3rd International
Jackal Symposium
02-04. November 2022
Gödöllő, Hungary

3rd INTERNATIONAL JACKAL SYMPOSIUM

abstract book

Editor: Miklós HELTAI

MATE
HUNGARIAN UNIVERSITY OF
AGRICULTURE AND LIFE SCIENCES
Institute for Wildlife
Management and Nature
Conservation

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Organiser:

Hungarian University of Agriculture and Life Sciences Institute for Wildlife Management and Nature Conservation

General Director:
Miklós Heltai

Book editor:

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MATE Institute for Wildlife Management and Nature Conservation

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Welcome message

On behalf of the International Jackal Symposium (IJS) Organizing Committee, we are honoured to invite you to participate in the 3rd IJS scheduled for 02-04 November, 2022 Gödöllő, Hungary. The 3rd International Jackal Symposium provides a platform to present research related to golden jackal management and conservation practices.

The 1st International Jackal Symposium held in Veliko Gradiste, Serbia placed the major focus on the ecology of golden jackals, and the 2nd International Jackal Symposium held in Attica, Greece aimed to create an active platform which gave space for novice and experienced golden jackal scientists to discuss the golden jackal (*Canis aureus*) species as well as other related species like African black-backed jackal (*Canis mesomelas*), side-striped jackal (*Canis adustus*) and African wolf (*Canis anthus*). Building on the past two successful conferences, this year the main objective of the third conference is to explore the reasons behind the spread of the golden jackal, to understand the behavior, feeding habits, distribution and genetic background of the species and, with this knowledge, to reduce human predator conflicts and to provide a basis for the conscious management and conservation of the species' populations.

Our goal is to build awareness around medium-sized carnivore management and critical issues that relate to it. Over the past few decades, the golden jackal population skyrocketed on the European continent and are quickly spreading in the central and south-eastern parts of Europe where for several decades they have been absent from. At the end of the 20th century jackals suddenly started to expand their range and repopulate its previous habitat in the Balkan peninsula. The jackal population began to grow exponentially in Hungary and was given a year-round hunting season. Observations have also been increasing in Serbia, Slovakia, Romania and Ukraine. Common question with regards to the golden jackal is what led to their such rapid expansion. Therefore, throughout the symposium, we will explore the following topics:

- Biological invasion or natural process? – Monitoring, evaluation, legal background
- Behaviour – feeding and social behaviour
- Conservation and management
- Human & jackal conflicts and public interest

We look forward to seeing you in Gödöllő!

Miklós HELTAI, PhD, DSc
General Director
3rd International Jackal Symposium

Programme

The longest day - Wednesday - 02.11.2022			
Hour	Session	Title	First Author
9:30	Opening Ceremony	Welcome speech of Prof. Dr. Csaba Gyuricza (rector), and Dr. Zsolt Semjén (vice prime minister)	
10:00	Plenary	Home range and movement activity of Golden jackal (*Canis aureus*) in Central Europe	Csányi, Erika
	Chair	Cirovic, Dusko	
10:45	Ecology	Exploring the ecology of the golden jackal (*Canis aureus*) using the first telemetry data collected in Italy	Frangini, Lorenzo
11:15	Ecology	Fine-scale spatial distribution and temporal activity patterns of three mesopredators: A case study from Greece	Giannatos, Giorgos
11:45	Ecology	Preliminary determinants of (long distance) dispersal behaviour in Golden jackal	Potočnik, Hubert
12:15	Ecology	Seasonal movement patterns and space use of golden jackal (*Canis aureus*) in the suburban areas of Serbia	Pantelić, Ilija
12:45		Coffee Break	
13:30	Plenary	Rise of a golden jackal (*Canis aureus*) population: genetic diversity and structure during expansion	Bogdanowicz, Wieslaw
	Chair	Guimarães, Nuno	
14:15	Ecology	Stay home, stay safe? High habitat suitability and environmental connectivity increase road mortality risk in a colonizing mesocarnivore	Frangini, Lorenzo
14:45	Ecology	Humans shield golden jackals from wolves in their expansion across Europe	Ranc, Nathan
15:15	Ecology	Habitat preference of golden jackal (*Canis aureus*) in Serbia	Bogdanović, Neda
15:45	Ecology	First record of multiple breeding and communal nursing within one social unit of European golden jackal (*Canis aureus*, L. 1758) in a low-density area in NE Italy	Stefano, Pecorella
16:15		Coffee Break	
	Chair	Lanszki, József	
16:45	Feeding habits	How urbanization and diet influence coyote behaviour	Ellington, Hance
17:15	Feeding habits	Developing correction factors for improved diet analyses of golden jackals (*Canis aureus*)	M Klinkhart
17:45	Feeding habits	Deer for dinner! First documented predation with camera-trap of golden jackal on roe deer and subsequent kleptoparasitism by wild boar in Italy	Frangini, Lorenzo
18:15	Feeding habits	Can the donkey be a possible prey for golden jackals? Description of the predation strategy on multiple attacks	Pesaro, Stefano
19:00		Dinner	

The day of the monitoring - Thursday - 03.11.2022			
Hour	Session	Title	First Author
9:00	Plenary	The story of the golden jackal in numbers: from the return to the conquest of Hungary	Csányi, Sándor
Chair		**Giannatos, Giorgos**	
9:45	Monitoring	Changes in Golden jackal (*Canis aureus*, L. 1758) and Red fox (*Vulpes vulpes*, L. 1758) population size in Romania with new records of local density in hunting terrains from Timiș county, Dobruja, and maritime levees from the Danube Delta	Banea, Ovidiu Constantin
10:15	Monitoring	On the past distribution of the Golden Jackal *Canis aureus* in Greece	Gasteratos, Ioannis
10:45	Monitoring	Interactive mapping of golden jackals?	Lelieveld, Glenn
11:15	Monitoring	Application of combined field methods in golden jackal monitoring: Howling, Conservation dogs and DNA analysis	Hatlauf, Jennifer
11:45		**Coffee Break**	
12:15	Plenary	Past and present of the golden jackal "*Canis aureus*" in Greece: the evolution of its distribution from the 1970s until today	Kominos, Theodoros
Chair		**Hatlauf, Jennifer**	
13:00	Monitoring	Evolution of the presence of the golden jackal in Slovakia	Guimarães, Nuno
13:30	Monitoring	Dynamic hierarchical model for the Eurasian golden jackal (*Canis aureus*) occurrence in Slovenia	Krasevec, Rudi
14:15	Monitoring	Long- and short-range jackal (*Canis aureus* L.) vocalizations: an ethnographic method of research	Konstantinov, Yulian
14:45	Monitoring	Teaching safety to the young? Longitudinal research with resident family group of Golden Jackals (*Canis aureus* L.) (Bulgaria)	Konstantinov, Yulian
15:15	Monitoring	Monitoring the Occurrence and Distribution, and studying the feeding habits of large and medium sized predators in Georgia	Kalandarishvili, Alexandra
15:45		**Coffee Break**	
	16:45	**Walk to Royal Palace**	
17:00	24:00	**Cultural Programme and Gala Dinner**	

All is well, that end´s well - Friday - 04.11.2022			
Hour	Session	Title	First Author
9:00	Plenary	Controlling overabundance jackal populations: from theory to practice	Dolev, Amit
Chair		**Dolev, Amit**	
9:45	Management	Sustainable management of Golden jackal populations at Samos and Kavala airports	Tsiratzidis, Athanasios
10:15	Management	Golden jackal as a case study of population control in Croatia	Šprem, Nikica
10:45	Management	The effect of the golden jackal on nest survival of ground-breeding birds in Estonian coastal grasslands	Triin Kaasiku
11:15	Genetics	Coat colour variations and possible hybridisation of Golden jackals (*Canis aureus*) in Hungary	Ninausz, Nóra
11:45	Genetics	The golden jackal (*Canis aureus*) reference genome assembly and annotation	Nagy, Tibor
12:15		**Coffee Break**	
Chair		**Banea, Ovidiu Constantin**	
12:45	Diseases	New data on heartworm disease in jackal population in Serbia	Penezić, Aleksandra
13:15	Diseases	Camera trapping as a tool for diagnosing and monitoring mange disease	Ertürk, Alper
13:45	Diseases	Study ont he prevalence and larval burden of the Nematode Trichinella spp.in jackals from hunting grounds from Timis county (Roumania)	Marin, Ana-Maria
14:15	Diseases	First comparison of the lifespan and spatial behavior between rehabilitated jackals and those captured in the wild with baits	Franchini, Marcello
15:00		**Closing Ceremony and Lunch**	

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Keynote Speakers

Prof. Sándor Csányi CSc – Department of Wildlife Biology and Management, Institute for Wildlife Management and Nature Conservation, Hungarian University of Agriculture and Life Sciences - MATE, Hungary.
Amit Dolev PhD – Israel Nature and Parks Authority, Israel.
Erika Csányi – founder and member of the board of Fauna and Flora Nature Conservation Foundation, University of Sopron, Roth Gyula Doctoral School of Forestry and Wildlife Management Sciences, Hungary.
Wiesław Bogdanowicz PhD – Museum and Institute of Zoology, Polish Academy of Sciences, Warsaw, Poland.
Giorgos Giannatos PhD – BIOSPHERE NGO/Department of Biology, National and Kapodistrian University of Athens, Greece.

General Information

The conference will be hosted by the Hungarian University of Agriculture and Life Sciences (https://uni-mate.hu/ ; https://archive.uni-mate.hu/en), Szent István Campus (https://szic.uni-mate.hu/), Institute for Wildlife Management and Nature Conservation (https://szic.uni-mate.hu/institute-for-wildlife-management-and-nature-conservation).

    The venue for accommodation, conference and dinner on Wednesday evening is the Gorka Hall of the MATE SZIC Dormitory: https://goo.gl/maps/j5YX51cYW2oaXXNg6

    The cultural programme and the evening gala dinner will take place on Thursday afternoon and evening at the Royal Palace in Gödöllő. (https://kiralyikastely.hu/royal-palace-of-godollo.html): https://goo.gl/maps/5MGeEPoHu-1KZQvUX7

    Route between the conference venue and the Royal Palace:
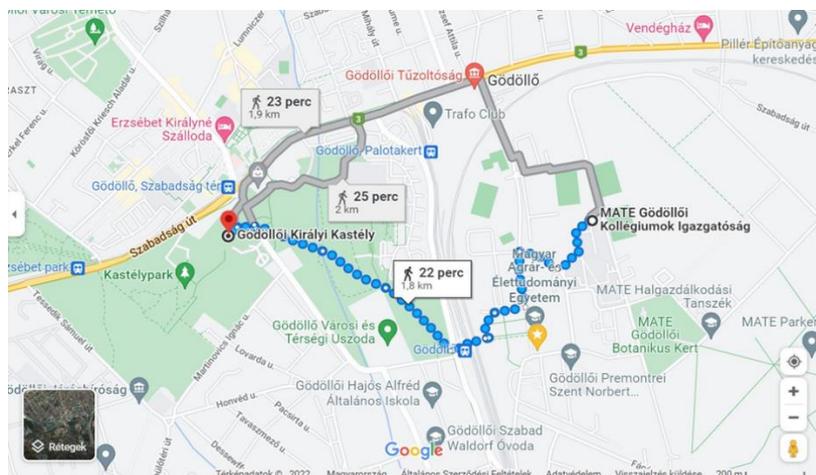
Most of them will arrive on 1st of November. This day is a public holiday in Hungary. Most shops will be closed. There will be a restaurant available in the dormitory until 9PM for dinner.

Coffee, water, pastries, and cakes will be available for all participants during the conference breaks. We will have dinner together at the conference venue on Wednesday evening. A cultural programme and gala dinner will be served On Thursday afternoon. Friday will conclude with lunch after the conference. The cost of these meals is included in the participation fee.

Plenaries

Controlling overabundance jackal populations: from theory to practice

Amit Dolev, Hava Goldshtein, Roi Federman, Iftach Sinai Ori Shapira, David Saltz and Roni king

Managing overabundant wild populations is expected to be the most effective when applying both direct control by culling combined with indirect control by reducing the availability of limiting factors (e.g., key resources). The Golden Jackal (*Canis aureus*) distribution in Israel is widespread, including the desert area. Typically, jackals are most abundant close to agricultural villages. However, in recent years populations have been established within urban areas. Jackal presence generates human - wildlife conflicts in several respects: (1) as diseases vectors (mostly rabies), (2) inflicting damage to agricultural infrastructure (e.g., watering systems), and (3) depredation of domestic pastured livestock and endangered wildlife such as mountain gazelle (*Gazella gazella*). In this study we focused on developing and applying effective methods to control jackal populations to decrease all aspects of human – wildlife conflict. Our results suggest that: (1) Although culling is the traditional and commonly used method and has been shown to be locally effective over the short term, significant "over culling" contributes to overcompensation in jackal populations with densities rebounding to 4 times the pre-culling density. (2) In terms of controlling key resources we found that while jackal numerical responses to sanitation (in the form of cattle carcass-removal from pastures) were equivocal, predation of domestic animals decreased, and mountain gazelle populations increased. Fencing succeeded in blocking jackal access to potential resource-rich sites (such as fishpond's, cowsheds, and garbage dump sites), and decreased adjacent jackal occupancy and densities. Lastly, while Oral Rabies Vaccination has a strong impact on rabies prevalence, it occasionally failed due to poor assessment of jackal densities and insufficient immunization rates. While theory has unraveled best practices to deal with overabundance populations, we found that the key issues to controlling jackal populations is a long-term process that requires a combination of few methods that must be based on the decrease of available anthropogenic food sources, limiting access and direct control.

