms of beaver control in Poland focusing on all range of biological, legal and practical limitations. Without, at least partial, change in attitude to beaver management problems secondary to activity of this animals are expected to grow altogether with financial losses an sociological tensions.

Effect of wild boar (*Sus scrofa*) rooting on soil organic matter and total nitrogen contents in a protected grassland in Budapest, Hungary

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Keywords: NIR, protected area, soil characteristics, urbanization, wild pig

Wild boar (*Sus scrofa*) population has been steadily increasing over the previous decades in all its range, reaching grasslands, forested, and even urban areas, including major European cities, like Budapest, Hungary. The effects of wild boar on vegetation affected by its grubbing, rooting, and other feeding behaviors, have already been widely studied. In our ongoing research we are interested in the long-term impact of the rooting behavior on soil characteristics, particularly in the ability of the soil to sustain herbaceous and woody vegetation, which largely depends on its organic matter and nitrogen contents. Our study area is

situated in Vörösk̋vár, Budapest, which is a protected peri-urban grassy area. There, intensive wild boar foraging activities have a profound impact on the vegetation dynamics of herbaceous species and on shrub encroachment. In April 2023 we sampled 40 rootings within a research grid of 100 × 500 m (5 ha). Samples were taken in three locations as compared groups, such as 1) inside the rooting (the pit), 2) in the ring (the circumference of the disturbed patch), 3) in a control location within 1–2 m distance from the rooting. Each sample was composed of 5 subsamples to increase the representativity for the local environment and taken from the upper 5 cm of the soil. The samples were refrigerated and later analyzed with a near-infrared (NIR) spectrometer to obtain information on chemical characteristics, including the pH, organic matter, and total nitrogen contents. A repeated measures ANOVA was conducted for each of the parameters. There were significant differences between the three groups (rooting, ring, control) in organic matter and total nitrogen content, although the pH did not differ significantly. Further analyses showed that the content of both, organic matter and total nitrogen were lower in the rootings, while being higher in the control measurements. A continuous one-year study with rooting mapping, vegetation survey and soil composition analysis are being carried out in the area, to determine if the impact is sustained over time and how it can influence the vegetation patterns. Wild boar is a high-impact species, monitoring their adverse and beneficial effects on protected grasslands for providing basis of species and habitat management is of paramount importance.

Estimating the genetic diversity of Mediterranean wild boar as a tool for future management strategies

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Keywords: gene flow, genetic structure, islands, microsatellites, *Sus scrofa*

The wild boar (*Sus scrofa*) is widespread across continental Europe and on the islands and coastal areas of the Mediterranean basin, as a result of natural migrations and anthropogenic impact. Monitoring the genetic diversity and structure of wild boar populations is important for developing management strategies and preventing potential epidemiological risks and negative environmental impacts. For this study, 216 wild boar samples collected in the coastal areas and islands of Croatia, Italy, France, Spain, Greece, and Tunisia were analysed and compared with 69 genotypes obtained from the continental parts of these countries, except Greece, and 30 domestic pigs using a set of 15 autosomal microsatellite loci. The wild boar populations from Arc en Barrois (France), Sicily (Italy) and Greece showed a high proportion of private alleles. The highest genetic distance (FST) was found between the two islands of Asinara and Caprera in Sardinia (Italy). Notable genetic diversity was found in more than half of the wild boar populations studied, with observed (Ho) and expected (He) heterozygosity ranging between 0.378 and 0.682, and from 0.376 and 0.693, respectively. Despite only the Greek islands showing a deviation from Hardy-Weinberg

equilibrium, nearly 70% of the populations showed statistically lower He than Ho. DAPC analysis revealed seven clusters and showed fragmentation of populations and isolated, genetically distinct island populations. The wild boar populations from Sicily and Tunisia showed distinct genetic clusters, whereas populations from the north-eastern part of Italy (Gorizia), the interior of France, Corsica, Istria, and northern Croatia shared a similar genetic composition despite the broader geographic range. Croatian wild boar populations were divided into three clusters separating populations from the southern islands from those from the northern islands. Gene flow between populations was found between neighbouring islands and islands and nearby coastal areas. The Sardinian populations shared the cluster with individuals sampled in the Apennine Peninsula. Two domestic pig breeds were assigned to a separate cluster while hybridisation was detected in the domestic pig from Sardinia. The analysis of the genetic diversity of wild boar in the Mediterranean basin provided the most relevant information on the population status of the species and will contribute to the advancement of monitoring strategies and indicators to improve management decisions.

Chemical screening of wild boar livers indicates contamination hotspots of per – and polyfluoroalkyl substances

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Keywords: Emerging contaminants, precursor potential, chemical monitoring, persistent compounds, bioindicator

Environmental contamination by per – and polyfluoroalkyl substances (PFAS) is a health risk for both animals and humans. PFAS are highly stable chemicals used e.g. in fluoropolymer production, paper and textile industry. However, their stability is also cause for long-term contamination in the environment. Currently, the EU debates a possible restriction of the entire chemical class. As omnivores, wild boars biomagnify PFAS in the food chain. Further, they are exposed to PFAS in a unique way through their intense rooting behaviour. Local authorities in Germany already issued warnings for the consumption of wild boar livers from certain regions. In this study, livers of 50 wild boars from two contamination hotspots and one reference area were analysed for 66 PFAS to assess the suitability of wild boar as a bioindicator for the terrestrial contamination. Sampling areas 1 and 2 are located in South-Germany where PFAS were emitted over years by leaching of PFAS-loaded paper sludges on arable land and by a fluoropolymer production site, respectively. The reference area is located in a part of North-East Germany, where so far no specific contamination has been reported. For PFAS analysis, the challenge lies in the variety of possible compounds (about 10'000), which cannot be covered by any targeted method. Therefore, in addition to a wide-scope target screening, a new method was applied – the so-called Total Oxidisable Precursor assay – which reduces the large class of oxidisable PFAS

to their common backbone structures and targets these structures in the next step. By combining both analytical approaches, the total PFAS load could be estimated in all liver samples. In total, 31 PFAS were detected at least once. Sum concentrations ranged between 100 and 1000 µg/kg wet weight depending on the sampling area (reference area/hotspot 1 < hotspot 2). Based on maximum values of four PFAS (EU 2022/2388) being exceeded by a factor of 3.9 and 16 at the respective area, all livers were considered unsuitable for human consumption. While one compound was prominent in all samples (perfluooctane sulfonic acid, PFOS), the overall PFAS pattern differed between hotspots and reference area. These site-specific differences support the hypothesis that wild boar is a suitable bioindicator for PFAS contamination in the terrestrial ecosystem. Further analyses should study representativity of the sample set and resemblance to other environmental compartments and food sources. This presentation will already include first results of such a comparative study.

Temperature and weather effects on fecal genotyping success in elusive mesocarnivores

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Keywords: capture-recapture, genetics, methods, microsatellites, non-invasive, scats, SNPs

Knowing the population density of the targeted species is crucial in wildlife management. Unfortunately, obtaining (precise) population estimates of elusive species, especially where individuals cannot be identified visually, can be challenging. In such cases, capture-recapture approaches using non-invasive genetic methods, such as scat or hair samples, can be a promising solution. However, these methods are both labour – and cost intensive and rely on the ability to genotype individuals correctly. Thus, optimising the factors that affect the success of environmental sampling is of interest for every monitoring program. Since

temperature and humidity affect the degradation of genetic material, adjusting the sampling period to the weather conditions could be one possibility for field ecologists. For this purpose, we investigated the genotyping success of two central European elusive mesocarnivores: red fox (*Vulpes vulpes*) and pine marten (*Martes martes*), in an experimental setting. Fresh scats were exposed to four different environmental treatments (combinations of temperature and precipitation) representing different climatic conditions in central Europe. Each scat was sampled multiple times over the course of the experiment resulting in a time series of genotyping performance for each treatment. We analysed fox and marten scats with microsatellite markers. In addition, fox scats were also analysed with a novel single nucleotide polymorphism (SNP) marker set. While the performance of the SNP marker set was generally better than of the microsatellite one, the environmental treatments had no effect on genotyping performance for both species. However, the duration during which a scat was exposed to the elements had a significant negative effect. As a consequence, for monitoring, the weather conditions during the collection of mesocarnivore scats can be neglected, as least from a genetic point, while efforts to obtain fresh scat samples should be prioritised (even though older scats still can be genotyped albeit to a limited success rate).

Anthropogenic food resourcing of red foxes (*Vulpes vulpes*) and their impact on breeding wading birds in a busy national park

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Keywords: anthropogenic food, breeding waders, predation, red fox

Across Europe ground-nesting wading birds continue to suffer from long-term population declines, and high levels of nest and chick predation are recurring causes of low productivity. To prevent further population declines and stimulate recovery, it's imperative that wildlife managers identify which predatory species are responsible for limiting breeding success so predation-risk can be effectively managed. Where common generalist predators are involved, it is also important

to understand which food resources are contributing to their local abundance. The New Forest National Park in southern England is a nationally important site for breeding waders of high conservation concern including Eurasian curlew (*Numenius arquata*) – which is now regarded as the highest conservation priority bird species in Britain – Northern lapwing (*Vanellus vanellus*), and Eurasian oystercatcher (*Haematopus ostralegus*). It is flanked by an urbanized coastal-zone, includes numerous settlements and has the second highest human population density of any National Park in Britain. It attracts over 15 million day-visitors a year, most of them during the bird nesting season. The red fox (*Vulpes vulpes*) is a generalist predator that thrives in human-modified landscapes. Foxes are highly adaptable scavengers, adept at living in both urban and rural environments and they can benefit from anthropogenic food sources. Between 2021 and 2022 we used trail cameras to monitor the fate of 140 wader nests across the National Park. We documented 62 nest predation events, of which 56% were attributed to foxes. Synchronously, we collected 452 stomach samples from foxes culled during the critical wader nesting and chick-rearing period by professional wildlife managers. Macroscopic analysis of stomach contents showed foxes to have a varied diet with no single food resource predominating. However, anthropogenic foods– especially human food waste – comprised 12% of overall fox diet and was closely associated with proximity to human settlements and tourist infrastructure. We conclude that high levels of nest loss caused by foxes poses the predominant threat to wading birds that breed in the New Forest National Park. More effective predation management solutions are urgently required to improve nest survival. In the short-term, intensifying lethal fox control is the only viable option, but longer term, better human waste sanitation coupled with an education program directed towards National Park residents and visitors will reduce the availability of anthropogenic foods which currently benefit foxes and other generalist predators.

