INTERNATIONAL CONGRESS ON THE ZOOGEOGRAPHY AND ECOLOGY OF GREECE AND ADJACENT REGIONS

ABSTRACTS

Hellenic Zoological Society
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15th ICZEGAR, 12-15 October 2022
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Organizing and Scientific Committee

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Foreword

The 15th Congress on the Zoogeography and Ecology of Greece and Adjacent Regions was held at Mytilini, on the eastern Aegean Island of Lesvos, between 12 and 15 October 2022 and was organized by the Hellenic Zoological Society and the University of the Aegean. This was the first time that ICZEGAR was held in the eastern Aegean and, following the SARS CoV2 pandemic, the first to be organized in hybrid form, allowing for both in-person and virtual attendance. A total of 191 participants from 12 countries attended the meeting, 146 physically present at Mytilini and 45 joining online. A high proportion of attendants were of younger generations, including many undergraduate and postgraduate students.

The current volume contains 116 abstracts of research contributions, out of which 45 had been approved for oral and 75 for poster presentations. A total of 349 scientists are included among the authors of these research contributions.

The Organizing Committee would like to express their special thanks to the four invited speakers, specifically Prof. Thord Fransson (Swedish Museum of Natural History, Stockholm University, Sweden), Prof. Stelios Katsanevakis, (University of the Aegean, Greece), Prof. Federico Morelli, Czech University of Life Sciences, Czech Republic) and Prof. Emeritus Eleftherios Zouros (University of Crete, Greece), for their kind offer to give stimulating presentations on subjects of wide interest among attendants.

For the Organizing Committee

Assist. Prof. Triantafyllos Akriotis – Prof. Drosos Koutsoubas

INVITED LECTURE ABSTRACTS

Bird migration and climate change

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Migration is a common event in the annual cycle of birds and an adaptation to exploit seasonally favorable areas for breeding and survival. The variation in distances and time involved varies greatly and can include movements between hemispheres and occupy more than six months. The majority of migratory birds have an innate annual program providing information about when and where to go. During migration, birds alter between fueling at stopover sites and flight stages. Some birds have the challenge of passing ecological barriers and more than 2 billion songbirds are estimated to migrate across the Sahara desert during autumn. Studies in Greece show that Garden Warblers *Sylvia borin* in autumn have a very precise preparation for crossing both the Mediterranean Sea and the Sahara, a distance of more than 2000 km. Studies using satellite transmitters are ongoing and will add detailed information about the desert crossing in some species. The distance travelled in spring is even longer and many birds have an urgent need of refueling as shown by studies in Greece. There is ample evidence to suggest that ongoing climate change adds further challenges for migratory birds with affects seen in both the timing and duration of key life cycle events such as migration and breeding. Populations of many migratory species are in decline, most evident in long-distance migrants. Expected changes due to climate change in areas close to the barrier crossing are worrying since it can affect a huge number of birds from a large geographical area.

Keywords: migration; birds; climate change; Greece

Mediterranean under siege - impacts of biological invasions and climate change

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The Mediterranean Sea is under siege from multiple global and local pressures, among which biological invasions and climate change have caused unprecedented biodiversity changes. Alien species have been introduced through the Suez Canal, shipping, aquaculture, and aquarium trade and, through a variety of impact mechanisms, such as competition, predation, creation of novel habitat, the release of toxins, modification of sedimentation, and disease transmission, have affected native species and habitats. The importance of the different pathways varies spatially, and the various taxonomic groups are introduced with differing success by the different pathways. This causes differing spatial distributions of the various taxonomic groups. Consequently, as the importance of impact mechanisms vary by taxonomic group, the mechanisms of impact substantially vary by Mediterranean ecoregion. A conservative additive model has been developed to assess the Cumulative IMPacts of ALien species (CIMPAL) in the Mediterranean, which allowed the identification of hotspots of impacts and rank invasive species by impact. In the easternmost part of the Mediterranean, sea warming has caused local extinctions of many native species. Currently, alien species dominate in terms of species richness and biomass. Due to climate change, this pattern of marked decline of native biodiversity and increase of xenodiversity is expected to expand westwards and northwards in the Mediterranean in the following decades. Furthermore, the observed increased frequency of marine heatwaves causes severe mass mortalities of numerous taxa. The combination of biological invasions and climate change causes the gradual tropicalization of the Mediterranean Sea. In this new era, marine conservation, particularly in the eastern Mediterranean, will probably have to shift from protecting native species to protecting ecosystem functions and services, as native biodiversity is largely doomed to be lost.

Keywords: invasive alien species; climate change; marine heatwaves; native biodiversity; cumulative impacts; marine conservation

Disentangling the main effects of urbanization on taxonomic, functional and phylogenetic avian diversity in European cities

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This lecture is based on a study aimed to assess the effects of specific elements of urbanization and urban pollution on complementary avian diversity metrics. The study recorded133 bird species at 1624-point counts uniformly distributed in seventeen different European cities. Overall, taxonomic diversity (bird species richness), phylogenetic diversity and relatedness were significantly and negatively associated with latitude, while functional dispersion of communities showed no association whatsoever. At the local level (within the city), was found that urban greenery (grass, bush, and trees) is positively correlated with the number of breeding bird species, while the building cover showed a detrimental effect. Functional dispersion was the less affected diversity metric, while grass and trees and water (rivers or urban streams) positively affected the phylogenetic diversity of avian communities. Finally, the phylogenetic relatedness of species increased with all the main indicators of urbanization (building surface, floors, pedestrian density and level of light pollution) and was only mitigated by the presence of bushes. Based on such results, was argued that maintaining adequate levels of avian diversity within the urban settlements can help to increase the potential resilience of urban ecosystems exposed to the stress provoked by rapid and continuous changes. Then, were listed some characteristics of the cities that provide positive and negative effects on each facet of urban avian diversity. Finally, I briefly discuss some additional responses of avian communities to urbanization: Introducing the escape behaviour (measured as flight initiation distance) as a reliable tool to focus on birds' perception and reaction against potential predators.