Home range and movement activity of golden jackal (*Canis aureus*) in Central Europe

Erika Csányi, Heltai, M., Horváth, M, Lanszki, J., Németh S., Pölös, M., Trefán, G., Varga, Gy., Sándor, Gy.

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 South-eastern Europe. In recent decades, there was not enough data available to research the movement ecology of the species in Europe. To explore the movement ecology of this meso-carnivore, we analysed a large sample from the Pannonian region, southwestern Hungary, in a primarily natural area with a high jackal population density. We applied GPS satellite telemetry to track 70 golden jackals for one year. We analysed the data of 20 of the 70 collared jackals. The animals were followed for an average of 233 days (83-365 days). The home range size was estimated with the minimum convex polygon (MCP) method and the Kernel (KHR90) method. In contrast, the core area was calculated using the KHR60 method based on 102,408 (males, n = 57,623; females, n = 44,785) localisation data. In line with the golden jackal's biologically relevant life stages, we identified three periods (mating: January-March, pup-rearing: April-June, and non-breeding). The average movement activity of the 20 golden jackals was higher than in previous European researcher with significant individual variations among females and similarity between the sexes. The core area was significantly larger in the pup-rearing period among females and during the mating season among males. Three of the 20 jackals dispersed (distance between centres of core areas: 12-22 km), and two returned to their original/earlier areas. It was concluded from our survey conducted in South-West Hungary, the first such survey in Europe based on the analysis of localisation data derived from GPS tracking of a large number of animals, that the golden jackal was, by global comparison, characterised by remarkably high movement activity, and large and variable movement range dimensions.

Past and present of the golden jackal "*Canis aureus*" in Greece: the evolution of its distribution from the 1970s until today

Theodoros Kominos, Antonia Galanaki, Nikolaos Kiamos, Nikolaos Bukas, Giannis Gasteratos, Sotiris Kountouras and Giorgos Giannatos

Purpose/Objective: Greece is one of golden jackal's historical strongholds in Europe, although its range and populations have undergone a significant decline in the country since the 1970s until the 1990s. Based on literature, by the 1990s the species' distribution had considerably shrunk and comprised of only isolated populations in southern (Peloponnese), central (Fokida), northern (Chalkidiki) and north-eastern (parts of Eastern Macedonia and Thrace) Greece and on the island of Samos in the eastern Aegean Sea. However, we argue that this distribution might have been underestimated and small populations have existed in other parts of the country, which contributed to the jackal's expansion in other parts of mainland Greece over the following years. Material/Methods: Our golden jackal study in Greece has started since 2008. Initially, all available information from bibliographic references was gathered, followed by fieldwork that is continuing until today. Main methodologies for data collection include field signs (tracks, scats), howling sessions, camera-traps (from many parts of Greece), road-kills and poisoned animals records and information collected via the social media. More recently, we have been using more state-of-the art tools such as thermal cameras and acoustics sensors and over the last 2 years we have trained and use a research detection dog. Until today, based on hard evidence collected, the golden jackal presence is confirmed at 1643 record points all over Greece. Results: The golden jackal population in Greece has slowly begun to increase since the early 2000s, in parts of southern, central, and northern Greece, resulting in the return of the species in most parts of its previous historical range until 2010. The species then started to expand to other parts of the country, in which no previous records had occurred. Nowadays, the species' populations have recovered all over the country, and it is also present on six Greek islands. Jackals have been found, except for the lowlands, and on very high altitudes (over 1700 m), in all habitat types all over Greece. Conclusion: This is the first effort to present the actual distribution of the golden jackal in Greece based on hard evidence and not only on estimates and/or testimonies. Similarly, to what has been reported in other parts of the Balkan Peninsula and central Europe over the last 20-30 years, the golden jackal has rapidly expanded its range and increased its population also and in Greece during the same period. This has resulted in the colonisation of most parts of mainland Greece and some islands by golden jackals. The species population in Greece is currently estimated to be over 30,000 individuals, with the Peloponnese to be its stronghold, with approximately 10,000 individuals.

The story of the golden jackal in numbers: from the return to the conquest of Hungary

Sándor Csányi

1. Purposes: The golden jackal (*Canis aureus*) started to reappear in Hungary between the end of the 1980s and the beginning of the 1990s. It became a game species in 1995, and we have a unique record of shot jackals for the country. The purpose of this presentation is to show the dynamics of the golden jackals in Hungary at three levels: 1) at the national level (temporal); 2) at the 19 counties (spatio-temporal), and 3) and at the level of 1200-1450 game management units (spatial). This presentation focuses on the visual demonstration, the patterns of change, and the recurrence of processes, resulting in the conquest of Heaven. [A strict quantitative approach of the same data is presented in the paper of Hanna Bijl and Sándor Csányi during 3 IJS]. 2. Material and methods: The Hungarian National Game Management Database (OVA) has collected the hunting bag data for golden jackals since 1995. The numerical information is collected annually from Game Management Units (GMU) in Hungary and can be spatially represented (maps of jackal bags). 3. Key findings, conclusions, and speculations: Since 1995, the hunting bag of the jackals has followed exponential growth. Except for the last years, after around 2020), the rate of change was stable. 1. Very similar patterns of exponential growth can be found at the level of the 19 countries. Jackals dispersed fastly north- and north-eastwards and J-shaped patterns were repeated with time delay. 2. The steep numerical increase in the jackal population(s) resulted in the spatial spread of the animals. Here the patterns are not uniform: on the one hand, some neighbouring areas (regions) were inhabited differently for long periods, while distant steppingstones can be circumscribed on the other hand. 3. Although the increase of the jackal bags has shown an exponential pattern, the golden jackal escaped management control and, in a quarter of a century, they conquested Hungary. The following factors might play a role (or can be speculated): (i) Wildlife biologists, game managers, and hunters initially underestimated golden jackals' flexibility and opportunism. Jackal was a curiosity for scientists, and hunters wished them for trophies. (ii) The results of studies showing the „invasive" traits of a native mesopredator have been over-looked or neglected, resulting in delayed reactions and lack of action. Even high hunting pressure could not control the core populations, and the proactive management of the edges was missed. (iii) Sport hunters cannot eradicate golden jackals when they inhabit an area. Long-term coexistence must be accepted, and high hunting pressures must be kept avoiding further increases. (iv) It is a key to better control to study golden jackal population biology and use the lawful methods of predator control, and to introduce 21st-century technologies to improve the efficiency of actions. 4. Take home messages: (i) Conservation research is biased, and preference is given to the glamorous endangered species. It is time to provide more resources to study and understand the successfully recovering species in Europe or other parts of the Earth. (ii) The population size and trend are not carved into stones but a trade-off of reproduction, mortality, migration, and the factor determining them. Consequently, the conservation status is constantly changing. During the last decades, beavers, bears, cormorants, ravens, wolves, golden jackals and many others have become local or regional problems. Silence and concealment don't solve the problems of this species. (iii) Learning from successful species is as important as the „small population paradigm" or the "declining population paradigm" for charismatic animals. Those celebrating the jackals arriving in areas far beyond any known range must read its triumphant march across the Balkans and the Carpathian Basin.

Rise of a golden jackal (*Canis aureus*) population: genetic diversity and structure during expansion

Wiesław Bogdanowicz, Robert Rutkowski and Małgorzata Pilot

The golden jackal (*Canis aureus*) is a medium-sized omnivorous carnivore with a flexible diet, undergoing a rapid range expansion in Europe, which is expected to continue with predicted climatic changes. Until the 20th century, its European populations were small, with distribution limited to a few coastal regions of the Mediterranean and Black Sea. Today, C. aureus is recorded in a large part of Europe (in addition to the Middle East and Central and Southeast Asia). The range expansion was especially intensive in the last two decades and occurred both geographically (reaching western Europe, the Scandinavian Peninsula and the north of European Russia) and in elevation, as golden jackals began to be seen more frequently at higher elevations than previously recorded. The spatial expansion of this species provides an interesting model for studying the mechanisms of rapid colonization across the European continent and understanding its natural or invasive basis. However, little is known about the golden jackal expansion routes, the source populations driving the expansion, and their connectivity with populations at the front of the expansion wave. Analyses of different genetic markers revealed low levels of genetic diversity, reflecting the unique history of the golden jackal among Europe's native carnivores. The highest genetic diversity among the European golden jackals studied was found in populations from the Black Sea and Caucasus regions. This is consistent with earlier studies and likely reflects the origin of the European population from the colonization from South Asia along the Ukrainian Black Sea coast. The Carpathian Arch, in its eastern section, is a barrier to gene flow; individuals from Pannonia, for example, were assigned to a genetic group different from that comprising jackals from Câmpia Română and Thrace. The recent colonization of the Baltic region occurred as a result of long-distance dispersal from three main source populations: the Caucasus, Câmpia Română and Pannonia. The colonization of the Baltic region follows a pattern of long-distance dispersal (with higher dispersal in males) without reproductive populations being established in the intermediary areas between the expansion sources and the newly established populations. In the future, more cases of long-distance dispersal toward the Baltic coast can be expected, as well as gene flow between different parts of the Baltic region inhabited by different jackal lineages, and further expansion toward Fennoscandia and northern Russia (which is already taking place). This pattern of colonization from multiple sources strongly supports the view that C. aureus is not an alien species, and that its appearance in new areas is a natural process.

Session presentations – Diseases

New data on heartworm disease in jackal population in Serbia

Aleksandra Penezić, Neda Bogdanović and Duško Ćirović

Purpose/Objective The golden jackal, *Canis aureus (Carnivora: Canidae)* is a medium-sized canid species, under significant and rapid geographic expansion. According to the literature data, jackals are hosts of almost 200 parasite species. Many pathogens are shared with domestic dogs and/or cats, but some of them also show a zoonotic character i.e., the heartworm which causes dirofilariasis. The objectives of this research were: to determine the prevalence of this parasite in the jackal population in Serbia and to analyse the habitat characteristics where jackals were found positive to adult heartworm presence. Material/Methods In collaboration with local hunting management units, legally hunted jackals specimens were collected. During the period 2014 – 2022, 370 subadult and adult jackals were inspected for the presence of adult heartworms. Hearts and pulmonary arteries were cut open and examined carefully. According to morphological characters, where possible, the number of female and male specimens was recorded, as well as the total number of parasites. QGIS software was used to extract data on land cover around locations of positive samples to examine the potential relationships to *Dirofilaria* occurrence. Results During this research period, the prevalence of adult heartworms in the Serbian jackal population was 14.9%. The highest prevalence was recorded in 2020 and the highest load of this parasite in the jackal heart was 36. The majority of heartworms were detected in the heart and pulmonary arteries and additionally two cases of unusual location were recorded. Jackals positive to adult heartworms were detected from lowlands in the north to mountainous regions in west of Serbia, where jackals have recently established a population. Conclusion *D. immitis* is widely represented in the jackal population in Serbia. Considering that this nematode species is of interest for public health as well as the health of domestic animals, continuous monitoring of its presence in wild canine reservoir host populations is highly recommended.

Camera trapping as a tool for diagnosing and monitoring mange disease

Alper Ertürk and Anil Soyumert

Sarcoptic mange is a widespread and highly contagious zoonotic ectoparasitic skin disease caused by the mite *Sarcoptes scabiei*. This parasitic disease is distributed worldwide and affects both wild and domestic mammals. However, diagnosing and monitoring disease in wild animals is more complicated than the domestic ones. This makes the non-invasive survey methods invaluable to track the disease in wild populations. From this respect, we used the long-term camera trap data to investigate the occurrence of sarcoptic mange in populations of wild mammals in north-western Turkey. Between 2007-2020, a total of 256 camera trap stations were distributed throughout 111.000 km2 area including one national park and five wildlife development areas. The outcomes of the camera trap surveys revealed 14 large mammal species in the region, and we obtained 20186 records belong to three canid species; grey wolf *Canis lupus* (n=5842), golden jackal *Canis aureus* (n=1709) and red fox *Vulpes vulpes* (n=12635). All the camera trap records were examined for visually identifiable mange lesions, and we detected compatible records for grey wolf (n=20) and red fox (n=27), but not for golden jackal. The localities of these records are not aggregate in a specific area and the dates are belong to all four seasons. Therefore, it may be concluded that grey wolf and red fox populations have the sarcoptic mange throughout the study region and they are affected of the disease year long. There is no difference for the surveillance of the disease among the seasons.