How quick and effective is popharvest for assessing the sustainability of migratory bird hunting in Europe?

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Keywords: birds, harvest, hunting, management, sustainability, wildlife

Concerns regarding the environment and biodiversity are increasing in Europe, and worldwide, making the sustainability of hunting a growing issue. This is especially the case regarding migratory bird species. In the EU, the Birds Directive regulates the hunting of birds, e.g., by setting sustainability obligations and restricting the species that can be hunted to 82, listed in Annex II of the Directive. EU Member States are required by the Birds Directive to report on the status of their birds every 6 years. After the assessment of the last reporting cycle (2013–18), the EU State of Nature report (2020) indicates that nearly half of all bird species have a poor or bad population status and that a third have a declining trend in the EU. Half of the game bird species have a non-secure EU status, of which 33 are migratory, most of them waterbirds. A recent policy process developed by the European Commission is now aiming at the recovery of bird species, starting with the species in Annex II and the assessment of the impacts of hunting. While these species have a non-secure EU status, some of them have large populations, increasing trends or low harvest across the EU. Individual assessments are therefore required. However, sufficient knowledge on population dynamics constitutes the main challenge for assessing the sustainability of hunting. To alleviate this, methods requiring only sparse or incomplete data have been computed, such as the Demographic Invariant Method (Niel and Lebreton, 2005). More recently, this approach has been made freely and easily accessible in the form of the R package Popharvest, specifically designed to provide a quick and easy tool for a first assessment of the sustainability of bird harvest (Eraud et al., 2021). Here, we provide a first straightforward example of test scenarios, comparisons, and practical use of this R package to wildlife managers and decision-makers. First, two species are used to propose a methodology in using the package for assessing hunting sustainability using the current data available and to test the choice of one parameter representing the caution with which the users choose to assess harvest sustainability. Comparing

with past situations, we show that for these species, an overly strict approach in the choice of the safety factor would have resulted in hunting being deemed unsustainable, and potentially resulting in unnecessary restrictions, while it was not the case. Second, two species for which Integrative Population Models have been produced in the framework of existing Adaptive Harvest Management Programmes are used to assess the reliability of popharvest results' against the results of programmes that involved much higher costs and workload. Comparing popharvest and the IMPs' results, we show that popharvest produces reliable outputs. Third, using the methods tested in the above scenarios, we produce a first global assessment of the sustainability of hunting for the 33 migratory species which are in a non-secure EU status. The assessment shows that popharvest does not detect potential unsustainable harvest for most species but also shows potential overharvest for some others. This first rapid assessment may serve as a basis for priority setting of case-by-case analyses.

On the dog's tail: An insight into GPS telemetry

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Keywords: behaviour, *Canis familiaris*, driven hunt, game management, population control, wild boar

Driven hunts are one of the most important and effective hunting methods for controlling wild boar populations and are conducted mainly during the winter months using hunting dogs, i.e., scent hounds. The behavioural patterns of hunting dogs during these hunts have rarely been studied, although GPS collars are commonly used on hunting dogs. GPS collars provide potentially useful information that can be used to model wild boar responses to hunting dogs. Therefore, the objective of this study was to quantify movement and behaviour patterns of hunting dogs in Mediterranean habitats using GPS collars. Data preparation and spatial analysis was performed using QGIS and all other statistical analyses were performed using R. During the winter season 2022/2023, we collected 153 tracks of GPS collars from hunting dogs of seven breeds of both sexes. The average duration of the hunt, i.e., the hounding was ~3 h with the average route length of 14,6 km. The altitude ranged between 27.4 m and 435 m a.s.l. Through the track

analysis, we detected 216 heat zones of dense signal in 72 tracks, assuming that these zones represent the zone of contacts between wild boar and hunting dogs. During these hunting events, the total of 83 wild boar were culled, averaging to ~4 individuals per hunt. Most of these contacts occurred in dense vegetation, in places where wild boar normally finds a safe hiding place during the day. These new findings on the behaviour and physiological mechanisms of hunting dogs may contribute to better guidelines for wild boar management.

Population viability of red deer as a free-ranging population in the Obedska bara region of Vojvodina, Serbia

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Red deer populations in Vojvodina are continuously present in the forested areas of the province, mainly within fenced enclosures with stock sizes fluctuating around 4,000 individuals, while established free-ranging populations throughout the province being up to five times less abundant (total estimated stock being up to 5,000 individuals). South of the Danube and Sava rivers, their populations frequently go locally extinct due to illegal hunting and habitat degradation. According to established state priorities for artiodactyls as followed up by the dominant management authority in the region (JP "Vojvodinašume"), we assessed red deer viability in the Obedska bara region (cc. 360 km^2). Presently, around 190 red deer are present in fenced enclosures, up to 30 are free ranging. First we assessed a habitat suitability profile for the area. We used five readily available forest management factors – urbanised and agricultural areas were separately assessed. Additionally, two factors related to anthropogenic pressure and disturbance were scored based on data obtained through fieldwork. Optimally suitable habitat patches were identified. Second, we used a spatially explicit demographic model with quantitative parameters following recently proposed and consensually accepted modelling guidelines, for viable and

persistent free-ranging red deer populations. The full model for the area was iterated with a complex protocol of initial conditions over a time span of 15 full generations under a proposed regime of demographic and environmental stochasticity (20%). Four suitable demes, widely differing in size with sporadically present inter-deme dispersion were identified. Average HS values for the four demes were 8.11/10. Roughly 66% of the area was unsuitable for red deer, while 22% was at least moderately suitable (> 7.5/10). The predicted best-case capacities for HS values greater than 7.5/10, were around 155 individuals (≈0.5 individuals per km^2 for the whole area, 1.13 ind. per km^2 for suitable demes area). The overall meta-population was viable for initial conditions for at least K/8 with ER < 10%. Two of the four demes had average occupancy < 20 time steps and ER >> 10%). The estimated MVP of the overall population is between 14 and 20 individuals with initial sex-ratios of 3:1 (pre-reproductive females to pre-reproductive males) for ER < 10%. The area has moderately high habitat suitability for free-ranging red deer. Factors related to anthropogenic pressure were the most important HS determinants. Synchronization of adaptive management practices is considered the most effective strategy for maintaining a continuous red deer presence with sufficient abundances.

Age determination and setting times of Bavarian roe deer fawns (*Capreolus capreolus*) in the first days and weeks of life

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Keywords: *Capreolus capreolus*, condition, mowing, crown rump length, growth, birthing time

Every year in spring, numerous fawns (*Capreolus capreolus*) are born in Europe's meadows and forests. It is not uncommon for freshly set fawns to die from mowing in their first days or weeks of life.

The aim was to investigate how the fawns develop conditionally in the first weeks of life. Based on the physical development, a risk score should be given at the end of the project in order to reduce the mowing death of fawns in future.

So far, condition parameters have been taken from 1074 (197 in 2020; 449 in 2021; 428 in 2022) fawns. The weight, hind leg length, total length, head length and crown-rump length are measured. Furthermore, the condition of the umbilical cord, as well as the behaviour before the finding was documented. The fawns were marked with ear tags and 100 fawns were equipped with telemetry collars. The age of the fawns was determined up to 8 days after birth using the umbilical cord development according to Jullien, Delorme and Gaillard (1992).

A positive correlation with age showed that the crown rump length increases by 0.62 centimetres every day during the first eight days of life ($r = 0{,}247$; $p < 0{,}001$). The weight of the fawns is also influenced by age. They show a positive correlation ($r = 0.328$), and the values are significant ($p < 0.001$). The examined fawns were born with an average weight of 1,229 grams and gained 138 grams every day. Using a generalised linear regression model with the parameters weight and crown rump length, the age and the time of setting could be calculated for the individual fawns. The mean birth date in the years 2020 to 2022 was the 146th day in the current year.

Both the change in crown rump length and the weight gain of the fawns show a significant linear growth during the first weeks of life. The mean setting time in the years 2020 to 2022 is just under 2 weeks earlier than described by Rick (1955) for the region.

The growth lines can be used to calculate the birth time for the recorded fawns, which is of great importance for the creation of a hazard line. In this way, the main birth time can be determined.

The timing of mountain hare (*Lepus timidus*) coat colour change in Norway is determined by elevation, latitude, and local climate

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Local adaptation to annually changing environments has evolved in numerous species. Seasonal coat colour change is an adaptation that has evolved in multiple mammal and bird species occupying areas that experience seasonal snow cover. It has a critical impact on fitness as predation risk may increase when an individual is mismatched against its habitat's background colour. In this paper we investigate the impact of landscape covariates on moult timing in a native winter-adapted herbivore, the mountain hare (*Lepus timidus*), throughout Norway. Data was collected between 2011 and 2019 at 678 camera trap locations deployed across an environmental gradient. Based on this data, we created a Bayesian multinomial logistic regression model that quantified the correlations between landscape covariates and coat colour phenology and analysed among season and year moult timing variation. Our results demonstrate that mountain hare moult timing is strongly correlated with altitude and latitude with hares that live at higher latitudes and altitudes keeping their winter white coats for longer than their conspecifics that inhabit lower latitudes and altitudes. Moult timing was also weakly correlated with climate zone with hares that live in coastal climates keeping their winter white coats for longer than hares that live in continental climates. We found evidence of some among year moult timing variation in spring, but not in autumn. We conclude that mountain hare moult timing has adapted to local environmental conditions throughout Norway.

Free-ranging cattle in the boreal forest: is their behavior affected by wolf presence?