Keywords: avian assemblages; cities; Europe; functional diversity; phylogenetic uniqueness; urban green

Antagonism and synergism from the dawn of life to human societies

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Since its origin, 4 billion years ago, life has evolved from the stage of the single-cell prokaryote to single-cell eukaryote, to multi-cell haploid and multi-cell diploid eukaryote, to loosely or tightly organized multi-individual societies. I will refer to these as "levels" of the complexity of life. Would it be possible to recognize a repeated pattern in the transition from one level to the next? I will view the course of the phenomenon of life as a travel of information in time. I will identify three major kinds of information (phylogenetic, ontogenetic and social) that form a hierarchy of units: the gene is a unit of information, the chromosome is a higher unit of information consisting of units of lower information (genes), the multi-chromosome genome is a still higher unit consisting of lower units (chromosomes), the organism is a unit of cells and the society is a unit of organism. Within a unit there is synergism of lower units (genes are in synergism within the chromosome, chromosomes are in synergism within the cell, cells are in synergism within the organism), but the carriers of units are in conflict (the carrier of a single chromosome, the prokaryote organism, is in conflict with another prokaryote organism, etc). The sequence "synergism → conflict → synergism" worked as an upward spiral in the course of life whose uppermost level is the present-day human society. I will end the talk by posing, but not answering, the question of what this means for us.

Keywords: levels of complexity of life; synergism; antagonism; course of life; human society

ORAL PRESENTATION ABSTRACTS

Strandings of Loggerhead Sea Turtles in the Central Aegean Coasts of Türkiye

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Mortality of sea turtles in the marine environment is critical in terms of conservation and management. Satellite tracking research demonstrates periodic use of the wintering and feeding grounds in the Central Aegean Sea (CAS) by loggerhead sea turtles nesting on the Greek and Turkish coasts. Between 1995 and 2022, 92 (21 female, 27 male, and 44 undetermined and juveniles) loggerhead sea turtle stranding cases, 15 (16.3%) alive and 77 (83.7%) dead, were found in the Turkish coasts of the CAS. One of the alive individuals encountered in gillnet was bycatch and the others were stranded on the shore. According to their decomposition levels, 43 fresh, 14 partially decomposed, 10 advanced decomposed, and 10 mummified individuals were observed. The cause of death of 15 individuals was ascertained and most died by gillnet (n=4) and fishing hook (n=3). Others were caused by boat collision (n=4) and intentional killing (n=4). The majority of the strandings were located in the Gulf of Izmir (n=82, 89.2%), 6 (6.5%) in the south of the CAS, and 4 (4.3%) in the north of the CAS. An average of 3.68 (min. 1, max. 8) cases were encountered annually, with the highest in 2017 and 2020 (n=8). Considering all years, 82% of the cases were observed in spring (n=31), winter (n=25), and fall (n=20), with fewer (n=16, 18%) in the summer. Our study indicates that the CAS is used extensively by the loggerheads outside the nesting season. Most of the turtles found in this study were reported directly to the university by individuals. The number of decomposed specimens discovered indicates that the actual number of cases is much higher.

Keywords: *Caretta caretta*, bycatch, mortality, feeding grounds, Turkey

Impact assessment study of wind energy infrastructure spatial planning on large birds of prey of Greece: the case of the Bonelli's Eagle (*Aquila fasciata)* on the Aegean archipelago, western Peloponnese and Crete

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The installation and operation of Wind Power Plants (WPP) has been proven to have negative effects on biodiversity, especially on birdlife. In the present work, we studied the interaction of WPP development in Greece with the Bonelli's Eagle (BE) (*Aquila fasciata*), a typical Mediterranean raptor and the main island predator in Greece, currently considered "Vulnerable" according to the National Red Data Book and particularly vulnerable to wind energy infrastructure. Specifically, we examined the spatial overlap of existing and planned WPP with the BE's historical (active before 2000) as well as contemporary (active after 2000) breeding territories among the species' main distribution area, specifically the Aegean archipelago, western Peloponnese and Crete, and we proceeded to the production of a sensitivity map using a Geographic Information System. In total, we found that 347 of the existing wind turbines are located at a distance of less than 5km from a total of 14% of all species' known breeding sites in the specified area, while in the hypothetical implementation scenario of all planned projects, 3528 wind turbines will extend in a radius of less than 5km from a total of 59.7% of all species' known breeding sites in the area. We conclude that the development of wind energy infrastructure in between the species' main reproduction territories, especially in the Aegean archipelago that occurs to be a hotspot area for the BE in Greece, can be extremely detrimental to the conservation status of the species, if appropriate spatial planning measures are not taken.

Keywords: Raptor's Breeding territories, Sensitivity mapping

Genetic Diversity Patterns and Population Structure of Cyprus' Endemic Lacertids

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Cyprus is an oceanic island laying within a biodiversity hotspot with a unique geological history and geomorphology offering thus, a great opportunity for studying intra-island evolutionary and biogeographic processes. Genetic diversity patterns and population structure of the three endemic Lacertidae taxa of Cyprus, namely Shreiber's Fringe-fingered lizard (*Acanthodactylus schreiberi schreiberi* Sindaco & Jeremčenko, 2008), Troodos lizard *[Phoenicolacerta troodica* (Werner, 1936)] and Snake-eyed lizard (*Ophisops elegans schlueteri* Böttger, 1880) were investigated using genetic and genomic analyses. Specimens sampled from different localities within Cyprus were sequenced for three mitochondrial (mtDNA) genetic markers (16S, cytb and ND4), while thousands of single nucleotide polymorphisms (SNPs) throughout the genome were identified through double digested restriction-site associated DNA sequencing (ddRADseq). Results from population analyses on mtDNA identified subtle genetic differentiation and structure, with the western part of the island being distinct from the rest. Chronophylogenetic analysis suggested different divergence times for the three taxa, some of which coincided with the Messinian Salinity Crisis while the other took part at an older period of the Miocene. Results from the phylogenetic and population structure analyses on ddRADseq data indicated that the Cypriot taxa are monophyletic and highly structured, reflecting distinct geographic entities within the island. Comparisons between the three lacertids show similarities and differences in their genetic diversity patterns reflecting the effect of Cyprus' palaeogeographic history and topology, providing new insights regarding the evolutionary and biogeographic processes at a local scale.