Study on the prevalence and larval burden of the *nematode trichinella spp.* in jackals from hunting grounds from Timis County (Romania)

Ana-Maria Marin, Dan Cornel Popovici, Joszef Tamas Fodor, Maria Monica Florina Moraru And Narcisa Mederle

Nematodes of Trichinella genus are cosmopolitan zoonotic parasites and are among the most widespread parasites of domestic and wild omnivores and predatory animals. The risk of infection with Trichinella spp. is a major concern in Romania due to eating habits. This disease is and remains one of the most important parasitic zoonoses, transmitted through the consumption of raw meat from domestic and wild animals. In the context that the jackals represent a sentinel of the intersection of the two domestic and sylvatic cycles, we followed in this study to evaluate the prevalence and the larval distribution of Trichinella spp. in the muscle samples collected from jackals from Timis County (Romania) hunting grounds. The study was carried out during 2019-2021. The muscles samples from a number of 42 jackals were examined by trichinelloscopy and artificial digestion. The results revealed a 78.57% prevalence of trichinelosis. The levels of larval distribution showed the high larval burden in the tongue muscles (37.8 larvae / gram), diaphragm (21.3 larvae / gram), intercostal (11.2 larvae / gram) and the lowest pourcent was in the temporal muscle (3.25 larvae / gram). We can conclude that the high prevalence of trichinellosis in a sentinel host such as the jackal had a predominant and similar larval distribution that identified in domestic animals. The results of the present study warn about the danger of infestation with a possible zoonotic parasite identified in a host of relationship between the wild and domestic cycle of trichinellosis. Keywords: jackal, trichinellosis, prevalence, larval distribution, Romania.

Parasitological survey on golden jackal (*Canis aureus l., 1758*) in Friuli Venezia Giulia region (Italy)

Beraldo P., Pesaro S., Saccà E., Dorigo L., Lapini L., Bregoli M. And Filacorda S

Purpose/Objective: The golden jackal (GJ) is an expanding mesocarnivore in Europe and its presence in north-eastern Italy has been documented since the 1980s, consolidating its presence over the time and, therefore, constantly monitored both from the ecological and health perspective. In fact, its biology and behaviour set the stage for infection by a wide range of pathogens, including parasites. Material/Methods: Therefore, over the past 10 years, 47 road killed GJs in Friuli Venezia Giulia (FVG) region have also been investigated for parasites. Carcasses were collected throughout FVG, frozen before examination, and submitted to biometric analysis, necropsy and parasite collection by total worm count. All recovered parasites were identified according to their morphology and selected parasites were preserved at -20°C for DNA analyses. IZSVe also investigated on *Trichinella* and *E. multilocularis* presence. Coprological analysis was performed with feces collected from the rectum. Results: 91.5% of the examined population was parasitised, although in general the average parasite load was quite low (29,5; range 1-499). 68%of the animals had polyparasitism with on average from 2 species/animal (range 1-6), only in 8.5% the infracommunity was composed of 5 or 6 helminthic species. A total of 1280 parasites were counted, identifying 18 helminthic species: 11 *nematodes (U. stenocephala, T. canis, T. leonina, A. putorii, C. plica, M. legerae, T. vulpis, P. affinis, A. vasorum, C. vulpis, E. aerophilus*) 2 digeneans (M. yokogawai and A. alata) and 5 *cestodes (T. hydatigena, T. pisiformis, T. serialis, D. caninum and M. litteratus)*. Faeces collected from carcasses (n=22) presented generally parasitic elements attributable to the identified endoparasites, while 59% of animals were positive for Sarcocystis sp.. Muscle tissues were always negative for the search of Trichinella as well as faecal/gut samples for *E. multilocularis*. Few hard ticks (*I. ricinus, D. marginatus and D. reticulatus*) and fleas (*C. canis*) were found in 40% of the animals. Until now, all the animals were negative for *Trichinella spp*. and *E. multilocularis*. Conclusion : This study represents the first investigation on GJ parasites in Italy. The parasitofauna of FVG GJ population is almost overlapping with that reported in other European countries. The good parasitic biocenosis (even if the prevalence and mean intensity of infrapopulations is generally low) of FVG GJ is related to juveniles' dispersion between Italy and Slovenia, territorial mobility, and a very unselective diet. Most of these parasites can be shared with other wild canids and domestic dog. Our data help demonstrate the importance of GJ as a wild reservoir of human and animal parasites and, therefore, it is essential the health monitoring of this wild canid.

First comparison of the lifespan and spatial behaviour between rehabilitated jackals and those captured in the wild with baits

Marcello Franchini, Stefano Pesaro, Lorenzo Frangini, Andrea Madinelli, Andrea Vendramin, Saimon Ferfolja and Stefano Filacorda

Purpose/Objective: Radiotelemetry represents a key tool to study the behavioural ecology of wild species. However, trapping systems and the history of collared animals (as well as the predisposition of the collar itself), could influence the lifecycle and behaviour of the individuals. The purpose of this study is to compare the life expectancy and spatial behaviour of golden jackals (*Canis aureus*) (hereafter, jackals) captured in the wild with those of animals injured and released after treatment and rehabilitation. Material/Methods: Our research was carried out in North-Eastern Italy, from 2019 to 2022. We have monitored seven jackals (five males, two females) with GPS/VHF/GSM collars (Vertex Lite, Vectronic): Two were captured with snares (1 M, 1 F), and one using a box trap (1 M) (Captured). Baits were used at capturing sites. The other four were released (3 M, 1 F) with collar after treatment and rehabilitation (Treated) at the wildlife, a rescue centre of the University of Udine. The latter were recovered by the regional forestry service and animal rescue centers after being hit by car (n=3) or found sicked (n=1). The periods of treatment and rehabilitation varied from three to forty days. All the animals were released at the recovery/capture place. We compared Captured and Treated groups, for apparent survival time (LSA, days from release to the last observation or fix collected) and home-range (HR) through autocorrelated kernel density estimation, after the first and second month from release. Results: All the Captured animals died hit by car (n = 2) or poisoned (n = 1), with an average of 107 days (d) of LSA (LSA: 36d M, 101d M, 186d F). Among the Treated animals, two lost contact due to battery off out or device problems (LSA: 143d M, 725d M) or are still alive (LSA= 287d F, 474d M). The average HR after one month was 704 ha in Captured jackals (n = 3), and 368 ha in Treated ones (n = 4). After two months, the HR was 2,071 ha for Captured animals (n = 2), and 2,088 ha for Treated ones (n = 4). After that, two treated animals (1 M, 1 F) dispersed. Conclusion: Although we lay on a small sample size, these results raise important questions about post-capture behaviour of animals captured with snares and cages which may be attracted to anthropogenic food sources (i.e., baits). At the same time, it was showed that appropriate care and rehabilitation, associated to the negative conditioning induced by veterinary manipulation and activities, lead to successful releases into the wild. Other research are needed to provide further insights.

Session presentations – Ecology

Synchronizing cranial morphometric measurements for *Canis sp.:* exemplifying on the first golden jackal (*Canis aureus*) skull from Finland

Hatlauf, Jennifer and Viranta, Suvi

Scholars use diverse methods to study skull morphology: photogrammetry, 3D scans, landmark-based geometrics and the traditional calliper measurements. The advantages of the latter are several. The measurements are less affected by post-mortal changes, such as missing teeth. The method works well for single teeth, especially the canine. Measuring with callipers is also a very time efficient and inexpensive, yet an accurate method. However, there is a methodological limitation: in large scale studies involving more than one researcher, the inter-observer variability in measurements may result in the loss of data. Precision and accuracy are highly dependent on the observer, however, with a protocol on the exact measurements, errors and variability might be strongly reduced. Therefore, for this study we focused on the exact documentation and description of the measurements taken by callipers. Our goal is to develop a method to standardize canid cranial measurements. As our trial specimen we used the first golden jackal (*Canis aureus*) skull sampled in Finland. We took 19 measurements using a digital sliding calliper (Mitutoyo Digital Calliper) with the precision to 0.01 mm, and repeated measurements to gain consistence. The results are presented in a line of pictures which can be used to standardize the basic cranial measurement in studies involving multiple observers However, larger datasets and collaboration are needed for our method is subject to further studies.

First multispectral imaging analysis of jackal skeleton and pelage

Krickl, Robert and Hatlauf, Jennifer

Multispectral imaging is a versatile technique for investigating the nature and mapping the distribution of certain material phases by detecting differences in absorption, reflection and emission of electromagnetic radiation. For it is non-invasive, with no need of sample preparation, and highly variable sample size ranging from submillimetres to kilometres, it is yet often applied in forensic, materials and archaeometric sciences. However, there are certain methodological limitations that may have hitherto restricted the use in certain study areas, especially in cases of non-microscopic investigations of mammals. To the best of our knowledge, multispectral imaging of entire body parts in high resolution has never been applied on jackals. This feasibility study was conducted on three skulls of golden jackals (*Canis aureus*) from the collection of the Golden Jackal Project Austria (www.goldschakal.at) as example for variations in bone and teeth, and a pelt of a black-backed jackal (*Lupulella mesomelas*), as an example for fur analysis. Applied techniques included high resolution imaging of reflected and emitted light from the ultraviolet to near infrared spectral region with the aid of a custom-made light-source and detector array. Images reveal marked differences between and within the investigated samples. A notable portion of the recorded variations of signals is attributed to measures of preparation and conservation of the biogenic materials – but even within the small sample number, there are also indications of osteological differences and pathologies. The results are a proof of concept that multispectral imaging can be applied to common canid zoological specimens. However, precise interpretation of many recorded signals is yet difficult and therefore subject of further studies. This successful feasibility study and promising results enable general conclusions on topics where this method may be applied in the future to provide data for jackal research. Possibilities include insights into not recorded conservation and preparation treatments of (historical) collection objects, localisation and assessment of the number of remnants of organic tissue on osteological samples, information on colonization and degradation by fungi and other microorganisms, revelation of pathologies and biological differences connected to life history and possible forensics of hunting marks (even after their visible removal by preparation). To further enhance practicability, building up expertise and reference data for future investigations is intended.

Potential effect of intraspecific isolation: observations of a golden jackal (*Canis aureus*) and red foxes (*Vulpes vulpes*) living in sociopositive relation

Felix Böcker, Hannah Weber, Janosch Arnold, Sebastian Collet and Jennifer Hatlauf

Interspecific interaction and competition within the guild of canids are intensely documented and researched all over the world. Still the relation between foxes and golden jackals is mostly competitive with a top-down effect. Both species can form various forms of intraspecific social bonds. However, both species are not known to build social coalitions with interspecific partners. The aim of this study was to observe a resident, single male golden jackal in the municipality Bad Wurzach in the district of Ravensburg, Baden-Württemberg, with the use of camera traps and active searches for scats using a scat detection dog. Eight camera traps were active in summer 2021. The observed behaviour was categorized to allow a better impression of the situation and quantities. From June 2020 on, a single jackal was documented regularly by different camera traps and genetically identified by scat analysis (genotype code GG008m). In August 2020 the jackal was photographed and filmed by camera traps in company with young red foxes. The interspecific group showed familiar behaviour, which could be documented again in September 2020. The behaviour of the foxes and the jackal was familiar and social. In 2021, a comparable situation could be observed. The golden jackal was again photographed with foxes. The recordings show interaction between a fox female, her cubs, and the jackal and that the jackal is also carrying food. To our knowledge, the described observation is the first record of a sociopositive behaviour between golden jackals and red foxes. It is important to consider the fact that the golden jackal observed here is a single male individual isolated from other golden jackals. Social isolation could be a driver for interaction and social bonding with another species. Red foxes might be an attractive alternative for golden jackals in situations where there is a lack of conspecifics. We assume that the golden jackal in this case benefits from the foxes' company in a psychological way, fulfilling basic social needs. We cannot draw any general conclusions from this exclusive behaviour of individuals to similar situations. However, interspecific groups at least between single individuals of the two species should be considered a possible scenario at the edge of the golden jackal's distribution range. In a comparable situation, where single golden jackals meet other relatives of the genus Canis, hybridization should also be taken into account as a possible scenario. Further research on such interspecific groups at the edge of one species' distribution range is necessary in order to figure out whether the observed situation is an individual or a common occurrence.

Exploring the ecology of the golden jackal (*Canis aureus*) using the first telemetry data collected in Italy

Frangini Lorenzo, Franchini Marcello, Stokel Giacomo, Madinelli Andrea, Pesaro Stefano, Ferfolja Saimon and Filacorda Stefano

Purpose/Objective In the last decades, GPS collars have been frequently used by researchers to investigate the ecology and behaviour of cryptic species, including carnivores. However, in Europe few telemetry studies have been conducted on the golden jackal (*Canis aureus*), a species that has been showing a notable expansion in the last decades. The purpose of our study was to explore the spatial ecology and activity patterns of jackals using the first telemetry data in Italy. Material/Methods We fitted seven individuals (two females, five males) with GPS collars with dual-axis accelerometers in 2019-2021 in NE Italy. We investigated movement patterns (stationary or dispersal) through the Net Square Displacement to estimate the 50% and 95% home-range (HR) size with autocorrelated kernel density estimation. Furthermore, we investigated the degree of habitat selection on landcover and tree cover density through selection ratios within 50% and 95% Brownian Bridge utilization distributions (UD). Finally, we explored the activity patterns of two jackals through the diurnality index. Results We obtained 4,457 locations with variable monitoring periods for each animal (36-453 days) and 53,107 bursts of acceleration. Two jackals displayed dispersal patterns, while the others showed a stationary behaviour. HR at 50% varied from 0.32 to 22.41 km2, and from 2.73 to 105.62 km2 at 95%. The pattern of habitat selection significantly deviated from random both within 50% and 95% UDs (p < 0.001). Within 50% UD, jackals selected the highest cover density class and mixed forests, avoided the lowest density class and complex cultivations, and avoided wetlands at 95% UD. The diurnality index revealed that jackals mostly showed a nocturnal behaviour (95% of the activity). Conclusion Our HR and habitat selection results were in line with other studies. We found only one exception for HR estimates as a young female showed extremely large values. Since field surveys and activity pattern analysis revealed that 50% UDs were mainly related to resting sites, it was not surprising to find out that they selected dense vegetated areas. However, at 95%, they avoided areas with no cover, but no other patterns were found. These findings may confirm the ecological plasticity of jackals, which enables them to exploit natural and anthropic resources during the night, as displayed by the activity pattern analyses.