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Keywords: behavioural classification, behaviours, interactions, livestock, remote monitoring, wolves

During the 20th century, when large carnivore populations were subject to eradication in Norway, farmers started to release their livestock unsupervised in the mountains and forests during summer. To make use of grazing resources in unproductive lands has since become a political goal. Since the 1970's, Norway has also committed itself to conserve large carnivores. The recent come-back of large carnivores causes high losses in unattended sheep herds, and therefore, farmers inside carnivore management zones are encouraged to use cattle as an alternative. Cattle have a hundred times lower depredation rate than sheep, indicating that cattle are likely an effective alternative for sheep in carnivore areas. Despite this pattern, farmers report negative effects such as increased stress and vigilance in cattle because of carnivore presence. Such non-direct effects potentially lead to income loss for the farmer because of reproductive and performance reductions. The need to further study the effect of carnivore presence on cattle is complicated by the difficulty of observing cattle in remote areas. We GPS collared all adult cattle (N = 70) in 8 herds in the Innlandet County of SE-Norway, stratified by animals both inside and outside the carnivore management zone. The collars had GPS and accelerometer sensors and were equipped with virtual fencing technology to keep the animals inside the grazing areas (areas were up to 25 km^2). Our primary aim was to understand how cattle were affected by carnivore presence through looking for changes in behaviours (e.g. grazing, resting, and vigilance). We classified behaviours of cattle using tri-axial accelerometry signatures and predicted the most common behaviours (e.g. grazing, walking, vigilance, and resting). We registered GPS positions

of cattle using 15-minute intervals with corresponding habitat and topographic information. We used step-selection functions at each change in behaviour and analysed how decisions of habitat related to detected behaviours. From preliminary results, we found that cattle used mostly forest roads for walking, as previously shown for both cattle and wolves. Additionally, we compared herds inside and outside the carnivore management zone to show potential effect of the presence of wolves. Our results provide novel insights about the compatibility of free-ranging cattle with carnivores and potential effects on animal welfare. Additionally, our results would contribute to informed decision making for wildlife management by providing insights about habitat use and the associated behavioral effects on cattle and how this knowledge can be used to aid co-existence with carnivores.

Demographic trends in huntable waterbirds in the UK using hunter-collected wing samples: A focus on Eurasian wigeon *Mareca penelope* and Eurasian teal *Anas crecca*

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Keywords: *Anas crecca*, demographics, hunting, *Mareca penelope*, waterbirds, wings

Wing surveys can provide invaluable information on the age and sex ratios of waterbird harvests. Many huntable species are showing population declines although there is a lack of accurate population data for many of these. In the UK, the British Association for Shooting and Conservation (BASC) has collected wing samples voluntarily submitted by hunters since 1965. However only a limited analysis of this dataset has taken place. This long-term dataset allows us to investigate any changes in the makeup of the shot population, when these changes occurred and why. In the present study, we explored demographic trends of waterbirds, with a focus on age and sex ratios, and breeding indices in samples of duck wings submitted by hunters. We specifically focus on Eurasian teal *Anas crecca* and Eurasian wigeon *Mareca penelope* due to their

popularity as a UK quarry species and the resultingly high sample size and consistent collection of data for these two species since the 1980's. This work discusses the biases in using hunter-supplied samples in demographic studies, but also highlights the merits of simple citizen science projects in enhancing our understanding of trends within under-studied quarry species. We will address both UK and flyway level trends derived from wing samples and what this means for sustainable shooting and areas of conservation concern.

Contrasting management goals for a transboundary moose population in Scandinavia

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Keywords: Äbin, activity area, hunter harvest, moose browsing survey, moose management, moose migration, Solbraa

The management of partially migratory moose (*Alces alces*) populations is challenging because costs from browsing damage on forest production and benefits from moose harvest are unevenly distributed among landowners. More complications arise if animals migrate across management units and even more across national borders. We studied this complexity in an area of boreal forest divided by the national border between Norway and Sweden. To map the spatial distribution of moose during two winters and summers 2019–2021, we conducted fecal pellet counts. In spring 2021, we conducted a large browsing survey that combined the Norwegian "Solbraa" and the Swedish "Äbin" method. Finally, we compiled harvest data from Norwegian and Swedish moose management units for the hunting years 2019/20 and 2020/21. Moose were evenly distributed throughout the study area during summer. During winter, moose concentrated in areas with little snow, while snow-rich areas in the north had very little moose. The winter concentration areas of moose were characterized by an increased browsing pressure on pine (*Pinus sylvestris*) shoots. The effect of moose on forestry

measured with the Norwegian method, i.e. the proportion of pine shoots that were browsed in the previous winter, showed that the browsing pressure on pine was mainly insignificant. In contrast, the Swedish method indicated a very serious state for the forest on the same sampling areas, based on the proportion of damaged pine stems. Consequently, there was a clear mismatch in the management of moose between the two countries. In Sweden, the management responded with high harvest rates to the high rate of browsing damage during previous winters. In Norway, harvest rates were reduced because browsing pressure was of no concern. Improved coordination of moose management across the border requires dialogue and collaboration between stakeholders, which can be facilitated by trans-boundary moose management units that span over the entire moose population range. We also propose calibration of browsing surveys and a joint traffic light model that is based on the density of undamaged pine stems rather than browsing pressure or degree of damage.

Exploring the Performance of Hunting Dogs in Driven Hunts

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Keywords: hunting dogs, driven hunt, hunting efficiency, dog performance, wildlife management, welfare

Driven hunts are one of the tools to maintain the population of wild ungulates, especially wild boars, in the Czech Republic. In this type of hunting, dogs are indispensable helpers. However, their performance in single drives is often discussed. This preliminary study aimed to analyse the factors affecting the performance of hunting dogs in driven hunts using GPS technology. The data were collected during 10 driven hunts (25 drives) in the hunting grounds of ČZU Forests in Kostelec nad Černými lesy in two hunting seasons 2019/2020 and 2020/2021. Hunting dogs were equipped with GPS collars to monitor their movements. A total of 99 hunting dogs of different breeds were evaluated. Data on the dogs' trails in the drive were edited in Garmin BaseCamp and Qgis. The results showed that the performance of hunting dogs on the drives decreased with the course of hunting time. Similarly, a decreasing trend is observed in the coverage of drives by hunting dogs, with hunting dog coverage decreasing as the number of drives increases. These results could help to highlight the importance of hunting management, especially by driven hunts. To increase the hunting efficiency and the outcome at the shoot, it would be advisable to focus on the correct composition of hunting dog groups in the drives and the optimal size of the drives so that their coverage by hunting dogs is maximized with maximum performance.

Forestry and environmental conditions as determinants of pine marten (*Martes martes*) occurrence in Norway

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Keywords: clearcutting, multi-scale, occupancy model, old forest

The pine marten *Martes martes* is often associated with late seral stage coniferous forest stands. Earlier research has indicated that this species may be negatively influenced by clearcutting practices. However, the effects of current clearcutting methods on pine marten occurrence in conjunction with changing environmental conditions are not well known. In this study, we combined four complete years of nationwide data collected during a long-term camera trap (CT) monitoring program in Norway. We employed a multi-scale occupancy model to investigate the relationship of pine marten occurrence to clearcuts (regenerating stands ≤ 10 years old) and forests ≥ 120 years old. We also examined pine marten detection in relation to habitat features (i.e., dominant microsite characteristics) and to varying snow depths and temperatures. We found no relationship between pine marten occurrence and the proportions of old forest and clearcuts at the landscape scale. However, at the habitat-patch scale, pine marten occurrence was positively associated with the presence of old forest patches and terrain ruggedness, but not with clearcuts ≤ 100 m from sites. At CT sites near clearcuts, the detection probability was negatively correlated with snow depth. In contrast, pine marten occurrence was positively associated with snow depth at CT sites > 100 m from clearcuts. Furthermore, the detection probability increased with temperature and the presence of boulders at CT sites. Boulders may provide important access points for foraging and cover for resting and predator avoidance. While studies indicate that pine martens prefer older forest and avoid clearcuts, the current level and scale of clearcutting in Norway does not appear to influence its occurrence at the landscape scale.

Occupancy dynamics of the Eurasian otter (*Lutra lutra*) and the American mink (*Neovison vison*) in riparian ecosystems in Western Macedonia, Greece

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Keywords: invasive species, Greece, *Lutra lutra*, mustelids, *Neovison vison*, occupancy

Understanding the drivers of population dynamics of wildlife species sharing similar resources is a fundamental requirement for their appropriate management. Revealing the pattern how an allochthonous species such as the American mink (*Neovison vison*) interact with a native protected species like the Eurasian otter (*Lutra lutra*) is of particular challenge. Knowledge on the interaction of species with different conservation concern is limited, especially in vulnerable riparian habitats in Greece. The aim of this study was to investigate whether habitat and landscape attributes may influence the presence of mink and otter by using multi-season single-species occupancy models. The study was carried out in riparian ecosystems of Western Macedonia in Greece under the LIFE ATIAS project (LIFE18 NAT/GR/000430). Forty-four transects of 500 m each, were located along the banks of lakes Mikri Prespa, Kastoria and Vegoritida, and Aliakmonas River. Each transect was surveyed two times per year (summer and winter) for two consecutive years (2021–2023). We ran occupancy models to estimate detection, initial occupancy, colonization, and extinction by applying a hierarchical process. Habitat and landscape features were obtained in a buffer of 25 m around each transect. Riparian Zones Land Cover (Copernicus Services) included habitat types, while landscape variables included 13 metrics which computed using FRAGSTATS. Eurasian otters were detected at 65.9% of sites surveyed, with a detection probability of 57.6% and a predicted occupancy of 68.1%. “Natural lakes” were the most influential predictor of Eurasian otter occupancy. Three habitat types, namely “land principally occupied by agriculture”, “railways and associated land”, and “river banks”, positively affected colonization of Eurasian otter. On the other hand, American mink was detected at fewer sites (25%) than otter, with a detection probability of 37.5% and a predicted occupancy of 29.8%.

The colonization probability and extinction probability of American mink were estimated at 9.15% and 59%, respectively. “Land principally occupied by agriculture with significant areas of natural vegetation” was the most important habitat variable explaining high American mink occupancy. Anthropogenic habitats such as “urban fabric with density < 80%” and “mineral extraction, dump and construction sites” favored colonization of mink. Habitat variables were more likely to predict both species occupancy, while landscape variables were failed. Colonization and extinction models for both species had low weights, and therefore should be interpreted with caution. However, other factors which contributed in the robustness of the models are discussed in detail.