Keywords: Biogeography, ddRADseq, Lacertidae, mtDNA, phylogeny, SNPs

How realistic is to Teach Evolution as the Unifying Theory of Biology via a university course? Reporting an experience

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The Theory of Evolution through Natural Selection (THES) is considered as the Unifying Theory of Biology as it is relevant to every aspect of the science of biology. Nonetheless, rarely it conquers such a central role in the teaching of Biology and in most of the cases it occupies the last place in the curricula of colleges and secondary schools, while the corresponding Biology Textbooks usually devote to THES the last chapter of their syllabus. Based on all these, a different way of teaching an introductory course in Biology for non-biology-major students was organized and applied, in which the Teaching of THES occupied a central role. The main issue that was examined is whether it is possible to teach Biology in such an alternative way: Is it possible, useful, and applicable to teach Biology, in such a way as to put in the center of Biology's introductory courses the Evolution as her Unifying Theory? What is the reception of such a practice by the students? Did they understood basic concepts of Biology as the result of Evolution and not as procedures leading to it? Can we change the structure of the curriculum and of Biology Textbooks to fulfill such a rationale? To answer all these questions a research questionnaire was organized and was answered by the responding students at the end of various semesters. The results were very positive, supporting the idea very much, as the students of the present study assessed very positively the course itself, its' structure, its' way of presentation, its' level of difficulty, etc.

Keywords: Unifying Theory of Biology; University course

Census of marine biodiversity in Zakynthos Island (Ionian Sea, Greece) over three decades of research

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Biodiversity assessments and updated databases provide critical baselines for the development of conservation initiatives. Nevertheless, biodiversity data are often lacking or remain fragmented and unpublished for several Mediterranean regions, and areas of special conservation interest such as Marine Protected Areas (MPAs). The aim of this work was to develop a comprehensive database about marine biodiversity in coastal waters of Zakynthos Island (Ionian Sea, Greece), including the MPA of the National Marine Park of Zakynthos (NMPZ). Species occurrence records were retrieved from scientific and grey literature, along with spatio-temporal meta-data for the period 1990-2022. The database contains records of 516 species (318 Animalia, 163 Plantae and 35 Chromista), which belong to 14 phyla. Most of them were found within the NMPZ, except for nine species. Species accumulation curves reached saturation in 2015-2020, thus suggesting high adequacy of biodiversity representation in the database. However, an increasing rate of non-indigenous species was detected, highlighting the need for their recurrent monitoring. The highest number of species and levels of taxonomic distinctness were found in the peripheral zone of the NMPZ, specifically in rocky reefs (HD code 1170) of Keri Peninsula, while the core zone – where the most important nesting beaches of *Caretta caretta* are located – hosted a lower number of species. Multivariate analyses showed that marine caves (HD code 8330) harboured a well differentiated assemblage compared to other habitat types, highlighting their conservation value. The results of the study provide a baseline for the development of future management and conservation measures.

Keywords: Marine Protected Area, Biodiversity database, Marine habitats, Taxonomic distinctness, Non-indigenous species, Mediterranean Sea

Non-invasive genetic sampling of Balkan chamois (*Rupicapra rupicapra balcanica*) reveals population structure in Greece

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Balkan chamois (*Rupicapra rupicapra balcanica*) is one of the subspecies of Northern chamois that inhabits mountainous areas of Balkan peninsula. In Greece Balkan chamois is considered as near threatened (NT) and is under protection by European and national laws. Its overall population is small (est. 1300-1800 individuals) and fragmented. Several groups of Balkan chamois still survive in Central and Northern Greece and mainly in Pindos Mountain range, Olympos Mt., Rhodopes Mts. and the mountains bordering with North Macedonia. In order to investigate genetic diversity and structure of Greek populations, a non-invasive genetic sampling was implemented, using DNA extracts mainly from faeces and hair samples. In total 110 samples collected from 7 areas were successfully genotyped for five microsatellite loci. Basic population genetics parameters (heterozygosities, allelic richness, Fis) were estimated for each population. Bayesian clustering analysis and Discriminant Analysis of Principal Components were used for assessing patterns of population structure. The results revealed low overall genetic diversity of the subspecies in Greece but significant genetic differentiation between populations from Frakto, Olympos and Northern Pindos. The presence of at least three distinct genetic clusters in the Greek chamois, corresponding to these mountainous areas, is possibly the result of recent population history of fragmentation and subsequent isolation.

Keywords: Genetic diversity, conservation genetics, faeces, hair, microsatellites, ungulate

Wildlife parasites: a meaningful conservation target

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Parasites may negatively impact human and animal health, even when infections/infestations remain subclinical. Accordingly, from a medical/veterinary aspect, parasites should be eliminated. However, from a biological perspective, it is vital including parasites in conservation efforts. Parasites represent the majority of organisms on the planet, outnumbering free-living biodiversity. Having co-evolved with their hosts they play critical roles in ecology and evolution. Parasitic life strategies maintain species coexistence and the cumulative impact of host–parasite interactions in the course of evolution, include the development of complex structures, mechanisms and behaviors, as well as macroevolution adaptations. According to the pioneer of parasite conservation movement Donald A. Windsor, "without parasites, ecosystems would deteriorate into just a few, vast monocultures of very aggressively invasive species. Biodiversity is due to parasites." For this reason, wildlife parasites should be considered meaningful conservation targets. This is particularly important, considering that parasites are often at higher risk of extinction than their hosts. For example, host specific parasites will become extinct if their host becomes extinct. When a species of interest is facing extinction, the last specimens are often captured and kept in a controlled environment for breeding, where treatments, including antiparasitics, are administered. This management may be successful for the animal conservation, but its host-specific parasites will be extinct. There is a long way until wildlife parasites are unequivocally recognized as worthy conservation targets but ignoring parasites in the efforts of protecting biodiversity equals neglecting fundamental aspects of organism relationships and essential elements that form healthy ecosystems.