Fine-scale spatial distribution and temporal activity patterns of three mesopredators: A case study from Greece

Giorgos Giannatos, Danai-Eleni Michailidou and Stefanos Sgardelis

Purpose/Objective: Species sharing the same fundamental niche can co-exist only if they find a way to partition the available resources, otherwise the competition between them will result in the subordinate species altering its use of resources. Here, we focus on three mesopredators, the golden jackal (*Canis aureus*), the fox (*Vulpes vulpes*), and the badger (*Meles meles*), to study their spatial distribution and diurnal activity patterns, and identify potential mechanisms that allow their coexistence. Material/Methods: We located camera traps in various habitat types within 12 Natura 2000 sites in Attica and Peloponnese to measure each species' activity. We measured the spatial overlap among species using Pianka's index. Finally, we estimated daily activity patterns as a probability density function using Kernel density estimation, as well as the coefficient of overlap to determine potential temporal activity overlaps among species. Results: Jackals and foxes exhibited higher overlap in their diurnal activity and spatial separation. On the other hand, badgers reduced their nocturnal activity but had more similarities in habitat use with jackals. Conclusion: Competition for resources pushes the subordinate species to modify its diurnal activity or fine-scale distribution. In this case, it seems that foxes avoid areas with high jackal activity irrespective of habitat type, but show the same diurnal activity pattern. Contrariwise, badgers use another mechanism to reduce/avoid competition with jackals, that is by reducing their nocturnal activity.

Preliminary determinants of (long distance) dispersal behaviour in Golden jackal

Hubert Potočnik, Jaka Črtalič, Ivan Kos, Boštjan Pokorny, Stefano Filacorda, Marcello Franchini, Lorenzo Frangini, Stefano Pesaro, Ilija Pantelić, Neda Bogdanović and Duško Ćirović

1 Purpose In recent decades, the golden jackal (*Canis aureus*) has experienced a remarkable expansion of its range, with vagrant individuals observed far outside the species' permanent range in the north and west - as far as the Arctic Circle in Norway, Denmark, and France. The species is highly adapted to thriving in human-dominated landscapes, where it benefits from abundant food sources. Dispersal affects the redistribution of organisms and is therefore a key factor in species range expansions. There is limited knowledge of the dispersal ecology of the golden jackal, based largely on indirect approaches. Occasional detections of vagrant individuals or large-scale genetic studies in Europe indicate the dispersal ability of the species and support the occurrence of long-distance dispersal in this species. 2. Methods We report dispersal characteristics of golden jackals at birth in six individuals (2 females and 4 males) aged 7 – 24 months, monitored between 2018 and 2022 using GPS telemetry. The individuals were observed during studies conducted in three countries: NE Italy, SW Slovenia, and in Serbia. We quantified some measures of movement paths from the pre-dispersal home-range (HR)/release site to post-dispersal HR. 3. Results The observed individuals started dispersal between January and April and lasted between 8 and 97 days. The maximum linear distance from pre-dispersal HR/starting site was between 23.6 and 163 km during dispersal, and the final linear distance to post- dispersal HR ranged from 6.5 to 159 km. The total distance travelled during dispersal ranged from 98.5 to 627.7 km, with the average daily distance ranging from 3.74 to 15.3 km. Different individuals travelled through extremely diverse gradient of habitat types, from urban and industrial areas to agricultural landscapes and contiguous mixed deciduous forests from lowlands to mountains. On their routes, some were frequently crossing highways and large rivers, such as the Sava or the Danube, at widths ranging from 300 to 600 m. 4. Conclusion Our study demonstrates the adaptability and ability of the species to disperse rapidly across human-dominated landscapes as well as through contiguous forested areas, and to cross major linear barriers such as large rivers, fenced highways, and mountain ridges. This high dispersal ability explains the past and ongoing rapid expansion of the golden jackal in Europe and may expand to large parts of still unoccupied Europe in the near future.

Seasonal movement patterns and space use of golden jackal (*Canis aureus*) in the suburban areas of Serbia

Ilija Pantelić, Neda Bogdanović and Duško Ćirović

1 Purpose/Objective The golden jackal (*Canis aureus* L.) is one of the most expansive species in Europe, but still, it is little known about species' movement ecology and space use. Thanks to a combination of adaptive strategies jackals can spread very efficiently through human-modified habitats. In such environments jackals feed mainly on food scraps that people leave in nature (illegal dumps), leading to a significant change in the species natural bahavior. Given their impact on both nature and society jackal ecology and especially their movement ecology presents an ever more important field of study. Determining the factors that drives jackals' movement and home range dynamics will represent an important starting point for establishing adequate management strategies. 2 Material/Methods We analysed movement patterns and space use of fourteen jackals (7 females and 7 males) collared between 2017 and 2022 using GPS collars (Vectronic Aerospace GmbH, Berlin, Germany) from Serbia. GPS collars were scheduled to record an animal location every 3h which resulted in 8 positions per day. To describe general movement behavior of monitored individuals we constructed regular movement trajectories from which we extracted hourly movement distances for each individual. For calculating general as well as seasonal home range sizes we used 95% MCP method. 3 Results Our analysis showed that home ranges of monitored individuals varied between 1.7 and 77 km². We also demonstrated that jackal movement patterns are strongly influenced by season (home range sizes ranging from 0.54 km2 in autumn up to 91.18 km2 in winter) but also by reproductive classes, with males covering much longer distances (average movement distance of males 225 km and 84 km of females). Our analysis also revealed a clear day-night movement dynamic, with predominantly nocturnal activity. 4 Conclusion Our study demonstrates that jackal movement behaviour and space use show great variability both in relation to the period of the year and reproductive class. Based on our finding we strongly believe that age as well as social status of the individual can significantly affect jackal movement. Understanding the jackals' ecology is now essential if we want to understand drivers behind their rapid expansion all over the Europe.

Stay home, stay safe? High habitat suitability and environmental connectivity increase road mortality risk in a colonizing mesocarnivore

Lorenzo Frangini, Ursula Sterrer, Marcello Franchini, Stefano Pesaro, Johannes Rüdisser and Stefano Filacorda

Purpose/Objective The golden jackal (*Canis aureus*) (hereafter, jackal) is among those species facing road mortality risk, mainly because of its scavenging behaviour on carcasses close to roads, use of human-altered areas and home-range size. The purpose of this study is to assess the main environmental/ecological factors affecting the road mortality risk for jackals, both through the analysis of habitat suitability and connectivity and by exploring the landscape metrics at roadkill sites. Material/Methods The study was conducted in the Friuli Venezia Giulia region, north-eastern Italy. We developed habitat suitability and connectivity models to derive 15 landscape metrics (i.e., topographic elements along road borders, vegetation, guardrail and/or fences, culverts, road type, distance from road intersections, human infrastructures and the Slovenian source population, road density, habitat suitability, connectivity, number of patches, mean patch area, Euclidean nearest-neighbour distance, and landscape division index). We investigated the effect of such metrics comparing 41 road-killed jackal locations (collected from 2009 to 2021) with 80 randomly generated points along the road network. To test the effect of the landscape metrics we used both Bayesian generalized linear models (BGLMs) and generalized linear models (GLMs). Results The BGLMs analysis showed that the risk for jackals of being road-killed significantly decreased in response to the distance from the nearest Slovenian source population (ResD = 104, p = 0.04), presence of guardrails and/or fences (ResD = 104, p = 0.01), and type of road (ResD = 104, p < 0.001). The GLMs analysis revealed that the risk for jackals of being road-killed significantly increased in response to the percentage of suitable habitat calculated within each buffer (ResD = 122.5, p = 0.02), landscape connectivity (ResD = 116.4, p = 0.03) and habitat fragmentation expressed through the landscape division index (ResD = 122.5, p < 0.01). Conclusion The results obtained from the models allowed us to identify those areas in which the road-killing risk for jackals is the highest and paves the way for management suggestions (e.g., creation of wildlife crossing areas, maintenance of road fences). Since road-killing represent a serious threat for wildlife and humans, the method used can be extended also to other species with the aim to minimize the risk of vehicle collisions and, therefore, preserving both human and wild species safety.

Humans shield golden jackals from wolves in their expansion across Europe

Nathan Ranc, Chris C. Wilmers, David Warton, Luigi Maiorano, Francesca Cagnacci, Ilya Acosta-Pankov, Francisco Álvares, Ovidiu Banea, Tomaz Berce, Jaroslav Červinka, Duško Ćirović, Nada Ćosić, László Gál, Giorgos Giannatos, Nuno Guimarães, Jennifer Hatlauf, Miklós Heltai, Gjorge Ivanov, József Lanszki, Luca Lapini, Peep Männil, Dime Melovski, Despina Migli, Marco Pavanello, Aleksandra Penezić, Anelia Petrova, Martin Šálek, Alexandra Sallay, Ivana Selanec, Aldin Selimovic, Tobia Sforna, Aleksandar Stojanov, László Szabó, Jasna Tarman, Igor Trbojević, Tijana Trbojević, Peter Urban and Miha Krofel

Humans influence the distribution of species through multiple pathways. Past research has largely focused on direct persecution or impact of climatic and habitat factors while overlooking the large-scale implications of altered biotic interactions among species. Here, we evaluate the influence of a large carnivore, the grey wolf, and its interaction with humans on the continental-scale distribution of a rapidly expanding mesocarnivore in Europe, the golden jackal. We found that wolf presence was the primary factor influencing the distribution of golden jackals, but the shielding effect of humans mediated this biological constrain. Large areas (72%) of Europe are suitable to become colonized by jackals in the future, but the ongoing, natural wolf recovery may limit this potential. We show that large carnivores, here wolves, have the potential to influence the large-scale distribution of mesocarnivores, here golden jackals, but this constrain is strongly mediated by humans.

Habitat preference of golden jackal (*Canis aureus*) in Serbia

Neda Bogdanović, Aleksandra Penezić and Duško Ćirović

1 Purpose/Objective Understanding the drivers of a species' distribution and identification of its most suitable habitats is crucial for sustainable population management, especially when it comes to fast-spreading species, such as golden jackals. Golden jackal (*Canis aureus*) is opportunistic mesocarnivore that has received significant public attention in recent years, given its ability to successfully spread and inhabit human-modified habitats. Many researchers have hypothesized the possible drivers of jackal rapid expansion among which the availability of anthropogenic food source and intensive modification of natural habitats are often disused, especially when it comes to developing countries such as Serbia. However, a lot of effort should be made to understand jackal ecology and the processes underlying the species' habitat selection. 2 Material/Methods We used habitat suitability models with a maximum entropy approach (MaxEnt) to analyze jackal selection patterns in Serbia at two different spatial (coarse and fine) scales. Considering species range expansion, we were specifically interested to see which environmental variables drive jackal's habitat selection. Two types of jackal presence data (GPS telemetry data and occurrence locations) and 11 environmental variables related to topography, land cover and human infrastructure were used for developing habitat suitability models. 3 Results Our results revealed that human population density is the most important driver of jackal habitat selection, both at the coarse scale (68%) and at the fine scale (60%) model. The variables distance to urban areas and percentage of infrastructure had moderate contributions at the coarse scale model, while for the fine scale we obtained that distance to urban areas, water bodies and first-, second- and third- order roads were more important for jackals. 4 Conclusion Our results provide the first insights into the jackal's habitat selection in Serbia, based on telemetry data, revealing that human derived variables have the greatest influence on jackal habitat selection. Preliminary analysis showed that there is much more suitable habitat for jackals to expand their distribution in Serbia. Given that jackals are now one of the most expansive species in Europe with ability to survive and establish in human modified landscapes, understanding the drivers of jackal's distribution is urgently needed.

First record of multiple breeding and communal nursing within one social unit of European golden jackal (*Canis aureus, L. 1758*) in a low-density area in NE Italy

Pecorella S., De Luca M., Fonda F., Viviano A., Candelotto M., Candotto S., Mori E. and Banea O.