The mink (*Neovison vison*) invasion: Understanding the drivers of non-native species spread in Greece

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Keywords: invasive species, occupancy, colonization, extinction, *Neovison vison*, Greece

Invasive species pose a major threat to biodiversity, and as a result, there is much interest in understanding the drivers of species’ occupancy dynamics outside their native range. The American mink (*Neovison vison*) was introduced to Greece for the fur farming industry. However, in 2010 an extensive deliberate release took place which resulted in several mink becoming localized in the general region of Western Macedonia in Greece. Following this event, in 2019 the LIFE ATIAS (LIFE18/NAT/GR/000430) project set off an effort to control the species’ spread and population size, by tracking and trapping individuals along Western Macedonia’s main rivers and their tributaries. Here, we aimed to highlight the key environmental factors associated with the species’ occupancy to better

understand and manage its spread. We recorded mink presence using floating rafts with clay cartridges as footprint tracking devices. We used dynamic occupancy models to investigate mink responses to certain landscape variables, as well as to predict mink site occupancy in the wider region. Records showed that mink were present throughout the study area, with an estimated initial occupancy of 58%. We found a positive association between occupancy and the availability of medium sized rivers (estimate: 1.37 ± 0.57), the percent cover of broadleaved forests (estimate: 1.91 ± 0.66), and the percent cover of agricultural land with natural vegetation (estimate: 0.65 ± 0.37). Colonization and extinction rates were estimated at 1.4% and 19%, respectively, with extinction being positively associated with the trapping efforts that took place in the region between 2021–2023. Finally, mink was more likely to be detected during fall and winter (estimate: 0.001 ± 0.001). The produced occupancy map highlights those areas that illustrate a high invasion risk, and can be used as a tool in guiding future management actions. In addition, assessing temporal and spatial trends in occupancy can give valuable information on the effectiveness of invasive species management programs, allowing managers to follow alternative approaches if needed.

Seasonal hair growth and loss in Eurasian wild boar (*Sus scrofa*) and its implications for research

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Knowledge about hair growth and loss in wildlife is important for research in different contexts like measuring stress and reproductive hormones, biomonitoring of heavy metals and – depending on the species – in telemetry studies, too. In wildlife telemetry, when devices are glued on fur it is essential to know when the fur is fully grown and when change of coat starts so scientists can plan the capture and tagging, recovery of tags and estimate how long the tag will

provide data. In wild boars, collars, the standard method for fixing GPS-tags on larger terrestrial mammals, often fail due the pig specific massive neck that has nearly the same diameter as the head, so collars often slip off or fit too tightly. Another solution for fixing GPS on wild boars is to glue the tag on the fur so it can`t get lost until it drops with next change of coat. The disadvantage of this method is, in contrast to GPS-collars that can remain on animals for up to years, is that the dwell time of the tag is limited by hair growth and loss. To maximise this time and therefore the data that can be collected, it`s vitally important to know when the felt like undercoat – that makes sure the glue does not get in touch with the skin – is fully grown. To get an overview of the seasonal hair growth and loss in Sus scrofa we used sustainable hunted wild boar from Nuremberg`s imperial forest (Nürnberger Reichswald) in Bavaria, Germany. Mid of each month (July 2022 – June 2023) we examined the fur of two to four specimens, depending on hunting bags, (N=X) from three different age classes (24 months (n=X) and both sexes (n=X males, n= X females) for presence of winter coat in autumn and loss of undercoat in spring. Mid of September undercoat was fully grown (first growth from mid of August), whereby shed of undercoat in some individuals starts in April. Consequentially telemetry tags can be glued on wild boar in September and can remain on the animals at least until April covering the interesting time of mating, birth and separation of previous year`s piglets from females and driven hunts. Furthermore, hair from undercoat for analyses can be used from mid of September as afterwards no further growth and therefore storage of hormones, trace elements etc. will happen. > Please note: data collection will be finished mid of June 2023, therefore final numbers can be provided in July.

Integrated monitoring of hares (*Lepus* spp.) in Sweden using thermography and environmental DNA

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Keywords: distance sampling, hybridisation, monitoring techniques, mountain hare, non-invasive DNA, single nucleotide polymorphisms, thermal imaging binocular

The harvest data of hares (*Lepus* spp.), and especially of the native mountain hare (*Lepus timidus*), have declined with 94% between 1990 and 2021 in Sweden. Based on this development, the mountain hare was listed as “near threatened” in the Swedish Red list in 2020. Reasons for this decline might be inter alia hybridisation between the native mountain hare and the non-native brown hare (*Lepus europaeus*), which might favour brown hare in an evolutionary point of view. Climate change and a mismatch of pelage colour to snow cover might contribute to that problem, since it might increase predation pressure on mountain hares. Population estimates are based on hunting bags, since other widely used monitoring results are lacking for hares in Sweden. When population size is high, precision is not vital, however when population size decreases, the demand for precision increases. To acquire more detailed estimates of population sizes and the degree of hybridisation we used an integrated monitoring approach to combine distance sampling with thermology techniques and DNA-sampling in one study. We used three different study areas in the middle of Sweden; Fiholm, Lisjö (Västmanland county), and Grimsö Wildlife Research Area (Örebro county). We walked four transects each of one kilometre length in a square. We revisited the study areas and transects five times. The monitoring was done in daylight using thermal imaging binoculars and frequent scanning for hares on both sides of the transect. Detected hares were approached and flushed to collect DNA-samples from the lay and, if possible, a visual species determination. Within 15 inventory days distributed from November 2022 to February 2023, we detected 29 hares in total of which 79% were detected with heat binoculars. The detection distance differed between land cover types and reached up to 315 meters in agricultural land. Among all observations, 55% were in forest habitats, i.e., hares that would not have been found without the thermal imaging binoculars. With distance sampling we calculated a hare density of 0 at Grimsö, 6.4

hares/km² at Lisjö, and 8.1 hares/km² at Fiholm. The DNA-samples to understand degree of hybridisation remain to be analysed. In this pilot study, we show that an integrated monitoring approach using thermal imagery increase the number of hares detected during distance sampling and provide more precise population estimates. The method has potential to gain knowledge in habitat preferences and degree of hybridisation among hares.

The spatio-temporal pattern of agricultural crops damaged by wild boar (*Sus scrofa*) in south-western Poland

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Keywords: cereal crops, damage compensation, grassland, maize, population density, root crops, seasonal changes

A survey of damage caused by wild boar to farmlands was carried out in 105 hunting districts covering a total area of 641.4 km² in the years 2014–2017. The surface area of 14 species of agricultural crops damaged by wild boar and the amount of damage compensation increased during the three years from 770.7 to 1050.8 hectares and from 319.9 to 407.1 thousand euros, respectively. A significant increase in the area damaged by wild boar and damage compensation only occurred in grasslands ($p = 0.014$, $p = 0.011$). The mean amount of damage compensation per one hectare was EUR 395.6 and varied from EUR 173.8 (grasslands) to EUR 987.8 (root crops). In early spring (March – April), grasslands experienced the largest proportion of wild boar-inflicted damage (65%). In late spring (May – June), damage occurred chiefly in immature green maize (70%), whereas in summer (July, August, September) damage to various cereal crops predominated (75%). In autumn (October – November), most damage was recorded in maize (90%). In winter (December, January, February), wild boar damaged mainly grasslands (45%). During the annual cycle, the percentage of farmlands damaged by wild boar formed two clusters: early spring (28.4%) and summer (31.9%). The lowest value of this parameter was recorded in winter (5.5%).

The relative population densities of wild boar and the surface area percentages of damaged farmlands in the study area ranged from 1.13 to 2.60 individuals/km^2 and from 0.16% to 0.38%, respectively. These two variables were positively inter-correlated ($r = 0.670$, $p = 0.033$, $n = 10$). Compensation values per hectare of wild boar damage obtained by Polish farmers are considerably lower than those provided to farmers in southern and western Europe.

Flower resources for pollinators in arable field margins – the potential food resources for birds in farmland habitats

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Keywords: annual and perennial plants, balks, blooming abundance, dicotyledonous, farmland birds, road verges

Numbers of flowering annual and perennial dicotyledonous species as well as numbers of their flowers occurring at road verges and balks were compared. The fieldwork conducted in 2019 and 2020 included data collection from 12 road verges and 12 balks, each measuring 150 m in length. The number of species found at road verges ($n = 78$) was higher than the number of species found growing at balks ($n = 44$). Likewise, the number of flowers at road verges ($n = 44.4$ thousand) considerably exceeded the number of flowers occurring at balks ($n = 21.1$ thousand). In total, 88 flowering species and 65.5 thousand flowers were recorded in the 350 ha study area throughout the two years. The mean number of flowering species at balks was lower in both years than corresponding variables measured for road verges, the differences being statistically significant. The mean number of flowers at balks was also significantly lower than at road verges. The demonstrated differences are mainly caused by herbicide spray drift from sprayed arable land. Consequently, floristic resources for pollinator insects are lower at balks than road verges. Measures are suggested to increase the biodiversity of semi-natural grassland communities for pollinator populations at arable field boundaries. Impact of pollinators upon amount of the potential resources for birds in farmland habitats is discussed.

Sex-specific seasonal variations of wild boar distance traveled and home range size

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Keywords: continuous-time, ctmm, daily range, movements, spatial behavior, *Sus scrofa*

Distance travelled and home range size describe how animals move in space. The seasonal variations of these parameters are important to comprehensively understand animal ecology and its connection with the reproductive behaviour and the energy costs. Researchers usually estimate the distance travelled as the sum of the straight-line displacements between sampled positions, but this approach is sensitive to the sampling frequency and does not account for the tortuosity of the animal's movements. By means of the continuous-time movement modelling which takes into account autocorrelation and tortuosity of movement data, we estimated the distance travelled and monthly home range size of 28 wild boar *Sus scrofa* and modelled their inter-sexual seasonal variability. Males travelled longer distances and used larger home ranges than females, particularly during the rut in autumn-winter, consistently with the different biological cycles of males and females. Males enlarged their home rages during the rut but travelled constant average distances along the year, whereas females travelled shorter distances in correspondence with the peak of food resources and birth periods but exhibited constant home range size across seasons. The differences between the seasonal variation patterns of distance travelled and home range size, observed in both sexes, revealed the complex relationship between these two aspects of spatial behaviour and the great opportunity of including both distance travelled and home range size in behavioural ecology investigations. We provided a detailed analysis of wild boar spatial behaviour and its relationships with the reproductive cycles of males and females, promoting a deeper comprehension of their behavioural ecology.