Keywords: Biodiversity, co-evolution, co-extinction, disease, ecosystem, host

Comparative study of Marine Cave communities of Cyprus (Eastern Mediterranean)

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Although sea caves constitute a typical feature of the rocky coasts of the Eastern Mediterranean, and a protected habitat (92/43/EEC) with rich biodiversity, only a few marine caves have been studied for their biodiversity in Cyprus. Herein, the first comparative study on the motile and sessile fauna of marine caves of Cyprus, along with an assessment of their ecological quality, are presented. During the summer of 2021, a team of scientific divers applied: (i) a protocol for the recording of motile fauna within a 3-minutes visual survey at different ecological zones (entrance, semi-dark and dark zone), (ii) photoquadrat sampling for the study of benthic community structure and (iii) visual census of biodiversity in five marine caves of Cyprus. Threats and pressures were also reported in each cave. In total, 23 motile taxa (eight of which were alien/cryptogenic) and 82 sessile taxa (two alien) were identified. Multivariate resemblance analysis for sessile benthos, based on coverage data, showed that all studied caves were statistically different, while semi-submerged caves were differentiated from the fully submerged ones. The ecological quality of the studied caves was calculated through the ecosystem-based index (CavEBQI) as "Poor" for four caves and "Moderate" for one cave. The lowest values of the CavEBQI index were observed in shallow semi-submerged caves which are exposed to a higher hydrodynamic regime and are more vulnerable to anthropogenic pressures and higher numbers of alien species. Based on the current study, management and conservation measures were proposed, aiming at protecting marine caves and their biota.

This study was funded in the framework of the Project "Mapping and evaluation of Posidonia meadows and other important marine habitats under the European Habitats Directive (92/43/EEC), in the coastal waters of Cyprus", of the DFMR of the Republic of Cyprus (25% National Resources, 75% European Maritime and Fisheries Fund, EMFF, 2014-2020).

Keywords: Sea caves, motile fauna, benthic communities, ecological quality, Eastern Mediterranean

Intra-island patterns of genetic diversification of *Schizidium fissum* (Isopoda: Oniscidea) on Cyprus

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Cyprus is a Mediterranean island of volcanic origin isolated for at least 5.3 Myr from surrounding continental areas, included in the list of the global biodiversity hotspots. The present study focuses on the diversification of the species *Scizidium fissum* within the island's narrow geographic limits including also specimens from neighboring continental areas. The genus *Schizidium* as currently considered *sensu lato* is probably non monophyletic comprising 26 species distributed from Greece to Iran. Up to date the only representative of the genus reported from Cyprus is *S. fissum*. Aiming to investigate the patterns of genetic diversity within the focal island, to evaluate the morphology-based taxonomy of the species, and at the same time to explore its phylogenetic relationships with mainland populations, genome-wide ddRADseq as well as Sanger sequencing targeting three mitochondrial (16S, COI and 12S) and the nuclear NaK loci, were applied. Although it is not evident in morphology, phylogenetic analyses revealed the presence of two distinct *S. fissum* clades with well-defined geographic boundaries, correlated with the known paleogeography of Cyprus. Clado-chronological analysis indicate a long isolation between these two clades, estimated at ~9 Mya, and the sharing of a common ancestor with *S. tiberianum* from Israel at 15 ~Mya. The diversification patterns revealed together with similar findings on other taxa, show that cryptic diversity, identifiable at the molecular level only, is much more extensive than previously thought so that a better understanding of evolutionary dynamics of terrestrial isopod lineages calls for genetic/genomic analyses even when there are no signs of morphological divergence.

Keywords: Cryptic diversity, ddRADseq, Paleogography, Phylogeography, Terrestrial isopods

Monitoring abundance of Indo-Pacific striped eel catfish *Plotosus lineatus* from Iskenderun Bay, the northeastern Mediterranean with underwater visual census method

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Indo-Pacific striped eel catfish *Plotosus lineatus* was first reported in the Mediterranean Sea by Israel, and then it was recorded in Egypt, Syria and Turkey and also its westernmost extension range in the Mediterranean Sea at the Tunisian coast. The underwater visual census is the most widely used approach for assessing the density and biomass of fishes. The Iskenderun Bay is the most important pathway for alien species in the northeastern Mediterranean, Turkey. In this study, Indo-Pacific striped eel catfish *Plotosus lineatus* was monitored in ten different regions at the Iskenderun Bay, the northeastern Mediterranean, by underwater visual census method. *P. lineatus* species was monitored by scuba diving in ten different locations from April to September 2022 in the Iskenderun Bay, comprising the Samandağ coast in Turkey. Dives took place in 10 different locations. The occurrence of *P. lineatus* populations was detected with high density in all diving locations. The total transect area monitored was 1.5 ha. *P. lineatus* was usually observed under rocky and dark habitats with aggregations. The mean density comprising 10-20 m depth was 109.8 n/ha^{-1}, indicating that *P. lineatus* has significant population increases after the first occurrence on Turkish coasts. The establishment and invasiveness of *P. lineatus* in Turkish marine waters were also confirmed with this study.