Purpose/Objective: For species listed in Annex V of Habitats Directive, EU Member States shall, if deemed necessary, take measures only because of surveillance work, to ensure that their exploitation is compatible with maintaining them in a favorable conservation status. However, game management plans are elaborated without specific data on local density, at official rates overpassing 90–100 % (i.e. Romania), while the main reproductive parameters of the species are not yet understood. Our aim was to investigate reproductive biology at the den site as a key element in defining lethal control policies or conservation measures. In Italy the species legal status is strictly protected. Material/Methods: The study area is located in NE Italy on the lower Isonzo River catchment. First, we calculated the density performing a preliminary survey combining bioacoustics monitoring method (Giannatos 2004) and jackal litters opportunistic occurrence with camera trapping. Afterwards, we monitored 24 potentially suitable burrows during 2021 and 2022 breeding seasons with IR sensor cameras. Results: The local density was 0.53–0.65 groups / 10 km2. One of the monitored burrows has been occupied by three adult jackals (one male, two females). In this site, one camera trap was active from 20/02/2022 to 30/06/2022, with 112 days of recordings and 18 days (four interruptions) without recording. 1814 videos of jackals were collected. Significant observations: 04/04 – last record of the dominant female pregnant; 09/04 – the dominant female brought inside the burrow 8 new-born jackals; 10/04 – a second female (helper) was observed at den site from this date; 26/04 – first den exit of a cub; 29/04 – the helper female appeared pregnant; 02/05 – the helper female was recorded all suckling from this date; 20/05 – the dominant female brought away from the den 3 inept new-born cubs, whom 10 min later were brought back inside by the helper. Later in the day, the dominant female moved away 4 new-borns; 21/05 – the helper female brought at least one new-born back into the den; 28/05 – jackals leaved the den. Conclusion: We documented the first case of multiple breeding and communal nursing within one group of golden jackals. The dominant female gave birth to 8 cubs between the 4th and 9th of April and the period between gestation and independent den exit was 17–22 days. The two females cooperated in rearing the first litter throughout the denning period (49 days). A second litter of 4 cubs appeared related to the same den, as result of parturition by the helper female. The birth of this litter occurred between the 29th of April and 2nd of May. Based on observations of threatening / aggressive behaviors from the male toward the helper, polygyny might be excluded. Apparently the second litter did not survived. Our findings open new scenarios and questions about the reproductive biology and applied ecology of C. aureus in areas with low density and low mortality.

Session presentations – Feeding habits

Dietary flexibility promotes range expansion: the case of golden jackals in Eurasia

József Lanszki, Matt W. Hayward, Nathan Ranc and Andrzej Zalewski

Ongoing global changes can lead to the expansion of species' geographic range. Exploring the drivers of the successful ongoing expansion of the golden jackal (*Canis aureus*) across Europe is essential to understand the species' trophic ecology. We analysed which climatic and environmental factors affected the dietary composition of golden jackals and compared these drivers in the species' historic and recently colonized distribution ranges. Using 40 published data sets, we modelled jackal diet composition using 13 food categories based on the relative frequency of occurrence of food items and trophic niche breadth (BA) against climatic and environmental factors from throughout the jackals recently colonized (22 studies) and historic range (18 studies) using general additive models. The proportion of small mammals in golden jackal diet decreased with annual mean temperature, whereas the consumption of wild ungulates increased with environmental productivity. Increasing temperature and environmental productivity positively influenced niche breadth, while increasing precipitation negatively affected it. The recently colonized distribution range of golden jackals in Europe had a lower mean temperature but higher environmental productivity compared to the species' historic range in Eurasia. In the recently colonized range, jackals consumed small mammals and/or wild ungulates (mostly from scavenging) more frequently, and fewer plants and/or domestic animals (again, mostly from scavenging). The golden jackal is an opportunistic, omnivorous carnivore with high dietary flexibility and biogeographical variation. Climatic and environmental factors shape the species' diet composition, which, in a changing environment, greatly enhances the opportunities for golden jackals to colonise new areas successfully. Golden jackals will likely continue to expand their range in the foreseeable future. The species' trophic niche is expected to broaden with predictions of overall increasing temperatures and reduced precipitation.

Diet composition of the golden jackal (*Canis aureus*) in the Balatoni Nagy-berek (Hungary)

Bende Z. and Lanszki J.

Targeted studies can elucidate the impact of carnivores on big game populations and domestic herds. Today, the golden jackal (*Canis aureus*) is a rapidly expanding canid in Europe. We examined the seasonal and age group-dependent diet composition and feeding habits based on stomach contents of 57 jackal individuals (adult 44, juvenile 13) collected during legal hunting in Balatoni Nagy-berek. Based on the known opportunistic foraging of the jackal, we hypothesized that the wild ungulate viscera and carcass consumption would be primary in its diet due to the intensive big game management in the area. In the diet of adult and young jackals, the viscera and carcasses of big game species (cervids and wild boar) were primary, plants (mainly fruits and seeds) were secondary, and small mammals (mostly rodents) were tertiary. The varied diets often included arthropods, rarely other types of food (e.g. hares, birds, lizards). In the area, which mainly comprises open, wet and swampy habitat types, big game viscera from intensive hunting activities were utilized decisively. It also played a role in removing naturally dead or injured individuals from large numbers of wildlife. Despite significant beef cattle keeping and grazing in the area, we detected no livestock consumption. Overall, consumption followed the food sources in the highest quantity and easily available in a given season. Despite significant jackal populations, we did not observe a decline in big game species or other potential prey species.

What do golden jackals (*Canis aureus*) in Austria feed on?

Hatlauf J. and Lanszki J.

Golden Golden jackals (Canis aureus) were firstly recorded in 1987 in Austria, and the first reproduction was confirmed in 2007. In 2016 the first family groups could be confirmed with the help of bioacoustics and a citizen science project started to collect data from hunters and the general public. Questions about the possible impact on potential prey species arose, and therefore the collection of stomach samples started to explore diet composition and feeding habits. Between 2016 and 2020, we collected 14 golden jackal stomachs from seven different areas in four Provinces in Austria: Burgenland, Lower Austria, Upper Austria and Styria. The samples come from diverse habitats with different food availability. All stomachs were obtained from either road-killed or legally shot golden jackals. From these stomachs, we could analyse the wet weight (W%) and the relative frequency of occurrence (RFO) of each food item. In this study, we present the first analyses of stomach contents from golden jackals in Austria based on macroscopic and microscopic examinations of the hard parts (e.g. hairs) from foods consumed. The results showed, that the most frequently consumed foods were plants (e.g. cherries, plums, grasses). However, based on quantitative analysis (wet weight measures), the primary foods of jackals were wild ungulates (mosly cervids – both as cadavers and fresh – and partially wild boar), domestic animals (in one case a rabbit) had secondary and plants tertiary importance. The intake of birds, bird eggs and invertebrates were subordinate. In one sample, we could detect smaller carnivores, namely marten (Martes sp.), while remains of fish, amphibians and reptiles were not present in the samples. The results support the fact that golden jackals show diverse and opportunistic foraging. The demonstrated feeding habits, similar to those experienced in the central-southeastern region of Europe, will predictably help further expansion of this species in Austria, and whole Europe.

How urbanization and diet influence coyote behavior

E. Hance Ellington, Seth D. Newsome, and Stanley D. Gehrt

Purpose: In the last several decades, coyotes (*Canis latrans*) have rapidly occupied urban landscapes across North America. In Chicago, USA, coyotes persist across the urbanization gradient, from natural fragments to the highly urbanized downtown. Because coyote space use and movement behaviour do not respond linearly to increasing urbanization, the way in which coyotes respond to urbanized landscapes is determined by more than just the physical components of urbanization. One potential confounding factor in coyote behaviour in urban areas is anthropogenic food. Anthropogenic food can be easier to capture and handle than natural prey and as urbanization increases. As coyotes switch from natural to anthropogenic food as urbanization increases, we expect their behaviour to change, but it is unknown how diet-driven behavioural change is related to landscape-driven behavioural change. Methods: We used a subset of coyotes for which we had fine scale GPS telemetry data (fix rate = 15 minutes) and isotopic signatures from whiskers (n=21). We use the GPS telemetry data and Hidden Markov models to estimate the time spent in four distinct movement behaviours: encamped, foraging, searching, and traveling. We used the isotopic signature found in the whiskers to estimate the amount of anthropogenic food in an individual's diet ($\delta13C$). We estimated the urbanization that an individual coyote experiences by estimating the proportion of the developed landscape within a 500m buffer of the 95% minimum convex polygon. Results: We found that urbanization and diet both influence coyote movement behaviour. As the landscape became more urbanized, coyotes spent more time traveling and more time encamped. However, not all coyotes adopted a more anthropogenic diet as urbanization increased. When coyotes consumed a more anthropogenic diet, they spent less time traveling and more time foraging relative to searching. Conclusion: Individual coyote behaviour is complex; it is driven not only by the underlying landscape, but also by the food resources that are available and consumed. Our work has also revealed further questions, such as whether seasonal variation in the food resources consumed leads to predictable variation in space use and behaviour. Coyotes also make choices about which features in an urbanized landscape to use (relative to their availability), and these choices are likely behaviour-specific and impact the food resources available.

Developing correction factors for improved diet analyses of golden jackals (*Canis aureus*)

Klinkhart M. and Hatlauf J.

The determination and understanding of a predator´s diet is essential for ecological and conservation purposes. As most carnivores show an elusive behaviour, indirect methods, such as the commonly used scat analyses, are often applied to study feeding ecology. The undigestible remains in scats can then be used to develop single correction factors (CFs) as relation between dry mass of remains to the fresh mass of ingested food. Such CFs are recommended for omnivorous species as the golden jackal (Canis aureus) since they are more accurate for estimating the actual consumption of different food categories (like small mammals, fruits, ungulates, innards). Because no species-specific CFs have yet been developed for golden jackals, CFs derived from data on red foxes (Vulpes vulpes) were commonly used to estimate prey biomass consumed by jackals. However, differences in body mass and metabolism can mislead estimations of biomass intake by applying CFs of other species. Hence, the aim of this study was to (1) determine and present jackal-specific CFs for different prey categories and (2) compare the results to previously used (red fox) CFs and the resulting prey body masses. Results show high variability within the calculated CFs for most food categories – indicating individual metabolic differences – but also divergence to the previously used red fox CFs.

Deer for dinner! First documented predation with camera-trap of golden jackal on roe deer and subsequent kleptoparasitism by wild boar in Italy

Lorenzo Frangini, Marcello Franchini, Stefano Pesaro, Saimon Ferfolja, Giacomo Stokel, Andrea Madinelli and Stefano Filacorda

Purpose/Objective The current literature report the presence of wild ungulates in the diet of the golden jackal (*Canis aureus*) (hereafter, jackal) in Europe. However, most authors ascribe these cases to the opportunistic behaviour of jackals (i.e., scavenging on either carcasses or remains left by hunters). Active predation on ungulates, on the other hand, is a more controversial topic. In the Karstland of Friuli Venezia Giulia (hereafter, FVG – NE Italy), the jackal population has been showing a notable increase (after its first appearance in the 80th), with an actual estimated density of 1.1 ind./100 ha. However, in the same area, the roe deer (Capreolus capreolus) has been suffering a drastic decline, from 15.6 ind./100 ha in 2011, to 9.9 ind./100 ha in 2021. Here the monitoring activities are still ongoing through camera-trapping, scat collection, jackal-howling, and GPS telemetry on jackals to understand the relationships between mammal species. Specifically, we aimed to understand how jackals influence the presence, population dynamics and behaviour of roe deer. Material/Methods The study was conducted in FVG from September 2021 to August 2022. Thirteen squares of 10 km2 were monitored with 13 infrared cameras. Cameras were set to record videos of 20 s in length for an overall sampling effort of 4,680 camera trap-days. Results One camera recorded the predation of two jackals on a roe deer near a water source (https://www.youtube.com/watch?v=RwWONQqAMU). The roe deer was grabbed on the throat by one individual (at 18:46 on 5/12/2021 CET) and, after death, the carcass consumption continued until the arrival of wild boar (*Sus scrofa*) (at 19:15 of the same day). From that point on, the carcass was consumed by wild boar, with the two jackals observing at a short distance. In the following days, wild boar, jackals, foxes (*Vulpes vulpes*) and martens (*Martes foina*) were detected at the killing-site (total min. recorded from predation: 53 and 40 s, from 05/12/2021 to 13/01/2022). Conclusion This video reveals that, in specific context, jackals may actively predate on larger prey, such as roe deer. Furthermore, the kleptoparasitism exerted by wild boar suggest the existence of complex interactions among mammalian species in the area. Further research involving different methods (e.g., scat analyses, camera-trapping, GPS telemetry) and among seasons are suggested to better understand the population dynamics, distribution and interactions among species in the area.

Can the donkey be a possible prey for golden jackals? Description of the predation strategy on multiple attacks

Stefano Pesaro , Marcello Franchini, Lorenzo Frangini and Paolo Benedetti

Purpose/Objective The golden jackal (*Canis aureus*) is an opportunistic carnivore, mainly showing a scavenging behaviour but also active predations. The available literature mostly refers to data obtained from the analyses of stomach contents and/or reports about the impacts on livestock. Very little is known and even less was described about the jackal predatory strategy, at the detriment of prey larger than its size. The purpose of our work is to describe different aspects: lesions on prey and jackal approach observed during cases of predation towards donkeys. Material/Methods In the restricted area of the Italian Karstland, 6 donkeys, 4 living and 2 died, were reported with perineal lesions from 2017 to 2021. Each site was visited and in both the causes of dead and lesions were evaluated. Clinical and necropsy examinations were performed, while the presence of feral dog and wild canid was assessed through searching for signs of presence (scats, footprints, hair) and camera-trapping. Results All the donkeys were females with an estimated weight ranging from 50 to 250 kg. As for the veterinary aspects, the alive animals showed good body condition. The perineal area showed lacerated braised lesions caused by bites, with absent loss of soft tissues components, except for one case in which the partial asportation of the anus and external genital organs was observed. Conversely, died animals showed moderate to severe poor body conditions, with bedsores on protruding bones. In both cases, the consumption was concentrated on soft tissues around the perineal area. Events were attributed to predations because of the presence of blood around the bite marks. The monitoring activities developed during years confirmed the constant presence of jackals and foxes in the area. Moreover, a camera-trap filmed multiple approaches to donkeys and bites on the perineal region. Conclusion Our findings contribute to enrich the scanty information available about the impact that jackals may have on livestock and represent the first documented cases of attacks towards donkeys. Despite rare, these events prove the capacity of the jackal to attack big prey. The choice of the perineal region can be interpreted as an attempt to induce severe and fatal injuries due to the high vascularized and thinness skin. These predatory events are most likely associated to the high density of jackals and presence of multiple packs in the area, as well as to the improper management of donkeys.