Behavioral plasticity of wood pigeons in migratory and feeding strategies

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Keywords: argos tracking, migration, wood pigeon, behavioral plasticity

The wood pigeon *Columba palumbus*, a species of forest origin, is particularly opportunistic in terms of the use of its habitats, at all latitudes and in all seasons. Indeed, the migratory status of the bird differs according to the latitude, according to a northeast/southwest gradient, in connection with the duration of snow cover on the ground and the winter temperature. It therefore employs three migratory strategies (strictly migratory, partially migratory and sedentary) throughout its European breeding areas. While the ringing data had provided some elements to identify the different behaviours used by wood pigeons, many gray areas remained. In partnership with the University of Giessen, we conducted a study on the migration strategies used by individuals breeding in Central Europe (Germany) and South-West Europe (Portugal, France) taking into account seasonal environmental variations (Schumm *et al*. 2022). To this end, satellite data from individuals equipped with Argos system were analysed very precisely. Of the sixty birds captured and then fitted with Argos, only those that provided multi-year data were retained. It has thus been possible to observe, on several occasions, differences in opposite migratory strategies for the same individual from one year to another (sedentary or migratory). These variable behaviours can result in annual fluctuations in the number of migratory and resident individuals. The very significant inter-annual variations highlighted by the monitoring of trans-Pyrenees migration carried out by GIFS France could be linked, at least in part, to these different migratory strategies. At first analysis, it seems that accessibility to food resources is also an important factor in the decision to stay or migrate, with the wood pigeon proving to be particularly opportunistic at this level as well (Négrier *et al*. 2020). Birds have the ability to adapt to the local resources available at a given time. Overall, the results highlight the behavioural plasticity of wood pigeons in migratory strategies, across individuals and populations.

Red deer stag home range and movement activity in Vrancea mountains, Romania

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Keywords: red deer, spatial ecology, home range, movement activity

This is the first study in Romania analyzing the spatial behavior of a male red deer (*Cervus elaphus*) from December 10, 2019, to December 31, 2020, using GPS telemetry at Mountain Vrancea, Covasna County. We captured and collared a male red deer with a GPS collar (Vectronic) and tracked it for 387 days. The study aims to obtain information on the ecology of red deer movement in a habitat where the species is a potential prey of a protected species, the grey wolf (*Canis lupus*). Based on the location coordinates 9,292, the adult male's annual mean home range size was: MCP100: 151.68 km^2, KHR90: 66.72 km^2, and KHR60: 19.83 km^2. We found a significant difference during the research period between each season's (winter, spring, summer, autumn) average home ranges for all three indicators (MCP, KHR90, KHR60). The difference was most significant in the case of MCP. The home range was significantly higher in autumn than summer for all three indicators. The annual movement activity of the stag was 1126 km. No difference in movement activity was found between day and night. Based on statistical tests, a significant difference in movement activity was observed across seasons, indicating that movement activity is significantly higher in autumn and spring than in winter and summer. We found a significant difference in the movement activity across different months in 2020. The movement activity in September (rutting season) was significantly higher than in the other months. The increased movement activity was observed from September 10 to October 10. Moreover, increased movement activity was observed in December. The home range of *C. elaphus* in the Mountain Vrancea was more extensive than that reported in previous European studies. The results from this study outline the need for detailed studies on the species' behavior as a vital part of red deer as well as protected species management and conservation.

Red deer stag home range and movement activity in Vrancea mountains (Romania)

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Keywords: red deer, spatial ecology, home range, movement activity

This study provides, for the first time in Romania, Mountain Vrancea, Covasna county, the analysis of the spatial behavior of a male red deer (*Cervus elaphus*) from 10th December 2019 to 31st December 2020 using GPS telemetry. We captured (drop off-net), collared a male red deer with a GPS collar (Vectronic), and tracked it for 387 days. Based on the location coordinates 9,285, the adult male's annual mean home range size was: MCP: 151.68 km^2, KHR90: 66.87 km^2, and KHR60: 19.88 km^2. We found a significant difference in 2020 between each season's (winter, spring, summer, autumn) average home ranges for all three indicators (MCP, KHR90, KHR60). The difference is most significant in the case of MCP. The home range is significantly higher in autumn than in summer for all three indicators. The annual movement activity of the stag was 1100 km. There was no difference in movement activity during the day and night. Based on statistical tests, there is a significant difference between the movement activity in seasons, which shows that movement activity is significantly higher in autumn and spring than in winter and summer. We found a significant difference between the movement activity of the months in 2020. The movement activity in September was significantly higher than in the other months. Increased movement activity can be observed from September 10 – October 10. Increased movement activity can also be observed in December. It is difficult to compare the home range and movement activity of the red deer we tracked with similar data described in other research due to the small number of elements. Therefore, our study is descriptive, short communication.

Using of thermovision eye temperature measurement to determine the stress response of farmed fallow deer – preliminary research

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Keywords: breeding, *Dama dama*, deer farming, thermogram, welfare

The introduction of new techniques for the analysis of stress reactions of farmed deer may improve the breeding work carried out so far and provide breeders with valuable information, e.g. about the welfare level of animals. Therefore, the aim of the research was to demonstrate the possibility of using the thermal image of the eye as a non-invasive method for assessing the stress response of farmed fallow deer. The research was carried out on a deer farm of the Institute of Parasitology PAN Research Station in Kosewo Górne, on 17 fallow deer aged 22–24 months. The stress factor was the waiting time in the handling facility before being introduced to the crush, which is a routine zootechnical procedure on deer farms. The research was conducted at the end of August 2022, over 2 consecutive days at the same time (8:00–10:00). On the first day, 6 individuals (group 1) were caught from the grazing paddock, which, after being chased away by the handling facility, were subjected to examination within crush in 60 minutes. On the second day, 11 individuals were herded, of which 5 (group 2a) were analyzed at the same time as group 1, and the remaining 6 (group 2b) after 1 hour of keeping in the handling facility. During the immobilization in the crush, body temperature per rectum and a thermogram of the left eye of each individual were recorded. The VITAMMY HF-700 electronic thermometer and the ThermoPro TP8S thermal camera were used to perform the measurements, and the Launch Guide IrAnalyser and Statistica PL software were used for the analysis. The results of the study indicate that regardless of the group and the time the animals stayed in the handling facility, the body temperature was similar, and its average was 40.2°C. No statistically significant differences were found here. However, the variability of the thermovision eye temperature as an effect of the duration of the stress factor was noted. The average temperature for the analyzed parameter for groups 1, 2a and 2b was 38.8°C, 37.7°C and 40.7°C,

respectively. Group 2b had a statistically highly significant eye temperature compared to 2a ($p \leq 0.01$). No significant differences were found in groups 1 and 2a. It can therefore be concluded that an increased eye temperature may confirm the occurrence of a stress reaction, suggesting the possibility of using thermovision to analyze physiological changes in the body.

Ungulate monitoring in German National Parks

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Keywords: adaptive management, camera-trap-distance samplig, national parks, ungulate monitoring, ungulates

National parks are required not to intervene in natural processes in a large part of their area and to reduce management to a necessary level in order to preserve biodiversity. However, due to a long and intensive history of settlement and land use, in Central Europe national parks cover only small areas and therefore are closely intertwined with infrastructure and economically oriented areas in their surroundings. This leads to sharp boundaries and emerging conflicting goals when it comes to ungulate management and game damage in the national park's surroundings. As a result, national parks undertake massive interventions in ungulate populations by wildlife regulation. These measures should be limited to what is necessary, clear, well justified as well as precisely documented and effective. Monitoring ungulate populations and their effect on vegetation therefore is a crucial part of the adaptive management process in protected areas as it serves as an important basis, justification and control of success for wildlife regulation. Within the large-scale research and development project "Ungulate Monitoring in German National Parks", funded by the Federal Agency of Nature Conservation, we developed a standardized ungulate monitoring system and run it from 2019 to 2020 in 10 large protected areas. In this talk we present the developed monitoring system and show first results of red deer (*Cervus elaphus*), wild boar (*Sus scrofa*) and roe deer (*Capreolus capreolus*) relative abundance, population density via Camera Trap Distance Sampling and activity

pattern in 10 German large protected areas. In order to derive population indicators, we randomly deployed 643 camera traps by putting a 1-kilometer grid over the entire areas and installing camera traps in the center of randomly selected grid cells. Our findings revealed the highest red deer relative abundance and density in Königsbrücker Heide and the highest wild boar and roe deer relative abundance and density in Hainich National Park. Furthermore, our findings suggest a spatial distribution of all three ungulate species towards the zones without wildlife regulation as well as a higher diurnal behaviour of wild boar and red deer in these areas, while the latter was not be observed in roe deer. Our monitoring allows tracking the development of ungulate populations and their effects on vegetation in a standardized and comparative way and therefore represents an important tool for future sustainable and adaptive wildlife management in protected areas and beyond.

Home range of the golden jackal in a predominantly agricultural habitat

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Keywords: golden jackal, movement ecology, home range, dispersal, agricultural habitat

The spread of the golden jackal has been significant in Europe in recent decades. Understanding the movement ecology and movement pattern of the species is crucial from the nature conservation point of view and can also help wildlife managers in human-wildlife conflicts. This research aimed to describe the home range of the golden jackal in a predominantly agricultural habitat in Hungary using GPS telemetry. Three male and four female jackals were captured and fitted with GPS collars between 15/03/2021 and 25/11/2022 with an average deployment period of 29 weeks resulting in 29,840 localizations points in total. We calculated the 100%, 95%, and 50% Minimum Convex Polygon where home range size averaged 174.03 km^2, 145.06 km^2, and 44.64 km^2 correspondingly, varying significantly between the individuals with a range of 18.64 km^2

and 719.88 km^2 (MCP100). Two individuals have shown a clear home range shift in the territory during the fall of 2021, with a female juvenile individual moving the centre of her home range 19.86 km to the north, while a male juvenile individual moved his 27.66 km to the south simultaneously . Resident individuals maintained an average territory of 2318 km^2 (MCP100). Altogether, the study's findings support literature on the average home range sizes of resident individuals who occupied territories between 18.66 km^2 and 27.84 km^2 and showcased examples of a presumable dispersal pattern of two juvenile golden jackals in an agricultural landscape.