Keywords: *Plotosus lineatus*, monitoring, density, northeastern Mediterranean, Underwater visual census

Non-indigenous marine fishes in the Marine Protected Areas at the Mugla coasts, Turkiye

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A total of 39 (37 Indo-Pacific, and 2 Tropical Atlantic) non-indigenous marine fish (N-IMF) species were documented in the Marine Protected Areas (MPAs) along the Mugla coasts. Concerning their status, the majority were classified as established (87.2%). The majority of these species (79.5%) were classified as abundant, while 20.5% were scarce. Most of the species were pelagic-neritic (51.3%) and demersal (43.6%), the remains were bentho-pelagic (5.1%). A great percentage of these species were omnivores (71.8%) and an important number were carnivores (20.5%) while only 5.1% were pure herbivorous fish. Furthermore, only 23.1% of the species are recognized as commercial species. The N-IMF populations are likely to continue increasing along the Muğla coasts, so implementing appropriate and effective policies as well as management actions are urgently required within MPAs for an effective control of biological invasions. A collaboration between researchers, policy makers and citizens is essential in order to ensure management strategies to be effective and long-lasting.

Keywords: Lessepsian, migration, ichthyofauna, Turkey

Echolocating Daubenton's bats are resilient to ultrasonic, masking noise without spectrally adjusting their calls

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Echolocating bats detect weak echoes to navigate and hunt, making them prone to masking noise and jamming from other bats and prey. To overcome this, bats need adequate echo-to-noise ratios (ENRs) but early experiments report high resilience to noise. Whether this is due to methodological limitations, advanced signal detection or increased call amplitude (Lombard effect) remains unresolved. Several studies also report that bats mitigate jamming by shifting their call frequencies (jamming avoidance response, JAR). We hypothesized that (i) bats with no spectral or spatiotemporal release from noise defend a certain ENR via a Lombard effect; and (ii) that they employ a spectral JAR in response to different noise bands. We trained nine Daubenton's bats (*Myotis daubentonii*) to land on a target broadcasting broadband noise at four levels and six bands. A seven-microphone array enabled acoustic localization and parameter estimation of bat calls. Call peak frequency during jamming and silent controls remained unaltered (p>0.05, 61±1 kHz, mean±sem). Instead, mean call source levels (SL_{RMS}, at 0.1 m as dB re. 20 µPa root mean square) increased from 112 dB in the control, to 118 dB (maximum 129 dB) at the maximum noise level. The Lombard effect magnitude was small (0.13 dB SL_{RMS}/dB of noise), resulting in mean broadband and narrowband ENRs of −11 and 8 dB, respectively, at the highest noise level. Despite these poor ENRs, the bats performed echo-guided landings without employing a spectral JAR, demonstrating their resilience to masking even when they cannot avoid it spectrally, spatially or temporally.

Keywords: Chiroptera, biosonar, acoustic interference, jamming avoidance response, Lombard effect, echo-to-noise ratio

National Action Plan for 10 species of cave bats

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In the framework of the project LIFE GRECABAT we elaborated a National Action Plan which aims to maintain or improve the conservation status for the following 10 bat species: *Rhinolophus hipposideros*, *R. ferrumequinum*, *R. mehelyi*, *R. euryale*, *R. blasii*, *Myotis capaccinii*, *M. emarginatus*, *M. myotis*, *M. blythii*, and *Miniopterus schreibersii*. All the above-mentioned species are included in Annexes II and IV of Directive 92/43/EEC, since they make big colonies in caves, mines, other artificial galleries and buildings, which makes them vulnerable to various human activities, resulting in the shrinking or even disappearance of their populations in several areas of their distribution. In Greece, the conservation status of the aforementioned species are Unsatisfactory-Inadequate (U1), with the exception of *R. mehelyi* and *R. hipposideros*, whose conservation status is Unknown (XX) and Favourable (FV), respectively. This National Action Plan contains detailed and documented information on the biology, ecology, distribution, pressures and threats, conservation status and priorities for the 10 bat species, as well as the measures and actions proposed to be implemented in order to ensure an appropriate conservation status for them. Four conservation objectives have been set: i) conservation and improvement of the status of specific bat habitats, ii) improvement of the institutional framework, iii) enrichment of the knowledge about the ecology of bats and the pressures and threats they face and iv) training of related stakeholders and raising of public awareness. These conservation objectives are expected to be achieved through the implementation of several actions and measures which are grouped into 16 bundles.

Keywords: Chiroptera, conservation measures, LIFE GRECABAT

Eastern Imperial Eagle (*Aquila heliaca*) in Czech Republic, and Greece as one of the wintering grounds of the Czech population

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Eastern Imperial Eagle (*Aquila heliaca*) is the new breeding species in Czech Republic, reaching the absolute north-western edge of its range (a part of Carpathian population). Besides the unconfirmed note about its breeding in 1920s, the first modern-time breeding was confirmed in 1998. Until 2022, the population continually grew up to min 18 territorial pairs (with 14 breeding pairs, 11 of them successfully, rearing 19 chicks – the highest ever number). In 2016-2021, 21 juveniles were tagged by GPS-GSM loggers. We could track the journey of 16 of them to their first wintering areas. While most of them stayed in Central Europe, two juveniles migrated to Greece but none of them returned back there in the consecutive winters. Juvenile LX522 (logger AUKI69), male born in 2017, spend his first winter on the islands of Psara and Antipsara (see also Zannetos et al 2018), up to 1460 km from his birthplace. In the beginning of 2019, this bird paired with the tagged female „Esperanza", born in Austria in 2013. Between 2019 and 2022 this pair reared successfully 5 chicks in the Czech-Austrian border area. Juvenile LX527 (logger KITE44), male born in 2018, spend his first winter on the island on Crete (1671 km from its birthplace). At present, none of these two loggers is working anymore, hopefully both birds are still alive. These two events confirm the importance of Greece as one of the wintering areas of the Czech population of Imperial Eagle.