Foraging ecology of African wolves (*Canis lupaster*) and its implications for the conservation of Ethiopian wolves (*Canis simensis*)

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African wolves (AWs) are sympatric with endangered Ethiopian wolves (EWs) in parts of their range. Scat analyses have suggested a dietary overlap between AWs and EWs, raising the potential for exploitative competition, and a possible conservation threat to EWs. However, in contrast to that of the well-studied EW, the foraging ecology of AWs remains poorly characterized. Accordingly, we studied the foraging ecology of radio-collared AWs (n = 11 individuals) at two localities with varying levels of anthropogenic disturbance in the Ethiopian Highlands, the Guassa-Menz Community Conservation Area (GMCCA) and Borena-Saynt National Park (BSNP), accumulating 845 h of focal observation across 2952 feeding events. We also monitored rodent abundance and rodent trapping activity by local farmers who experience conflict with AWs. The AW diet consisted largely of rodents (22.0%), insects (24.8%), and goats and sheep (24.3%). Of the total rodents captured by farmers using local traps during peak barley production (July to November) in GMCCA, averaging 24.7 ± 8.5 rodents/hectare/day, 81% (N = 3009) were scavenged by AWs. Further, of all the rodents consumed by AWs, most (74%) were carcasses. These results reveal complex interactions between AWs and local farmers and highlight the scavenging niche occupied by AWs in anthropogenically altered landscapes in contrast to the active hunting exhibited by EWs in more intact habitats. While AWs cause economic damage to local farmers through livestock predation, they appear to play an important role in scavenging pest rodents among farmlands, a pattern of behaviour which likely mitigates direct and indirect competition with EWs. We suggest two routes to promote the coexistence of AWs and EWs in the Ethiopian highlands: local education efforts highlighting the complex role AWs play in highland ecosystems to reduce their persecution and enforced protection of intact habitats to preserve habitat preferred by EWs.

Session presentations – Genetics

Weak signals implicate potential relation between MHC genes and parasites in golden jackal (*Canis aureus*) – preliminary results

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Golden jackal (*Canis aureus*) population is currently rapidly expanding across Eastern and Central Europe. Due to its adaptation and affinity for human-dominated landscapes golden jackal is interesting as a potential source of diseases for humans, livestock, and companion animals. The aim of this study was to investigate intestinal parasites of golden jackal and their potential relation to immunologically important major histocompatibility complex (MHC) genes. We examined genetic variability at MHC class II DRB, DQA and DQB loci in 28 individuals collected in Croatia. The analysis revealed three individuals that carried dog specific MHC haplotypes (DLA-DRB1*00201/DQA1*00901/DQB1*00101), implying golden jackal/dog hybrids. In further two animals, one locus failed to amplify. Finally, we detected five DLA-DRB1/DQA1/DQB1 three-locus haplotypes in 23 individuals. Haplotype DLA-DRB100901/DQA1*00402/DQB1*02305 was the most frequent one, while DLA-DRB1*13101/DQA*100402/DQB*06801 occurred only once. Following morphological and molecular analysis, 9 species/families of intestinal parasites were detected: *Taenia serialis* (26.7%), *Mesocestoides litteratus* (6.7%), *Echinococcus multilocularis* (1 animal), *Uncinaria stenocephala* (16.7%), *Toxocara canis* (10%), fam. *Strongylida* (6.7%), *Toxascaris leonina* (3.4%), *Alaria alata* (16.7%), and fam. *Opistorchiidae* (16.7%). In two cases we found statistically significant relation of DQA and DQB alleles and *Strongylida sp*. parasites, whereas in two other instances the result was marginal (dependence of *Echinococcus multilocularis* on DQB1 and DQA1). However, results are preliminary and in all four cases restricted to single infected animal, but still indicative and encourage further investigation on larger sample set, ideally with N>100, with specific focus on parasites and MHC haplotypes.

Population structure and genetic variability of jackals in Bosnia and Herzegovina

Dragana Šnjegota, Mihajla Djan, Jelena Nikitović, Marina Antić and Duško Ćirović

1 Purpose/Objective: The European golden jackal has experienced the expansion of its range since the end of the 20th century. In Bosnia and Herzegovina (hereafter BIH), the jackal has also expanded its range. In the past, the species was recorded in the south of BIH, while recently individuals from Croatia and Serbia have established the core population in the northern lowlands of BIH. The north of BIH was not inhabited by wolves in the past and is highly populated by humans. Given the preferences of jackals, both aspects probably facilitated their expansion in this part of the country. The core population has gradually spread into the other parts of the country, sneaking steadily into regions inhabited by wolves. Given the absence of population genetic studies on jackals in BIH and potential concerns regarding their range expansion, such as conflicts and hybridization with other Canidae, we aimed to produce the first results on the population structure and genetic variability of the species in the country. 2. Material/Methods We analysed 24 autosomal microsatellite loci from 48 jackals sampled mainly in the northern lowlands of BIH, considered the core area of the species` distribution. The samples were muscle tissues from individuals found dead for various reasons from 2018 to 2021. We explored the population genetic structure of jackals using STRUCTURE, DAPC, and sPCA. Basic parameters of genetic variability were calculated using the following R packages: adegenet and hierfstat to determine the number of alleles per locus (Na), observed (Ho) and expected (He) heterozygosities, and pegas to test for Hardy–Weinberg and Linkage Disequilibrium. 3. Results All analyses indicated the absence of population structure, despite K=2 suggested as the most likely number of genetic clusters by Structure and DAPC. The absence of population structure was expected given the results of previous population genetic studies of jackals in Europe, where only individuals from Dalmatia differed. Genetic diversity was higher compared to neighbouring and other European populations (Na=5.83, Ho=0.56, He=0.59). 4. Conclusion The results of this study are important as they form the basis for future population genetic studies on jackals and other Canidae in BIH. The absence of a population structure and the high genetic diversity of jackals in BIH indicate a continuous gene flow throughout the country and a possible further expansion of their range. The high genetic diversity could also indicate the hybridisation of jackals with dogs and wolves due to the gradual overlap of their territories. To investigate these hypotheses, further population genetic studies on jackals in BIH should include i) jackals from the wider region and ii) samples from dogs and wolves.

A population genetics-based study of the recolonization of the golden jackal (*Canis aureus*) in two core areas in southern Hungary and southern Romania

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The golden jackal (*Canis aureus*) is a medium-sized canid, distributed across southern Asia, the Middle East and South-eastern and Central Europe. In Europe in the last two decades populations have undergone significant changes. During the first two decades of the 21st century the size of the jackal populations increased in their distribution and abundance across Europe. Hungary and Romania apply similar game management practices, and the golden jackal appeared approximately at the same time in both countries. In this study our objectives were to determine the genetic structure and the origin of the expanding jackal populations. We analysed samples obtained from Romania and Hungary. Twenty-two canine autosomal di- and tetranucleotide microsatellites were optimized for multiplex PCR, and analysed using multivariate, Bayesian – to determine the number of genetic clusters and visualise any suspected hybrid individuals – and landscape genetic methods. In the Romanian samples all loci were polymorphic with 3–12 alleles. The overall observed (HO) and expected (HE) heterozygosities were 0.552 and 0.647, respectively. In the Hungarian samples 20 out 22 loci were polymorphic with 2–11 alleles. The overall observed (HO) heterozygosity (0.561) was higher, and the expected (HE) heterozygosity (0.564) was lower than the corresponding Romanian value. Based on our clustering results, Romanian and Hungarian samples separated into two different genetic clusters. No evidence of hybridization was found in the Hungarian and Romanian samples. These results show that smaller groups of golden jackals could settle in different regions following several episodes of colonization at different times and arriving from various locations.

Coat colour variations and possible hybridisation of Golden jackals (*Canis aureus*) in Hungary

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Golden jackal (*Canis aureus*) is a resettling species in Hungary and in recent years several colour variations occurred in the Carpathian Basin – namely white, black, and mottled. Our research aimed to investigate whether these colour variations emerged due to a de novo mutation or because of possible hybridisation with dogs. For species identification we used mitochondrial D-loop sequencing, for detection of hybridisation we used 20 canine microsatellite markers. Our candidate genes for coat variations were MC1R, in which several mutations are known to alter coat colour in mammals, and CBD103, in which a 3bp deletion is known to cause black fur colour in dogs. We identified possible hybridisation with dogs in 4 instances, in one case the D-loop sequence identified as a dog, which assumes dog maternity. The black animals were both hybrids and heterozygous for the 3 bp deletion in CBD103. We sequenced the MC1R gene of 23 animals, all white animals were homozygous for the same R306Ter mutation that cause white colour in most dog breeds, and we could identify two agouti-coloured animals, that were heterozygous for the same mutation. None of these animals showed hybridisation with clustering analysis. One black coloured, hybrid animal was also heterozygous for the R306Ter mutation. Our findings support that hybridisation is possible between golden jackals and dogs and new colour variations are either caused by hybridisation or a possible common ancestor.

The golden jackal (*Canis aureus*) reference genome assembly and annotation

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Population genomics is the latest tool for studying the structure and dynamics of the different animal and plant communities and populations. the advantage of this approach is that it provides important information in higher resolution than the traditional marker-based genotyping-based studies. However, these genomics-based methods require having a high-quality, chromosome level and well annotated reference genome sequence of the given species. In order to facilitate this kind of studies, we have decided to sequence the golden jackal (*Canis aureus* L.). For sequencing, we had chosen a male animal legally shot in the south part of Hungary in the Baranya County. High molecular weight DNA was isolated from blood and RNA was isolated from seven different tissues. We used the golden standard hybrid assembly approach. We sequenced the DNA using the PacBio hifi, the Illumina PCR-free short read and the Nanopore technologies. The same blood sample was also used for a high resolution Hi-C sequencing. For the accurate genome annotation RNA samples were isolated from different tissues and sequenced with both Illumina and PacBio technologies. The reference genome sequence assembly and annotation were carried out on either the European ELIXIR Galaxy server (https://galaxyproject.org/eu/) and on our high computing Unix servers. Initially we used both the Galaxy's VGP and the PacBio's Falcon unzip pipelines to assemble the contigs from the PacBio hifi reads. We then used the Illumina short reads for polishing them. We built scaffolds using the nanopore reads. Next, we used the Hi-C reads to determine the order of the contigs and scaffolds. Finally, we used the latest dog assembly as the backbone to build the final chromosomal level golden jackal reference genome assembly (CanAur1.0). For the annotation of the new CanAur1.0 reference genome sequence, we used the available human, mouse and dog transcriptomes and proteomes together with our processed golden jackal RNA-seq transcripts. In summary, we built the first chromosome level high quality reference genome sequence assembly CanAur1.0 for the golden jackal. During the sequencing and the assembly, we always followed the recommendations of the European Reference Genome Atlas (ERGA, https://www.erga-biodiversity.eu/). ERGA has also helped us in sequencing, curating, and annotating the new CanAur1.0 reference genome sequence. This new golden jackal reference genome will allow us and other groups to further study the different golden jackal populations and to better understand the genetic background of this and other jackal species.

Session presentations – Management

Golden jackals in Poland – an emerging threat or a victim of ignorance? Preliminary results

Hatlauf J., Bojarska K., Lanszki J., Bende Zs., Okarma H. and Śnieżko S.

The fast-expanding golden jackal (*Canis aureus*) made its way to Poland. The first individual was observed and photographed in 2015, and the first reproduction was reported the same year. With only 19 hard-proof records so far, very little is known about the species´ status, distribution, and ecology in Poland. To adequately plan the species management, research is crucial for understanding potential impact on biodiversity and economy. As the golden jackal is enlisted in Annex V of the EU Habitats Directive, its exploitation may be subject to management under the condition of maintaining its proper conservation status. Despite the international obligations, the golden jackal has become a game species in Poland. Since 2019, eight individuals have been officially shot in the country. In the beginning of 2021, first observations in southern Poland indicated the presence of a golden jackal family group. The local hunters have agreed to cease hunting jackals for one year to enable detailed and comprehensive research. We began our study involving a combination of methods: active and passive bioacoustics monitoring, scat-detection dogs, genetic analyses, camera traps, parasitic- and diet analyses. Here, we present the preliminary results of the ongoing research project. Bioacoustics stimulation on 10 preselected points in the first field season showed potentially 2 groups (likely closely related). In a second step, three trained human-dog teams (handlers with their scat detection dogs) searched the area in a total of 94 km transects, identifying 19 potential golden jackal scats. Next, the scats were analysed genetically to confirm the species and to assess the number of individuals. The promising incorporation of a combination of modern techniques that allow time-effective collection of high-quality data will be finally evaluated at the end of this study. The outcomes will help to fill knowledge-gaps on basic ecology of the golden jackal in the recently colonized areas of Poland.