Cadmium (Cd^{2+}) and lead (Pb^{2+}) contents in some organs and tissues of red deer (*Cervus elaphus*) kept in captivity

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Keywords: red deer, microelements, cadmium, lead, mineral providing

The aim of studies was to estimate the content of cadmium (Cd^{2+}) and lead (Pb^{2+}) in: liver, kidneys, lungs, internal fat and in heart muscle, hind limb muscles with tendon, extrinsic and intrinsic hind limb muscles, long back muscle, intercostal muscles of red deer (*Cervus elaphus*). Samples of tissue were taken from three animals immediately after slaughter. The samples were previously dried in a drying cabinet at a temperature of 85–90° C, then mineralized in a muffle furnace at a temperature of +450° C. For flame atomic absorption spectrophotometry, samples were prepared by acid extraction, all calculations were performed on the raw tissues mass. It was found that the highest cadmium content was in the tissues of muscles and tendons of the hind limb compared to the content of this trace element in other organs and muscles. The least amount of this trace element was in the internal fat with fascia (1.02%), in the heart muscle (1.61%) and in the external muscles of the hind limb (2.7%). Regarding the studied organs of the red deer, the highest cadmium content (14.30%) was observed in the kidney, slightly lower (12.01%) in the liver and even lower (8.54%) in the lungs. The highest lead content was observed in the kidneys (4.56 mg/kg), the lowest

in visceral fat with fascia (0.18 mg/kg), and among the group of red deer muscles studied, the highest content of lead was in the heart muscle (1.73 mg/kg), the smallest — in the muscles of the hind limb with a tendon (0.23 mg/kg), in the intercostal muscles (0.31 mg/kg). As a result of the research on the content of cadmium and lead in some muscles and some organs of red deer, no deficiency of these microelements was found. Knowledge of the content of potentially toxic elements in red deer organs and tissues is particularly important for potential consumers as well as for animal health and the need to introduce uncontaminated feed in breeding

WHEN AND WHERE? The risk of wildlife-train collisions based on animals reactions to oncoming trains and crossing railway tracks in different types of their surrounding

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Keywords: animal behaviour, brown hare, railway ecology, red fox, road ecology, roe deer

The aim of the study was to determine the reactions of animals to oncoming trains and to describe the environmental surroundings of places where animals crossed the railway tracks. The data on animals' reactions to oncoming trains were collected using digital cameras. The research was conducted in years the 2008–2012 in central Poland along chosen stretches of two railway lines (E20 and E65). The data on sites where animals crossed tracks were collected during winter tracking. The survey was conducted in central Poland along the E20 line (between Mińsk Mazowiecki and Siedlce) in the years 2009–2012. The total length of 24.4 km of railway tracks, where the research was done, was divided into 100 m stretches (in total 244 stretches). For each of those stretches the type of environmental surrounding on both sides of the tracks was described (using one of following: open areas, woodland, shrubs, water bodies, build-up area). Doing the combination of environmental surroundings from both track sides, we got 15 possibility combinations. We used the Ivlev index (Ei) to see what

types of surrounding were preferred by mammals to cross the railway tracks. Eleven wild and two domestic species of mammals were observed in the vicinity of the railway tracks. Most numerous were: roe deer, moose, wild boars, red foxes, brown hares, domestic dogs, and cats. The majority of mammals were observed in spring (especially roe deer, moose, wild boars, brown hares, and cats). Only carnivores like red foxes and dogs were observed more frequently in winter. When the train was arriving, three types of behaviour were observed: escaping, getting alarmed, and showing no reaction. The study discovered that the majority of the animals escaped when the train was approaching. Among factors tested (seasons, months, part of the day, hours, moon phases), only the moon phases influenced animal reactions to the train. The animals became more alarmed at the approaching train when the nights were brighter. During winter tracking twelve species of mammals were registered. Most of the species were recorded when the tracks were surrounded by woodlands on both sides of the tracks. The mammals preferred to cross the stretches of tracks surrounded by woodland and water bodies (Ei = 0.24) and avoid the places surrounded by open areas on both sides of the tracks (Ei=-0.20). The results of the study may be useful while planning the location of mitigation measures.

Comparison of the disturbance of waterbirds during and after lockdown periods related to the COVID19 pandemic in a marine natural park

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Keywords: disturbance, COVID19, waterbirds, migration,

The global pandemic linked to the COVID19 in 2020 generated, in France, several restrictions on travel and activities due to health imperatives. Thus, many human leisure activities in particular were banned for certain periods of time: in fact, large stretches of coastline were deprived of human activities. This virtual absence of activities was an opportunity for the French Biodiversity Agency to measure the impact of these disturbances on waterbirds. Indeed, disturbances can have direct effects on birds by modifying their behaviour or by causing them to flee, for example. This can lead to a reduction in the quality

of the wintering and migration stopover or even deprive birds of their access, thus generating a loss of habitat, as well as potentially increasing their energy expenditure. These indirect effects can directly affect the conservation of species. Understanding the effects of human activities on coastal waterbirds is therefore crucial. The Gironde Estuary and Pertuis Sea Marine Natural Park, located on the west Atlantic coast, aims to reconcile human activities with the protection of biodiversity. It hosts more than 300,000 waterbirds in winter and is a site of international importance for several waterbird species. The sanitary restrictions provided a control situation without human activities, potentially allowing birds to adjust their behaviour to unprecedented conditions of tranquillity. By comparing the results of a study on disturbance within the Park's perimeter, i.e. a more of three years of monitoring, on three sites with different habitats and functionalities for birds (a mudflat, an estuary and a sandy lagoon), we propose a first approach to assess the impact of these restrictions linked to COVID on the behaviour and numbers of shorebirds and waterfowl and on the human activities present within a marine protected area.

The African Swine Fever in the Kampinos National Park: are protected areas ready for pandemics?

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Keywords: Kampinos National Park, ASF, wild boar, depopulation, prevetion

The aim of the study was to analyse the spread of the African swine fever virus in the Kampinos National Park in the years 2017–2021. The empirical data came from the search by the Park services for dead wild boars and depopulation, which were carried out in the National Park and adjacent areas. The spatio-temporal course of ASF in the area of KPN was in the nature of an eruption. Within 5 years from the appearance of the disease, 408 cases of the disease were confirmed in wild boars. The culmination took place in 2019, when 284 animals suffering from ASF were found (69.6%). The largest group of infected animals in terms of sex were females - 178 individuals (43.63%). In terms of age, piglets

and yearlings accounted for over 50% of dead boars. Dead wild boars or their remains were found most often in winter. This is probably due to the greater availability of fertile forest habitats in the dormant period, which are covered with dense vegetation in summer. Spatially, ASF spread from the east to the west of the Park (according to the direction of the "wandering" of this disease throughout the country). The distances between successive dead wild boars found ranged from 100 m to 15,000 m – an average of 7,760 m. Since the largest number of dead wild boars were found in areas of the Park often penetrated by tourists (KPN is visited by an average of 1.5 million tourists a year) and in agricultural areas, a legitimate question about the role of humans in both the spread and detection of ASF in protected areas. National parks in Poland do not have the appropriate services ready to react, for example, to the state of epidemiological threat. In KNP, apart from about 45 guards, not always hunters, who monitor the park (38.5 thousand ha), there are no officers who could react with weapons in emergency situations (e.g. during depopulation). In such situations, the park is forced to use the volunteer help of local hunters. It is worth noting that the area of the Kampinos National Park corresponds to the area of three average Forest Districts in Poland. Usually in one Forest District there are several hunting grounds leased by even several hundred available hunters. The question of whether National Parks, lacking appropriate infrastructure, are ready for new global threats is fully justified.

Movement behavior of red foxes in rural areas, Germany

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Keywords: animal movement, canids, habitat selection, movement ecology

Red foxes are a very flexible species, which is widely distributed over the globe. Thus, it is not surprising that red foxes use a wide range of social and spatial organisation, dependent on different ecological factors. Individuals have

to adapt continuously their movement to the habitat. To examine the explorative movement behaviour and habitat selection of canids red foxes are a good study species. Whereas movement structures inside home ranges (defined as 'known habitat' in the study) are already well understood, questions about movement patterns in unknown habitats (e.g. during dispersal) remain open. To this end, the presented study analysis movement patterns and habitat selection of red foxes in unknown habitats, compared to movement behaviour inside the usual home range. The study was conducted in Southeast Germany from 2020 till 2023. We collected high frequented GPS data of adult and sub adult red foxes, in total 27 individuals, during the dispersal and the mating period. Additionally, genetic data of the collared individuals are analysed with SNP analysis to reveal genetic relationships between the individuals and its influence to the movement behaviour of red foxes. Our results about explorative movement patterns in red foxes in rural areas add to a better understanding of how canids explore and acquire knowledge about new habitats with the possibility to adapt and settle in new areas. This knowledge might influence the habitat and hunting management of predators, by forecasting movement patterns and population dynamics, which have an impact on conservation management of prey species.

Variation in the individual quality characteristics of roe deer (*Capreolus capreolus*) bucks in Poland

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Keywords: individual quality, antler weight, carcass weight, age, roe deer, bucks, hunting management, Poland

The aim of the study was to determine the basic quality characteristics of roe deer bucks in view of the hunting strategies for managing the entire deer population in Poland. The evaluated quality parameters in the roe deer population were antler weight and carcass weight as related to age. The study involved 162118 males that were hunter-harvested in more than 4,500 hunting areas leased to Polish hunting clubs. The materials for the study were collected in three hunting seasons (2019/2020, 2020/2021 and 2021/2022). In the analyzed

hunting seasons, the average antler weight was 341.5 g (SD = 92.2) the average carcass weight was 17.5 kg (SD = 2.4), and the average age of hunter-harvested animals was 4.9 years (SD = 1.71). Males accounted for 45.5 % of the studied population. A total of 49 hunting districts administered by the Polish Hunting Association were analyzed, and red deer populations had the most desirable quality characteristics in Zamość, Chełm and Biała Podlaska hunting districts. In these districts, antler weight was determined at 402.7, 391.5 and 380.7 g, respectively, and carcass weight reached 18.8, 18.7 and 19.1 kg, respectively. The average age of roe deer bucks harvested in the analyzed hunting districts was 5.5, 5.3 and 5.7 years, respectively. Roe deer populations had the least desirable quality characteristics in Gdańsk, Suwałki and Katowice hunting districts. In these districts, antler weight in roe deer bucks was determined at 312.7, 313.0 and 314.8 g, and carcass weight reached 17.1, 18.3 and 16.8 kg, respectively. The average age of roe deer bucks hunter-harvested in the three districts was 4.6, 4.5 and 5.0 years, respectively. The study provides valuable information about the individual quality of roe deer males in Poland, and the obtained results were discussed in relation to environmental conditions and effectiveness of game management. The results can be used to compare the quality of the Polish deer population with the quality of deer populations in other European countries.