Keywords: *Aquila heliaca*; breeding; Greece

Fish species composition, distribution and community structure in the Manavgat River Estuary (Antalya, Turkey)

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The current study examined at seasonal changes in the composition of the fish assemblage in relation to density and species number in the Manavgat River Estuary. Coastal areas of Manavgat River are widely used for tourism activities, agriculture, aquaculture, settlements and other uses. Fish were sampled seasonally by different nets in the Manavgat River Estuary from November 2014 and June 2017. Water quality parameters were measured at each survey site at the start of each field sampling. Thirty three fish species, representing 16 families, were recorded in the Manavgat Estuary. A total of 7804 individuals was caught throughout the study. Mugilidae was the family most represented in terms of number of species (seven species). Mugilidae was followed in species number by Cyprinidae (five species) and Sparidae (four species). The alien and native fish belonged to 16 families. *Chelon aurata*, *C. saliens*, *Alburnus baliki*, and *Mugil cephalus* were the dominant species and comprised over 75% of the total number. The fish fauna included 23 marine, eight freshwater, one migrant, and one brackish species. Regarding the alien fish species, 382 individuals, belonging to the following 10 species were caught: *Carassius gibelio*, *Gambusia holbrooki*, *Planiliza carinata*, *Oncorhynchus mykiss*, *Pseudorasbora parva*, *Siganus rivulatus*, *Sillago suezensis*, *Sphyraena chrysotaenia*, *Upeneus moluccensis*, and *Upeneus pori*. *Oncorhynchus mykiss* had the highest population abundance (37.4%) among all alien species. The indexes of species richness, Shannon-wiener diversity, and evenness showed a consistent seasonal pattern.

This research was financially supported by the TÜBİTAK (Scientific and Technological Research Council of Turkey) under the Project numbered KBAG, 114 Z 259.

***Keywords*:** Fish assemblages, functional guilds, non-indigenous species, endemic fish, endangered fish, Water quality

The Importance of the Evros Delta National Park, Greece, as an International Wintering Site for the Mallard *Anas platyrhynchos*

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The Evros Delta wintering population of the Mallard belongs to the Eastern Europe/Black Sea & Eastern Mediterranean sub population which shows a downward trend in recent decades. This study demonstrates that the Greek part of the Evros Delta is an internationally important site for wintering Mallards, meeting the 1% criterion over the period 2007-2019. Average number of wintering birds in the period 2007-2019 was 35,676 ± 18,510 (sd). The largest number (84,814 individuals) was recorded in 2017 and constitutes the maximum count of the species in Greece. The second largest record (53,810 individuals) took place in 2016. During the study period there was an increasing population trend. During summer numbers are almost nil. They gradually increase from August and mainly from November and peak in winter months (the averages were: 16,951 ± 10,516 for December, 33,681 ± 18,441 for January and 19,452 ± 11,437 for February). They leave the area after March. Mallards represent 34.1% of all ducks present during the study period. At national level the Evros Delta is the most important wintering site for the species and hosts on average more than 50% of wintering Mallards. The Delta is one of the most important wintering sites for the species in the Western Palearctic. As the Delta is shared between Greece and Turkey, the above numbers represent the 94% of all Mallards present while the rest 6% is found in the Turkish part, for the period 2012-2015

***Keywords*:** Mallards, *Anas platyrhynchos*, Evros Delta

Disentangling the origin of the Cretan wild goat, *Capra aegagrus cretica*

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Cretan wild goat or agrimi (*Capra aegagrus cretica*, Schinz, 1838), an emblematic animal for the island of Crete (Greece), constitutes a natural population assumed to have reached the island with humans. Yet, its taxonomic identity, genetic structure and potential hybridization with domestic goats remain controversial. Here attempting to address questions related to the taxonomic status and genetic identity of the Cretan wild goats, genome-wide loci and SNPs were collected using the double digest Restriction Associated DNA (ddRAD) method for 48 domesticated goats from Crete (*Capra hircus*), 25 Cretan wild goats 7 of which were sampled from the National garden of Athens, 5 *Capra ibex* and 2 *Capra pyrenaica.* Genomic information of all modern samples was compared to respective information of ancient previously published genomes of *C. hircus* and *C. aegagrus*. Phylogenomic, population genomic and demographic analyses proposed that *C. a. cretica* is genetically distinct from the domesticated *C. hircus* populations inhabiting Crete. Furthermore, our findings reveal extensive hybridization between the domestic *C. hircus* and *C. a. cretica*.

Keywords: Population genomics, hybridization, feral species, ancient DNA

Population status of the Bonelli's eagle (*Aquila fasciata*) in Greece & Cyprus

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In the framework of a 5-year conservation project (2018-2023) for the Bonelli's eagle (*Aquila fasciata*) in the east Mediterranean, a monitoring scheme on the species strongholds in Greece and Cyprus was carried out. The main objectives were to fill our knowledge gaps on the species population size, breeding performance and mortality causes. Here, we present data on the species population size, productivity, breeding success and mortality causes by surveying territorial pairs in Attica, southeast Peloponnese (mainland Greece), the island complexes of Cyclades and Dodecanese (Aegean archipelago), the island of Crete and free parts of Cyprus. Overall, during three consecutive breeding seasons i.e., 2019- 2021, 40 and 19 occupied territories were located in Greece and Cyprus respectively with the lowest productivity recorded on the island of Crete (on average, 0.7 young/ territorial pair/ year) and the highest one in Cyprus (avg. 1.13 young/ territorial pair/ year). Similarly, breeding pairs performed better in Cyprus (avg. 1.4 young/ egg-laying pair/ year) than in Crete and the Aegean islands (avg. 1.07 & 1.06 young/ egg-laying pair/ year respectively) most probably reflecting the regional foraging conditions and prey species available. Telemetry data acquired during the aforementioned study period revealed that the main threats and mortality causes for the species population were electrocution and collision to power lines on mainland Greece and the Aegean islands, direct persecution and drowning in water-tanks and reservoirs in Crete and poisoning as well as poaching in Cyprus.