Sustainable management of Golden jackal populations at Samos and Kavala airports

Athanasios Tsiratzidis, Lamprini Peleka and Dionysios Ntampakis Marianna Moira

The number of reported collisions between aircraft and wildlife is increasing globally, with consequences for flight safety and monetary losses for the aviation industry. The risk is greater if large flocking birds or large mammals are involved, than compared with small individual birds. Fraport Greece (FG) is responsible for maintaining, operating, managing, upgrading, and developing 14 regional airports in Greece over a period of 40 years. The operational transfer of the airports to FG took place on April 11th, 2017. An innovative effort has been underway to manage the populations of Golden jackal (*Canis aureus*), residing within the areas of Samos Airport "Aristarchos of Samos" and Kavala Airport "Megas Alexandros". The Golden jackal is the rarest canid species in Greece and is protected under Annex V of the European Union Habitats Directive. The Samos Island population is the only island population in the Mediterranean and is genetically unique compared to other Golden jackal populations in the Balkans, as demonstrated by recent research on Plos One. Since 2017 and for two consequent years, FG has been monitoring Golden jackals at Samos airport with zoology scientists, in cooperation with the Archipelagos Institute of Marine Conservation. During this first phase of the study, a phase out method took place to repel Golden jackals to an adjacent wetland. Thereafter, regular monitoring at Kavala and Samos airports is conducted by the FG Wildlife Control and Biodiversity Conservation Team. New generation infrared cameras with motion detectors and passive acoustic monitoring systems, record jackal presence and behaviour during day and night. Daily observations from FG airside operations personnel at these two airports indicate Golden Jackal behavioural adaptations to avoid human and aircraft presence. Even though aircraft strikes with Golden jackals rarely occur at these airports, the risk shall be mitigated. A programme based on aviation safety and sustainability principles, is designed, and implemented to resolve the conflict between flight safety and Golden jackal conservation. The programme's actions include regular fence monitoring to exclude them from entry/exit points, intensive habitat management with vegetation clearances and monitoring of their populations within the airports' premises. The concept of tolerating Golden jackal presence on airports is presented together with the pros and cons, both for aviation safety and biodiversity conservation. This programme is a world first and aims at becoming an international model for the sustainable management of large mammals in airport spaces, balancing the need for flight safety and the principles of environmental sustainability.

Golden jackal as a case study of population control in Croatia

Nikica Šprem, Valentina Barukčić, Igor Ilić and Boštjan Pokorny

In recent decades, golden jackal (*Canis aureus*) has experienced a dramatic population increase in Croatia and many other European countries, probably fuelled by human-induced landscape changes and persecution of competing predators. As a result, human-jackal conflicts (e.g. damage to livestock and wildlife, general nuisance in urban areas) have increased dramatically, and there is an urgent need to develop and use a range of mitigation tools. Hunting is one of the well-known tools for population control and jackal hunting is allowed in Croatia. There is no hunting season except hunting is banned for pregnant females or when they are leading small cubs. The objective of this study was to determine the best hunting method, hunting effort, and the effect of habitat type and weather conditions on hunting success. In 2020, a total of 191 jackals were sighted in 52 days on approximately 2,000 ha of lowland habitat along the Sava River (45°16'15"N, 16°54'41"E). A total of 70 jackals (63% males, 37% females) were culled with a thermal scope and smaller caliber rifle (222 Remington), 56 were missed, and 14 were wounded. Based on age structure, 14% juveniles, 50% subadults and 36% adults were culled, and the combined hunting success was 1.3 individual/day. The best hunting success was achieved by attracting jackals with an acoustic method, i.e. by reproducing the sound of a jackal and a wounded hare. In terms of habitat type, 71% of the culls were on cultivated, non-forested areas. The influence of weather conditions on hunting results was assessed using a regression model. We confirmed that weather conditions, i.e. daily temperature and precipitation, influence both hunting effort and hunting success. Hunting success was lower on days with lower temperatures and on dry days without precipitation. In conclusion, we can state that hunting with thermal imaging devices in combination with acoustic methods can be an effective tool for successful hunting of golden jackal, and consequently also for stabilizing the densities of jackal populations.

The effect of the golden jackal on nest survival of ground-breeding birds in Estonian coastal grasslands

Triin Kaasiku, Peep Männil and Riinu Rannap

The golden jackal (*Canis aureus*) was firstly recorded in Estonia in 2013 and by now a stable reproductive population is established. The species favours wetlands, igniting concerns about its impact on species dependent on these habitats. Waders is a group of threatened ground-breeding birds mostly inhabiting open wetlands. While the main reason behind their population declines has been habitat loss, recent evidence suggests that high predation pressure on their nests is limiting the population viability of these birds. For the first time, we aimed to record the effect of the golden jackal on nest survival of ground-breeding birds in a recently occupied part of its range. We followed wader nest survival over three years on ten coastal grassland sites, half of them located on the mainland Estonia where the golden jackal is common, and half on an island where the species has not reached yet. We used camera traps to identify nest predators and investigate possible interactions within the predator guild. Where present, the golden jackal depredated an equal proportion of nests with the main nest predator, the red fox (*Vulpes vulpes*). However, we propose that nest predation by the golden jackal is compensatory, as daily nest survival differed only slightly between the two regions, possibly to due golden jackal's negative effect on the presence of the red fox. Keywords: nest survival; red fox; waders; wet grasslands.

Session presentations – Monitoring

How many territorial und reproductive golden jackals are there in Germany?

Felix Böcker, Hannah Weber and Sebastian Collet

The golden jackal (*Canis aureus*) is a species which is currently expanding from eastern towards western Europe. The presented study describes the first records of golden jackal cubs in south-western Germany and therefore confirms the first known reproduction of the species in Germany. After single records of golden jackals in an area between the black forest and the Swabian Alp (district Schwarzwald-Baar, Baden-Württemberg) in October 2021, camera traps provided pictures of a juvenile individual on 26th October. This picture was the first proof of reproduction which could later be confirmed by further genetic evidence and camera trap pictures. In total, three to four cubs and one parent could be genetically identified. In June 2022 pictures showed two adult golden jackals accompanied by cubs in the same area. As the migration of sub-adult individuals to adjacent areas might be the consequence of this development small scale monitoring was established for further investigation. As golden jackals do not only appear in south-western Germany but in all other regions of Germany and neighbouring countries, unnoticed territorial single jackals or even reproducing pairs are likely. A focused view on suspicious cases and good communication about this species can help to gather better insight to the development of golden jackals in Europe. Besides the known reproduction from Baden-Württemberg there is another very recent case of confirmed golden jackal cubs from Germany in September 2022. The hunting association from lower-saxony reported the proof of golden jackal cubs (Landesjägerschaft Niedersachsen 2022). References: Landesjägerschaft Niedersachsen (2022) Aktuelles – Goldschakal, 26.09.2022. https://www.ljn.de/ueber-uns/aktuelles/news-artikel/news/goldschakal (30.09.2022)

High density population of Eurasian jackal in Deliblatska Peščara (Serbia)

Rudi Kraševec and Nik Šabeder

Purpose/Objective: In our study, we surveyed the population of Eurasian jackal (*Canis aureus*) of the Special nature reserve Deliblatska Pešćara (South Banat region, Serbia). Our goal was to assess whether the population densities of the jackal differ within and outside reserve. Material/Methods: The study was conducted between 29. 4. and 1. 5. 2019, at night at least one hour after sunset. We have used acoustic survey method on 13 calling stations, using playback record of territorial jackal group calling, with 4 consecutive broadcasting series. Survey was conducted in the special nature reserve (10) and its vicinity (3). Based on the direction of jackal response, we determined whether a certain group was situated within or outside the reserve. We estimated the survey area within 1.5 km radius around calling station (79.8 km2 surveyed – 51.4 km2 within reserve boundaries and 28.4 km2 beyond reserve boundaries). Results: Altogether we recorded 21 jackal group (two or more ind.) and three individual responses on nine (69 %) of the calling stations. The jackals' groups responded to the broadcasting in 38 % after first series, 14 % after second series and in 48 % after the third series. After the fourth series we received no further responses. Average jackal group density per 10 km2 was 2.6, the density within reserve was 3.7 and 0.8 outside reserve. Conclusion: First results from our study of the jackal show a significant difference between jackal densities within the natural reserve and outside it. We assume that be so, due to strong difference of habitats. The reserve is mostly covered by grasslands and shrubs, the latter provide daily shelters, places for rearing the young, and better food sources (small rodent communities, wild ungulates, slaughter remains etc.), in contrast, surroundings of the reserve are mainly very intensive farmlands and human settlements. The intensive farmlands are suitable feeding habitat, but the lack of shelter makes it inadequate for breeding habitat. The downside of our study is rather small study area. Further detailed study on jackal group densities and habitat available, on the scale of the reserve and its vicinity, is needed.

Modelling the expansion of the golden jackal (*Canis aureus*) in Hungary

Hanna Bijl and Sándor Csányi

1. Objective: In Hungary, the golden jackal (*Canis aureus*) was one of the first to reappear in Europe at the beginning of the 1990s. Since then, the species has been of growing concern for game managers and hunters and reignited the human-carnivore conflict debate. This research takes a quantitative approach to model the expansion of the species in Hungary temporally and spatially. We model 1) how large the annual increase in the population size/hunting bag of the golden jackal was in Hungary during the last 25 years; 2) how large the annual increase in the range of the species was in the country during this period; 3) if there was a change in population density, if yes, then how much? Lastly, 4) if the spatial rate of increase during this period changed, and if yes, how? The aim is to present the population change of the golden jackal throughout the years and make predictions for the future on which to base management actions. 2. Material and methods: Official hunting bag data from the Hungarian National Game Management Database has been used since 1995 and were obtained from Game Management Units (GMU) in Hungary. As GMUs change over time and are therefore biased, the UTM grid system was used (10x10 km). The population of the golden jackal was modelled by carrying out a temporal and spatial analysis based on these hunting bag data. 3. Results: Since 1995, exponential growth in the hunting bag and a strong increase in the occupied area with a slight deceleration can be seen in the last two-three years. The annual increase in occupied areas (km2) shows a logistic curve where a difference can be observed between the first half of the period (1995–2006) and the second half (2007–2019). The golden jackal spread with an average velocity of 536.9 km2/year in the first period and 5581.3 km2/year in the second period. The spatial analysis shows that the annual spatial rate of increase is in the range of 15-25% of the occupied area. The annual increase in occupied UTM grid cells reveals that the expansion of the golden jackal has exceeded its maximum, and the annual increase is declining. Additionally, the numbers of occupied UTM grid cells and the occupied area sizes have grown at roughly the same rate. 4. Conclusion: In the near future, we will face a further decline in population growth which might be observed in neighbouring countries too. Moreover, it is crucial to continue monitoring the golden jackal population and their (negative) impacts on the ecosystem. To further mitigate the expansion, the species needs to be managed according to an action plan that includes active, density-dependent control measures.

Changes in Golden jackal (*Canis aureus, L. 1758*) and red fox (Vulpes vulpes, L. 1758) population size in Romania with new records of local density in hunting terrains from Timiș County, Dobruja, and maritime levees from the Danube Delta

Banea OC, Farkas A. and CA Țâru

Purpose/Objective: Golden jackal and red fox are sympatric species. The red fox abundance might be an interesting ecological factor to assess the invisibility and settlement of new suitable habitats by the golden jackal. The red fox hunting indicator of population density (HIPD) (i.e., the number of foxes shot annually per km2) during 2015/2016 hunting season showed country-regional differences in Central and Southeast Europe with total hunting bags (HB) of 136.182 shot individuals in Austria and Hungary (similar HIPD of 0,78 / km2) and 45.727 individuals in Romania and Bulgaria (HIPD 0,1 and 0,17 / km2). We aimed at analysing interannual changes in red fox and golden jackal population size and control rate (CR) at country and loco-regional level in Romania. Additionally, we present new data of golden jackal densities in a hunting ground from western part of Romania and Danube Delta Biosphere Reserve. Material/Methods: We analysed red fox and golden jackal stock assessment and hunting bag for 2006-2022 period from centralized data published on the official website of the Romanian Environmental Board Authority. CR f\was calculated for both species retrospectively. We also calculated data from four counties with different habitat type and environmental conditions. We performed bimodal monitoring surveys with bioacoustics monitoring (Giannatos 2004) and wildlife video camera trapping in April, August and December 2021 in two hunting terrains from western and eastern parts of Romania (FV 2 Cheglevici, Timis county and FV 28 Gura Dobrogei, Constanta County) and in two critical areas from Danube Delta Biosphere Reserve ROSCI0065, Caraorman and Letea maritime levees. A total number of 35 stations were installed in a study area of 40.000 ha. Results: The number of shot foxes in 2007 was 22.797 and this increased gradually until 2019, when it started to decrease from 41.845 specimens in 2019 to 35.978, in 2021 at an estimated population size of 76.381 alive individuals in 2022 (CR 0.48). The golden jackal HB changed from 746 in 2007 to 11.292 shot jackals in 2021, at an estimated population size of 23.042 in 2022 (CR 0.58). At county level, Giurgiu realized harvest quota of 57.4%, while Gov approved 96%, Ialomița realized 64% (Gov 99%), Cluj showed CR of 39,6% (Gov 82%) and Satu Mare realized a CR of 61% (Gov 82%). Jackals showed an increased abundance of up to 258 shot jackals in Ialomita and Giurgiu and remained with less than 29 and 75 individuals removed in Cluj and Satu Mare where the number of shot foxes is almost double (1239 in Cluj and 1046 in Satu Mare). Density derived from BAM was in 2021 between 0,7 in -3,3 territorial groups / 10 km2. Conclusion: The process of golden jackal natural colonization in Romania is constant and shows increasing population from year to year with jackals being now removed from all 41 counties. Red fox population hunting bag started to decrease in the last two years. There are important differences between harvest quotas proposed by the Government and the realized numbers by GMU, the former ones overpassing 100% in many cases. Local density in hunting terrains and Danube Delta is like in previous records with optimum densities in Danube Delta.