Testing tools in experimental areas to improve the management of red deer (*Cervus elaphus*) populations

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Keywords: demography, indicators of ecological change, hunting, quotas

In the current context of increase in number and geographic expansion of wild ungulates combined with the decreasing hunting pressure, wildlife managers need efficient tools for better control of populations. In general, managers use

theoretical maximal growth rates of population and/or abundance estimates to set hunting plans. Concerning the use of population growth rates, these can vary greatly depending on the year, the status of the population (e.g. in the colonisation phase), or others factors, and therefore lead to poor management decisions. When relying on population abundance only does not, however, give a comprehensive picture of the population functioning. To become more insightful, abundance needs to be complemented by additional biological measurements such as individual performance (e.g. body mass) or the browsing pressure. The complementary use of several aspects of the population-environment system is the heart of indicators of ecological change (IEC) proposed to manage large herbivore populations. Although the use of IEC makes it possible to improve ungulate management by adjusting quotas upwards or downwards according to the its temporal trends, the numerical adjustment of hunting plans is based on expert opinion. To achieve more objective decisions, we suggest to combine IEC, hunting data and demographic parameters from long-term monitoring of two red deer populations into a demographic model and to predict past and future population trajectories to get a reliable of estimate of the annual population growth rate. We here developed an age-structured matrix model incorporating harvest data to predict population abundance variation and to improve the setting of annual hunting quotas (quantitatively and qualitatively by age and sex classes). We used longitudinal observation of animals of two red deer populations to parametrize the model with empirical demographic rate estimates: La Petite Pierre and Chambord (France) along with the corresponding harvest data. As expected for a long-lived species, natural survival of females showed little variability among years. Conversely, pregnancy rates of females varied with age class (yearling vs adult) and between years in a density-dependant manner. From these demographic rates, we could back-cast population trajectories using relative abundance time series from spotlight counts (IEC), to force simulations within biologically realistic boundaries. Finally, we used this model to predict future population trajectories and propose hunting quotas according to the management objectives. Since 2013 at la Petite Pierre and 2015 at Chambord, we successfully experimented this approach to help managers to both decrease abundance population and improve demographic performance.

Economic consequences of the occurrence of African Swine Fever (ASF) on the territory of Poland in terms of a market economy

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Keywords: African swine fever, market economy, wild boar, financial consequences

African Swine Fever (ASF) disease has so far been usually analyzed from an epidemiological and sanitary point of view. These studies show the impact the effects of ASF on the territory of the Republic of Poland in terms of a market economy. Over the years, the pig population decreased from nearly 16 million to 11 million. The disease is also of importance for wild boar, which is the main vector of disease transmission. The effect of the disease was a decrease the number of wild boars from 284 thousand in 2014 to 52 thousand in 2022. Instead of the declining export of pigs, which is the result of the spread of the ASF disease, a disturbing impact on the domestic market has been noticed, which in turn changed the approach to food production. The growing demand for pigs on a global scale has resulted in a steady increase in prices per kg of livestock (from PLN 4.3/kg to PLN 5.89/kg in 2019).

To explain the effects of ASF on the behavior of the market economy, an empirical analysis was used, including: the number of wild boars and pigs, financial outlays incurred for the fight against ASF disease e.g. compensation paid, the number of cases with confirmed ASF disease, revenues from the sale of wild boar carcasses and live pigs, pork and the value of exports. A very important effect of the ASF disease in Poland on the market economy is the distribution of prices obtained for the disposal of carcasses of dead wild boars and pigs and the market value of refrigerated containers. It was noticed that with the development of the disease, the prices related to carcass disposal services changed almost every year. There was a decrease in the prices of services related to cleaning up the effects of ASF and keeping wild boar carcasses along with the increase in the number of ASF cases. The analysis indicates that the presence of ASF in Poland is of great importance for the development of a market economy, especially in the area of pig farming. As a result of the developing disease, pork exports fell. It is worth noting that the increase in the number of ASF cases in wild boars has no direct impact on the shape of pork exports. ASF has contributed to the development of other, so far niche areas of the economy, especially those related to the disposal of sick animals and biosecurity measures. Funds spent on the ASF virus disease for the usual number of wild boars and for the preservation and slight increase in the number of pigs.

Potential of drones with thermal vision cameras for migrating and breeding bird monitoring

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Keywords: birds of prey, black grouse, black stork, common crane, grey partidge, greylag goose

Very often the classical methods for bird census are time consuming and expensive or not precise enough. The drones with thermal vision cameras are used widely to study larger mammal species, however thermal methods for bird monitoring often seen as complicated due to its smaller size and perfect thermal insulation of plumage. We aimed to evaluate the potential of the drones with thermal camera to improve the evaluation of breeding and migrating bird

species. The study covered four groups of bird: (I) migrating geese (*Anser* sp.) and common cranes (*Grus grus*) flocks, (II) greylag goose (*Anser anser*) nests in reed areas, (III) ground nesting bird species and (IV) large birds of prey (Falconiformes) and black storks (*Ciconia nigra*) nests. The study was performed in central part of Lithuania. The drone flied in 50 and 100 m height. For large nest detectability study the angle of camera was on 45°, 65° and 90° degree, bird nest detectability evaluated within the scale from 0 to 3. We used unmanned aerial vehicle DJI Enterprise Matrice 300 combined with Zenmuse H20T series camera (combined thermal sensor, 20×zoom and wide-angle cameras). (I) As geese and cranes frightening flying drones, the night is a perfect period to count migrating birds with thermal camera. Exploratory flight for mostly suitable for small wetlands visiting potential sites, however for larger 500 ha areas systematic survey is reasonable, with flying at 100 m height. (II) Best time for breeding greylag goose count is egg incubation period, when bird sits on their nests. Methodology cover flying during the day above dense reed and other areas, detection nests place with thermal vision camera and identifying species with optical zoom. Exploratory flight survey at 50–60m height gives best results. (III) We selected grey partridge (*Perdix perdix*) and black grouse (*Lyrus teterix*) for ground nest surveys, and concluded the technique is not suitable because of species rarity and randomly scattered nest sites of these species. The battery recourses are limited and nests observed very rare. (IV) Best detectability of black stork and birds of prey nests was the camera angle at 45°, flying at 50m height. Under these conditions the score of detectability was moderate ($F = 3.65$; $p < 0.03$). Differences among results when flying from different cardinal points were not significant ($F = 0.39$; $p < 0.75$).

Wolf population monitoring for effective management and conservation actions in Lithuania

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Keywords: age, *Canis lupus*, genetic, hunting, sex, mange

Wolf population monitoring in the territory of Lithuania was started in 2018 year. Hunters are the basic data providers for the further researches, data analysis, and also management and conservation of wolves' population decisions. Hunters are obliged to take samples for researches from every wolf they hunt. Hunters also note whether the hunted wolf was infected with mange mites or had other physical injuries. Every year, all hunted wolves are subjected to genetic testing, age determination (based on annual ridges in the tooth), and reproductive testing of females (based on signs in the uterus). Hunters are encouraged to register all observed signs of wolf activity in a unified online system all year round. There are registered reports about observed individuals of wolves, their tracks, heard howls, remnants of prey and other activity of wolves. Each case should be described and a location marked on the map, photos or video recordings should be attached.

Bag harvest monitoring in Latvia by means of sent-in photos

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Keywords: hunting statistics, waterfowl

According to Article 12, Birds Directive all EU member states are requested to monitor bird species and send a report every 6 years following an agreed format which for huntable species includes also totals of hunting bag. Several studies have shown, that hunters are not 100% correct in species identification

(Christensen et al. 2017). Countries overcome this by more precise subsamples as wing surveys (Denmark, Great Britain, Finland) or by requests to send photos of the bag (Russia, Canada). In 2019 with support of MSAF (Game Management Development Fund) a website www.nomeditie.org was established with two goals 1) identification manual 2) a site for sending photos to ornithologists. During the first four years 3127 photos of 18 bird species have been received. Gains (precise species identification, data on demography, colour aberrants and hybrids, sarcocystosis, phenology) and pitfalls (time consumption, photo quality, correspondent turnover caused bias) of this reporting scheme are discussed.

Concentration of toxic elements in farmed fallow deer antlers depending of diet and age

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Keywords: *Dama dama*, dangerous component, ICP-MS, winter food, pasture plants

Deer antlers, usually harvested annually on a farm, are an easy material used to determine the concentration of toxic elements. Comparison of antlers from animals of different ages allows to assess the level of diversification of contamination of the deer habitat during their growth. The aim of the study was to analyze the concentration of 8 potentially toxic elements (cadmium – Cd, lead – Pb, arsenic – As, barium – Ba, nickel – Ni, strontium – Sr, lanthanum – La, and cesium – Cs) in individual positions of the antlers and in the food that the animals consumed during the growth of individual antler fragments due to possible physiological exhaustion as well as depending on the age of the farmed fallow deer (*Dama dama*). The mineral compositions of tissues were analyzed using inductively coupled plasma mass spectrometry. The analysis included 31

male deer 2–8 years old. The farmed fallow deer were bred at the Research Station of the Institute of Parasitology, Polish Academy of Sciences, Kosewo Górne in Poland. Samples from individual antler positions were taken as in the study by Tajchman *et al.* (2022), and sampling of winter and pasture food is described by Kulik *et al.* (2023). The average concentration of Pb, Ba and Ni was clearly higher in the 2nd position of the antler, and As, La and Cs in the 3rd position. In addition, the oldest individuals showed a higher concentration of Cd, Pb and As in position 3 of the antlers. A significant positive relationship was found between As and the age of animals, and a negative relationship between Ba and Sr and their age ($p < 0.05$). The average content of Ba and Sr also significantly negatively depended on body mass and antler mass stags ($p < 0.05$). The mean Cd concentration was significantly higher in early summer/June compared to winter, spring and late summer ($p < 0.05$). On the other hand, the average concentration of Ba in food was significantly higher in spring and winter than in early and late summer ($p < 0.05$). The average concentration of Sr was significantly higher in early summer compared to winter and spring ($p < 0.05$). Increase toxic elements in pasture food determined the concentration of this components in fallow deer antlers. The high content of toxic element in antlers farmed fallow deer, especially in young males, may reduce their endurance in distal parts.