Keywords: *Aquila fasciata,* population size, productivity, breeding success, mortality

The autumn migration of Willow Warbler *Phyllocopus trochilus* (Phylloscopidae, Aves) in Greece

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The Willow Warbler *Phylloscopus trochilus* is among the most numerous breeding and strictly migratory passerine species in Europe, wintering mostly throughout sub-Saharan Africa. The aim of the research was to identify the species' body mass and fat score changes during the autumn migration period (August – October) in Greece, and to identify its important staging – refueling sites before traversing the most critical barrier of its flyway, the Mediterranean Sea. The research was carried out during bird ringing expeditions in five areas at the north, central and southern part of Greece (mainland and islands). Willow warblers were mist-netted and ringed during autumn migration periods 2001-2020 (19 years). Data on age, body mass and fat score were collected according to standard protocols. In total, 3454 Willow Warblers were analyzed. The mean body mass was 10.2±2.9 gr (n=3278, range: 6.1-20.1). The mean fat score was 2.96±1.75 (n=3285, range: 0-10). Differences among sites for both, body mass and fat score were significant ($F=257.6$, $p<0.000$, $F=802.4$, $p<0.000$, respectively) with the birds in the south being heavier and fatter. Birds migrating from north to the south increased their body mass and fat score by 34.5% and 231.5%, respectively. Migrating Willow Warblers seem to gain body mass and fat in several stopover sites along their southward flyway. However, the body mass and fat recorded at the two southernmost sites in Greece, are probably not sufficient for the birds to cross the Mediterranean; an issue to be further investigated.

Keywords: Bird ringing, biometrics, flyway, body condition

Greece's Next Micro Model: Species distribution of micromammals

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Non-volant micro mammals are an understudied group of mammals in Greece, although they are integral parts of every terrestrial ecosystem. Our study aims to investigate the distribution of the Greek micromammals through Species Distribution Models (SDMs). SDMs have gained popularity amongst ecologists due to their usefulness, accessibility and the minimum requirement of species information, namely presence records. We created models for 14 species of micromammals in mainland Greece to investigate their potential distribution. We derived presence records from three datasets: Natural History Museum of Crete collections, literature and data from the 2014 national census. Our pellet collection was used to produce absence datapoints with a degree of uncertainty. Climatic, topographic and land cover variables where investigated. We combined three different feature selection (FS) algorithms as well as four SDM algorithms producing presence-only (background) and presence-absence models. Tuning of our combinations of algorithms produced 1377 models for each species. We projected the best model by AUC for each FS and SDM algorithm (12 combinations) along with their variable importance. We then compared the results to derive the best model based on the respective specie's ecology while taking in consideration the bias of our data. Our methodology produced high performing models with ecological relevance. We recommend the use of various algorithms to determine an accurate distribution of the species as well as the inclusion of absence data.

Keywords: Eylipotyphla, Rodentia, machine-learning

Changes of passerine species' wintering distributions in Africa according to their preferred type of habitat

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The persistence of migratory birds depends on factors acting at different spatial and temporal scales. For Palearctic species, how conditions in wintering grounds are being altered due to the joint action of climate change and habitat loss is a highly unexplored issue. Moreover, bird populations could be affected differentially according to their preferred habitat type since different types of habitats are expected to experience varying degrees of change. To assess habitat suitability for the different groups of birds, we used occurrence data from the GBIF network for 22 passerine species that breed in Europe and overwinter in Africa and grouped them into 5 categories according to their habitat preferences. We used ensemble species distribution modeling to estimate their present habitat suitability and predict how it is changing in the next decades due to the joint action of climate and land use change. Our results seem optimistic compared to other studies, indicating an increase in suitable habitats in the future for most of the groups under the "sustainable" climate scenario (ssp1-2.6). Under the "fossil-fueled" scenario (ssp5-8.5) the results are mixed with the most affected birds being those that inhabit *terrestrial habitats with shrubs and trees* and, in a lesser degree, birds that inhabit *wetlands*. However, the predicted increase of suitable habitats occurs mostly in the Sahel while a strong decrease is observed in South Africa. It is therefore uncertain if birds could undertake such a large range shift to respond to the changing conditions.

Keywords: Climate Change, Data Analysis, Migratory Birds, Citizen Science

Ranging behaviour and habitat selection of sedentary Western Marsh Harriers in the Mediterranean estuarine landscape

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The Western Marsh Harrier *Circus aeruginosus* is a partly migratory raptor commonly found throughout Europe. We studied home ranges, roosting, foraging strategy, and habitat selection of sedentary Marsh Harriers in Evros Delta, Greece, and the Mediterranean coast in Portugal using results of satellite telemetry tracking. The size of the home range for Greek birds was 158 km^2 (dynamic Brownian Bridge Movement Model, 95 %), while for Portuguese, more than nine times greater (1488 km^2). The 73% and 84% contours bounded the core areas in Greece and Portugal, respectively. Monthly home ranges were noticeably increased during winter in both years studied, showing a similar and regular annual fluctuation in home-range size. Birds chose habitats as the non-irrigated arable land, watercourses, inland marshes, and dump sites for foraging. In contrast, they avoided habitats like the rice fields, the complex cultivation patterns, and the permanently irrigated land. Water-related natural habitats like estuarine inland and salt marshes were intensively used as nocturnal roosting places. Despite the general negative effect of human pressure on the occurrence of Marsh Harriers, our results showed that the species seemed to tolerate and even benefit from some types of humanised environments of estuarine landscape.