On the past distribution of the golden jackal *Canis aureus* in Greece

Gasteratos Ioannis, Zoi Fondoulakou, Theodoros Kominos and Antonia Galanaki

There had been no effort so far to try to evaluate the former presence of the Golden Jackal in Greece. We tried to clarify that by examining available historical evidence, such as published archaeological finds, written sources, government records, interviews etc. The species appeared in Greece in the Neolithic Period. The fact that ancient and later Greeks and Greek-speaking, pre-Ottoman writers mentioned that the mammal called those, was a sociable wolf-type animal, reddish-blond coloured, that was howling and was feeding on injured animals, but was neither a Gray Wolf nor an African Golden Wolf, leaves no other candidate species for this name, except the Golden Jackal. Locally, as for example on Corfu Island, the term wolf, seems that was used to describe the Golden Jackal during 16th and 17th centuries. On the other hand, the term jackal was and is still used to describe the Eurasian Badger on a few Aegean islands. In the 16th - 18th centuries period, the Golden Jackal was described as very common locally, while probably this was the case in the rest of its later known range too; just written sources concerning wildlife were missing. From 1800 until the 1960s it was a very numerous species in a significant part of the country (including some continental islands), despite hunting pressure since it was considered a pest, but also for its fur. In the 1960s-1970s, while in the rest of the Balkans the jackal slowly began to recover, in Greece the extensive use of poison baits for pest and rabies elimination, led the species to severe decrease.

Interactive mapping of golden jackals?

Glenn Lelieveld and Ellen van Norren

Animals have no boundaries as maps do. Most of the maps stop at national borders, thus creating a narrow view of the range of species. Therefore, WWF Germany commissioned the Dutch Mammal Society to create a web-based interactive map of territorial wolves across the Benelux and Germany. This map is available in 4 languages and has approximately 10.000 unique visitors per month. At this moment the map shows highly detailed information of each wolf territory (represented as a dot) at some distance of the core area. It is possible to add data in lower quality, e.g. polygons of the range. The technical solutions behind the map are built in a way that it is easy to add any other language and make a web-based interactive map of the range of golden jackals in Europe. The map will be hosted and maintained by the Dutch Mammal Society but can be incorporated in any other website by use of an iframe. In our presentation we will demonstrate the map and invite you to join our initiative by sharing your language and the bare minimum of your monitoring data. Link to the map: https://wolvesmap.zoogdiervereniging.nl

Application of combined field methods in golden jackal monitoring: Howling, conservation dogs and DNA analysis

Hatlauf J., Szabó L., Böcker F., Wirk L., Marton M., Hackländer K. and Heltai M.

To monitor a secretive species like the golden jackal (*Canis aureus*), researchers use diverse methods. The work with scat detection dogs is an emerging and promising method. In a previous feasibility study, we have already proven the advantages of conservation dogs in jackal research and therefore continued to apply this method in our project (funded by the Action Austria-Hungary). We expanded the study area not only within Hungary but also added two more regions in Austria (in Styria and Burgenland). The three study areas are quite distinct, ranging from shrubby almost inaccessible land to large, forested areas, and open agricultural areas near wetlands. The bioacoustics stimulation on 14 preselected points in the first field season resulted in the confirmation of at least four golden jackal family groups in our study areas. Altogether, the human-dog teams (dog handlers with their scat detection dogs) searched a total of over 250 km transects, identifying 63 potential golden jackal scats. 29 samples have already been genetically analysed and 22 could be assigned to golden jackal. The remaining samples still need to be evaluated. After the genetic confirmation and individualization, the relevant scats will be analyzed on their components to study the diet providing insights into effects on local prey or livestock and to indicate potential competition and/or possible impacts on prey species. By a combination of methods – bioacoustics and scat detection dogs – we have quickly received a solid amount of data to build a basis for further insights into family structures and kinship, seasonal differences in habitat use and territory sizes. The use of detection dogs still proves to be a very versatile method to monitor golden jackals on a long-term basis and to learn more about behavior and population dynamics.

Evolution of the presence of the golden jackal in Slovakia

Nuno F. Guimarães, Jozef Bučko and Peter Urban

Purpose/objective: Golden jackal (*Canis aureus*) is the carnivore with the largest range expansion in the past 50 years and it is widely dispersed across Europe today. Since first records in Slovakia, in 1989, its range has increased considerably, and it is now found throughout the southern lowlands. Despite its preference for lowlands, golden jackal presence was reported in mountainous regions (800 to 1500 m.a.s.l.). The aim of this study is to review the distribution range and population trends of the golden jackal in Slovakia. This allows us to speculate about the future of the species in the country by producing a prediction model of the dispersion range of the population in the country. Material/Methods: All records of the golden jackal from 2018 up to 2021 have been compiled. An analysis of the distribution of records from categories C1 to C3 was performed, which included bioacoustics, ground tracking survey data, reports of hunters' presences, and hunting bags. Once a hunting ground had presence records for more all the 3 years consecutive year, it was considered as occupied. To understand the direction of the dispersion, we then construct a model of presence. By analysing the collected data, we try to determine if Slovakia's trend is comparable to the one of the neighbouring countries. Results: We found that from 2018 to 2021 the number of records of killed individuals (C1) nearly triple, and the official counts of observed individuals (C3) doubled. Their home range also increased and now is all over the country with higher incidence of golden jackal presence in the East. In terms of its dispersion patterns, analyse show an increasing trend from East to West. Even so, the presence of golden jackals is becoming more common in high altitude regions, including areas with snow cover, thus bringing the golden jackal within the habitats of the 3 largest carnivores (wolf, bear, and lynx). The Growing trends are quite like neighbouring countries although numbers are still far lower from the ones presented in Hungary. Conclusion: In Slovakia some concerns about the increase of golden jackal presence are rising, especially in human-dominated landscapes where conflicts with humans are prone to happen. It is fundamental to assess the future of this autochthonous species, from the evaluation of ecosystem services they provide to their possible influence to native biodiversity. Therefore, it is necessary to urgently implement the Action Plan for the species, for ensuring a long-term coexistence between golden jackals, humans and other species (ex: hare, pheasant, partridge, ground-nesting birds) under natural conditions, as well as a detailed analysis of the needs of local golden jackal populations, their limiting factors, conditions for population stabilisation and the necessity for a transnational approach.

Dynamic hierarchical model for the Eurasian golden jackal (*Canis aureus*) occurence in Slovenia

Rudi Kraševec, Maja Kajin and Hubert Potočnik

Purpose/Objective: The Eurasian golden jackal (*Canis aureus*) has been a regular annual visitor to Slovenia since the end of the 20th century, with the first territorial packs formed in 2009. Since then, the population has increased and spread throughout the country. Here we developed a hierarchical model to assess the dynamics of jackal occurrence in Slovenia. We analysed the environmental factors that best describe the occupancy and detectability probabilities, as well as the probabilities of colonisation and local extinction of the species in the country. Finally, we used the model to predict how the dynamic pattern might change under the climate change scenario. Material/Methods: We used a dynamic hierarchical occupancy model to quantify the relationships between four model parameters (1 - occupancy, 2 - detection probability, 3 - colonisation, and 4 - local extinction) and the environmental variables identified as the most relevant in the existing literature. We used the dynamic occupancy model to assess changes in dynamic occurrence behaviour between the 4 primary occasions (seasons September-March, etc.), with 24 secondary occasions (between which dynamic parameters remained constant). The model was fed with data collected by hunters as part of the National Jackal Monitoring Programme between 2016 and 2019. We used the Unmarked package in Programme R (ver. 1.1.456). We first elaborated a candidate set of biologically plausible models based on a priori hypotheses and selected the one that best represented the data using Akaike's information criterion corrected for small sample sizes (AICc). Results: The best-ranked model included: 1) initial occupancy as a function of distance to nearest settlement and average index of forest fragmentation, 2) detection probability as a function of number of days with snow cover between September and March 3) colonisation probability as a function of average index of forest fragmentation and annual days with snow cover, and 4) extinction probability as a function of average elevation and distance to nearest settlement. The coefficients of the best-ranked model showed a positive correlation of occurrence with shorter duration of snow cover. We extrapolated the values of the parameters to a 3 x 3 km grid covering the entire territory of Slovenia. We predicted the change in parameter values for the year 2050 according to the IPCC climate change scenarios RCP 4.5 and 8.5. No significant expansion of occupied areas was found under the climate change scenario. Conclusion: The lack of evidence of further expansion could mean: a) that jackals already occupy all potential and available habitats, or b) that there are other environmental variables besides duration of snow cover that were not accounted for in our candidate models that contribute to jackal expansion, such as changes in land use. Further research on this topic, both on of environmental factors and interspecific interactions, is needed.

Long- and short-range jackal (*Canis aureus L.*) vocalizations: an ethnographic method of research

Yulian Konstantinov and Nikolai Spassov

Current consensus claims that the functional meaning of long-range jackal vocalization ('howling') is to achieve avoidance of inter-group conflicts, as well as to be employed as a partner-seeking device and a means to achieve social cohesion. In the course of the last five years (2017-2021), we have been looking seasonally (April to September) at this thesis from the vantage point of a stationary bait-site, monitored by a camera trap and a sound recorder. A single researcher lived close by the bait-site, ensuring continuous contact with a resident non-captive jackal family group, who established themselves as 'hosts' of the bait-site. A degree of commensalism was ensured by the researcher's sharing of food with the jackal family daily, thereby achieving a variant of participant observation. The study of 2021 included 133 recorded nights with 554 recorded jackal visits, and a total of 92 registered long-range (a), and short-range (b) vocalizations, in which type (a) dominated. Results from the field-study of 2021 suggested that advertising group presence did not deter competing neighbouring groups from entering the core-territory of the bait-site 'hosts. Neither did it deter 'hosting' and 'trespassing' groups from agonistic behaviour and conflict. What our visual and audio records showed was that while hosts vs. trespassers' conflicts occurred all the time, they resulted only in the hosts chasing away the trespassers, without any bloodletting taking place. Conflict situations were signalled by short-range individual vocalizations, here termed 'cackling', and 'shouting'. Long-range chorus vocalizations, particularly their last ('yip') phase, supported the social-cohesion part of the reigning theory. The other argument, that 'howling' had a conflict-deterring function as regarded a given territory was not supported. What our findings showed was that both long- and short-range vocalizations were motivated by defence of prized resource-points (our bait-site being a focal one), rather than engaging with the defence of whole territories.

Teaching safety to the young? Longitudinal research with resident family group of Golden Jackals (*Canis aureus L.)* (Bulgaria)

Yulian Konstantinov and Nikolai Spassov

A longitudinal study of a resident jackal family group has been conducted on the Bulgarian bank of the Lower Danube between 2017 and 2021. The 2021 field-research season (April-September) was focused on adult transference of risk-avoiding skills to three yearlings from the 2020 litter. Our main claim is that the teaching process relies on synonymy between in-group hierarchical dominance, on the one hand, and existential danger, on the other. The principal material device through which the metaphorical operation is performed is food distribution in a sharing commensal context in which adult and yearling/s act as a supervisor-pupil pair. Key words: jackal (Canis aureus), family group, longitudinal field-research, transference of survival skills, synonymy in animal education, Lower Danube, Bulgaria.

Monitoring the occurrence and distribution, and studying the feeding habits of large and medium sized predators in Georgia

Alexandra Kalandarishvili and Miklós Heltai

As wildlife management is a new field in Georgia there is a significant shortage of scientific research related to carnivore management. Human-wildlife conflict is a frequent complaint from the local populations that lacks the appropriate preventive measures. For Georgia, the country that is just now starting to make its first steps towards sustainable wildlife management, understanding carnivore distribution and feeding habits is essential information to possess. The study will be carried out over the course of 4 years from 2021, ending in 2025. We aim to conduct the monitoring of the predator species with the primary focus on golden jackal (*Canis aureus*) at the country and county level, assess the feeding habits of the predator species and evaluate niche overlaps of the species based on the finding. Using acoustic surveys and DNA analyses we aim to estimate the minimum population of the carnivore species and understand the public attitude towards neighbouring carnivore species. Our preliminary results suggest that the golden jackal is highly concentrated in central Georgia where there is the highest human population. Our results indicate that there is a minimum population of 4,357.65 (SD 707.23) jackals present countrywide. Based on the public survey the local communities are highly concerned about the neighbouring wildlife and the most effective tool for management is seen to be the active removal of carnivore species. The next steps of the research consist of active and frequent field studies in Georgia for the purpose of collecting scat and stomach contents for further laboratory analyses.

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