Methodology of verification / creation of hunting divisions on the example of the Regional Directorate of State Forests in Lublin

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Keywords: hunting managment, GIS, big game

Hunting management be an integral part of forest management, and game should be an entire part of the forest ecosystem. The task of foresters and hunters

in hunting management is, among others, to creating the best living conditions for animals and mitigating conflicts between forest animals and the human activity. The conception of creation and functioning in Poland the Hunting Divisions as a modern field unit, as a population management space especially of big game was discussed introduced by Polish Hunting Law of 1995 (Article 8(3)(1)) and when Hunting Divisions in Poland were appointed. The idea of Hunting Divisions existence is the year-long management of game population in its range. Actually within the country exist 147 Hunting Divisions. For each Hunting Division, Long-term Hunting Management Plans are created, on the basis of which breeding directions are adopted, so that after the period of validity of the multi-annual plan (10 years), the state of game population recorded in it was achieved. The experiences and actual stage show many week points in functioning of divisions. One of them is the very fast changes in the development of the environment, and above all the emerging and emerging barriers in the form of highways. The aim of the research was to develop a method for determining or verifying the boundaries of Hunting Divisions using the example of the Regional Directorate of State Forests in Lublin, based on objective criteria. The analysis examined data provided by the Regional Directorate of State Forests in Lublin regarding the current density of red deer (*Cervus elaphus*), forest cover, fragmentation of forest patches, and categories of hunting districts (in accordance with the Minister of Environment Regulation from 2019, Polish Journal of Laws 2019.536), as well as the routes of existing, under construction, and planned highways and expressways (according to the Official Journal of the General Directorate for National Roads and Motorways 2023). The boundaries of the Hunting Divisions were determined by aggregating hunting districts with similar characteristics using GIS software, taking into account ecological barriers. The analysis results indicated the need to establish 11 instead of the current 8 hunting districts, and the course of their boundaries significantly deviated from the previous delimitation. The obtained results demonstrated the necessity of verifying the boundaries of Breeding Regions nationwide.

Management of the deer population in the area of the Regional Directorate of State Forests in Lublin in the seasons 2012/2013–2022/23

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Keywords: cervidae, hunting plan, damages, forest protection

Every ten years, each Regional Directorates of State Forests in Poland (RDSF) draws up a Multiannual Hunting-Breeding Plan, a document describing the current state of the game population (current number) in individual Hunting Divisions and the target state (intended number). For this purpose, it was analyzed data provided by the RDSF in Lublin regarding the number, harvesting plan, and harvesting performance in the following years 2012/13–2022/23 for red deer (*Cervus elaphus*), roe deer (*Capreolus capreolus*), fallow deer (*Dama dama*) and elk (*Alces alces*) inhabiting the individual Hunting Divisions and the area of damage caused by these species in the considered period. The length and area of fences were also assessed. The conducted statistical comparisons made it possible to determine trends in deer population management in the analyzed period. There was a significant increase in the number of elk and red deer ($p < 0.05$), a meaningful increase in the density of elk, red deer per 1000 ha, and roe deer per 100 ha of the total area, as well as an important increase in the density of elk and red deer per 1000 ha of forest area ($p < 0.05$) despite that at the same time the harvesting for red deer and roe deer significantly increased ($p < 0.05$) in the area of RDSF Lublin in the seasons 2012/13–2022/23. The level of damage caused by deer in the study hunting seasons meaningfully increased only in the case of damage above 40% caused by elk and red deer ($p < 0.05$), at the same time, the length of the fences used ($p < 0.05$) and their area (p40% positive), but not significant. A satisfactory effect of increasing the length and area of fences was shown in the case of a meaningful reduction in damage caused by roe deer at the level of 21–40% ($p < 0.05$). It is worth emphasizing that a significant impact on the reduction of damage caused by red deer, fallow deer, and roe deer ($p < 0.05$) had the implementation of the harvesting Multiannual Hunting-Breeding Plan. To sum up, in the area of RDSF Lublin

in the seasons 2012/13–2022/23, the planned and harvested performance is lower than the actual increase in the population of these species, which translates into an increase in the number and density of red deer.

Variation in the individual quality characteristics of red deer (*Cervus elaphus*) stags in Poland

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Keywords: individual quality, antler weight, carcass weight, age, red deer, stags, hunting management, Poland

The aim of the study was to determine the basic quality characteristics of red deer stags in view of the hunting strategies for managing the entire deer population in Poland. The evaluated quality parameters in the red deer population were antler weight and carcass weight as related to age. The study involved 59698 males that were hunter-harvested in more than 4,500 hunting areas leased to Polish hunting clubs. The materials for the study were collected in three hunting seasons (2019/2020, 2020/2021 and 2021/2022). In the analyzed hunting seasons, the average antler weight was 3.97 kg (SD = 1.92), the average carcass weight was 123.21 kg (SD = 27.31), and the average age of hunter-harvested animals was 6.0 years (SD = 2.74). Males accounted for 32.4% of the studied population. A total of 49 hunting districts administered by the Polish Hunting Association were analyzed, and red deer populations had the most desirable quality characteristics in Olsztyn, Szczecin and Krosno hunting districts. In these districts, antler weight was determined at 5.04, 5.02 and 5.01 kg, respectively, and carcass weight reached 145.37, 126.48 and 151.55 kg, respectively. The average age of red deer stags harvested in the analyzed hunting districts was 6.6, 7.1 and 6.7 years, respectively. Red deer populations had the least desirable quality characteristics in Jelenia Góra, Gdańsk and Wałbrzych hunting districts. In these districts, antler weight in red deer stags was determined at 3.07, 3.15 and 3.26 kg, and carcass weight reached 105.61, 110.51 and 113.51 kg, respectively. The average age of red deer stags hunter-harvested in the analyzed districts was 5.9,

5.0 and 5.9 years, respectively. The study provides valuable information about the individual quality of red deer males in Poland, and the obtained results were discussed in relation to environmental conditions and effectiveness of game management. The results can be used to compare the quality of the Polish deer population with the quality of deer populations in other European countries.

Variation in the individual quality characteristics of fallow deer (*Dama dama*) bucks in Poland

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Keywords: individual quality, antler weight, carcass weight, age, fallow deer, bucks, hunting management, Poland

The aim of the study was to determine the basic quality characteristics of fallow deer bucks in view of the hunting strategies for managing the entire deer population in Poland. The evaluated quality parameters in the fallow deer population were antler weight and carcass weight as related to age. The study involved 12 600 males that were hunter-harvested in more than 4 500 hunting areas leased to Polish hunting clubs. The materials for the study were collected in sixteen hunting seasons (2006/2007–2021/2022). In the analyzed hunting seasons, the average antler weight was 1.65 kg (SD = 0.75), the average carcass weight was 51.88 kg (SD = 9.82), and the average age of hunter-harvested animals was 4.6 years (SD = 1.87). Males accounted for 29.8% of the studied population. A total of 49 hunting districts administered by the Polish Hunting Association were analyzed, and fallow deer bucks were harvested in 44 hunting districts. In 21 hunting districts, the number of hunter-harvested fallow deer bucks was lower than 20 individuals per season. The highest number of bucks (more than 100 individuals per season) were harvested in the following 9 hunting districts: Poznań (264), Koszalin (152), Bydgoszcz (134), Opole (126), Leszno (117), Toruń (117), Olsztyn (110), Piła (107), and Katowice (103). Fallow deer populations in the districts of Toruń, Opole and Poznań are characterized by the most desirable quality traits. The study provides valuable information about the quality of the fallow

deer population in Poland, and the effectiveness of game management. The results can be used to compare the quality of the Polish deer population with the quality of deer populations in other European countries.

Management of wildlife populations in Poland in an era of social and economic change in the 21st century

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Keywords: hunting clubs, wildlife management, wildlife damage compensation, commercial hunts, game meat prices, Poland

The aim of the study was to evaluate economic conditions in hunting areas (hunting clubs administered by the Polish Hunting Association), to propose solutions to current problems in wildlife management, and to describe a hunting management model that contributes to the preservation of wildlife biodiversity. The financial status of hunting clubs affects the management and protection of wildlife populations. The following factors exert the greatest effect on the financial results of hunting clubs: 1/ wildlife damage compensation, 2/ game meat prices in the local supply chain and the organization of the game meat market, 3/ hunting tourism, including commercial hunts and increasing costs of hunting management. Changes in hunting regulations and the outbreak of African Swine Fever (ASF) in Poland also play a role. Differences in the financial performance of Polish hunting clubs were analyzed in the study. Various methods are often required to minimize the negative effects of financial crises in hunting areas. The revenue streams and operating costs of hunting clubs in selected districts administered by the Polish Hunting Association were presented, and the relationships between game meat sales, commercial hunts, and agri-environmental subsidies were analyzed in the last 6–7 hunting seasons. In some hunting districts, the dire financial situation of hunting clubs significantly undermines the effectiveness of hunting management. Some districts post positive overall financial results, whereas other districts face a catastrophic financial situation with budgetary deficits of several million Polish zloty per fiscal year. These problems have to be

resolved in the next 2–3 years to preserve the existing structure of Polish hunting districts. The following goals should be achieved in the next 3–5 years: 1/ Wildlife populations should be brought to socially accepted levels in some Polish regions. The value of damage compensation should be limited, preventive programs should be implemented, wildlife damage should be assessed by professionals, and good relations with farmers and local communities should be built in hunting areas; 2/ Professional solutions for monitoring hunting operations should be implemented in all hunting areas; 3/ The management of game and predator populations, including large predatory animals such as wolves, should be standardized; 4/ Legal and financial regulations for combating infectious wildlife diseases, including ASF, through hunting should be standardized; 5/ A standard training program should be developed for hunting clubs and professional hunters in the Polish Hunting Association and State Forests to increase professional competence levels in hunting administration.

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