Keywords: *Circus aeruginosus*, Ecology, Home range, Raptor, Telemetry

Composition and functional diversity of reptile and amphibian communities on Mount Chelmos

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Functional diversity is increasingly recognized as an essential factor in determining the state and functioning of ecosystems. In recent years, interest in the study of the functional traits of organisms has developed in the field of Ecology of Ecosystem & Biocommunities. Functional traits are defined as morpho - physiophenological (and behavioral for animals) traits which impact fitness indirectly via their effects on growth, reproduction and survival, the three components of individual performance. Functional diversity has been used to investigate how plant communities are organized in continental regions. Similar approaches have recently begun to be applied to animal communities. Nevertheless, no corresponding studies have yet been attempted in mountain communities. Therefore, our knowledge of how functional traits are distributed in mountains is very limited. This study examines the composition patterns of the communities of the groups of terrestrial Reptile/Amphibian organisms in terms of their functional traits on Mount Chelmos. It is also examined whether the functional diversity of the examined groups of organisms is influenced by the environmental and spatial characteristics of the study areas (e.g. altitude, habitat types). The factors that determine the composition of the communities of these groups of organisms as well as the possible effects of the latter on the ecosystems of the studied area are determined.

Keywords: Functional diversity, Functional traits, Amphibians, Reptiles, Mountain Biocommunities

Parallels between organisms and languages as evolvable systems

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Based on the consensus that languages evolve similarly to species, historical linguists have applied evolutionary techniques to approach specific problems, such as the construction of language phylogenies. The field, however, has not systematically engaged in disentangling the basic concepts (population, reproductive unit, inheritance etc.) and the core processes underlying evolutionary theory, namely mutation, selection, drift and migration, as applied to language. We develop such a proposal identifying the parallels and the differences between language and life as evolvable systems. Treating language as an evolvable system places previous studies in a novel perspective, as it offers an elegant unifying framework that can accommodate current knowledge, utilize the rich theoretical framework of evolutionary biology and synthesize many independent strands of inquiry, initiating a whole new research program.

Keywords: Language phylogenies, evolutionary techniques

Extreme Robertsonian (Rb) chromosomal variability in wild *Mus musculus domesticus* populations: The current situation in Greece

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The house mouse, *Mus musculus domesticus*, is characterised by the appearance of Robertsonian (Rb) fusions in its karyotype, i.e. biarmed chromosomes formed, when uniarmed chromosomes join at the centromere, reducing the diploid chromosome number from the typical 2*n*=40 down to 2*n*=22. Over a hundred Rb fusions have been recorded in nature, which in turn lead to the formation of many Rb races and complex Rb systems, mostly around Europe. The relevant study in Greece has revealed the existence of three Rb systems, i.e. in Peloponnese, in Ipeiros and in E. Sterea Ellada. This work presents the results that have been gathered over the last years from the systematic study of all three Rb systems. Among new findings that will be presented, we point out a) the much larger size of the Rb system of Ipeiros, than previously known, characterized by 2*n*=28-39 and distributed over an extended contact zone with the 2*n*=40 population; b) that the Rb system of E Sterea Ellada is also much larger than earlier assumed, extending from an area E of Athens, for ca. 140 km on a NW direction; c) the study of a very interesting contact zone among the major Rb races in the Rb system of Peloponnese, which has even revealed the occurrence of natural hybrids between Rb races with monobrachial homology; d) a new case of Rb chromosomal variability in SW Sterea Ellada, opposite of NW Peloponnese, which, based on Rb constitution, appears to be related to the Rb system of Peloponnese.

Keywords: Rb race, Rb fusion, heterozygote, contact zone, monobrachial homology, chromosomal evolution

Monitoring of bird species at regional airports operated by Fraport Greece

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A diversity of bird species may be found on airports and their vicinity, constituting a potential hazard to aviation safety. According to the European Union regulation, an airport operator shall identify, assess and manage this hazard to reduce the risk of wildlife strikes on aircraft. Fraport Greece (FG) company is granted by the Greek state to operate 14 regional airports, since April 2017 and for 40 years. Consequently, FG implements a unique Wildlife Hazard Management Programme (WHMP) for each of the aforementioned airports, apart from Aktion and Chania Airport, due to provisions of the concession agreement. A WHMP describes the required procedures that airport personnel shall follow to collect data on bird species and populations, understand birds' behavior and build dispersal methods that will not let birds occupy critical zones for aviation safety. Equipped with binoculars and cameras, FG personnel monitors and records birds' movements on and off-airport in regular time intervals. Annual analysis of these data sheds light to the bird species geographic distribution over Greece. In addition, it reveals records of birds that occur rarely in Greece, such as the Cream-coloured Courser *(Cursorius cursor)* on Rodos Airport, or recovery details of ringed birds such as an Osprey (*Pandion haliaetus*) on Kerkira Airport. FG is committed to further develop the systematic study of biodiversity on airports, under the FG Biodiversity Conservation Programme, including non-hazardous to aviation safety species such as insects, reptiles and small mammals.

Keywords: Migration, rare bird records, aviation safety, biodiversity conservation

Marine local extinctions and their drivers: a systematic review

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The marine biodiversity crisis intensifies while humanity identifies ever-expanding local, ecological, and commercial extinctions. A systematic review was conducted to determine marine local extinctions and their drivers globally, according to PRISMA-EcoEvo guidelines. The Scopus search engine was used to identify relevant literature, which, through the screening process, resulted in 134 articles being included. Critical appraisal of the evidence was also conducted based on the detection method, temporal coverage, and type of evidence of the studies included. The data extracted was enhanced with status assessments from the IUCN Red List. We recorded local extinctions for 682 species, of which 18 were global extinctions. Mollusca was the most frequent locally extinct taxonomic group (33%), followed by Cnidaria (23%), Fish (17%) and Macroalgae (11%). Most of these extinctions were recorded in Temperate Northern Atlantic (42%), half in the Eastern Mediterranean, and the Central Indo-Pacific (32%). The temporal evolution of reported drivers revealed that from the late 1990s, climate change surpassed in frequency overexploitation, pollution, and habitat destruction. In the Eastern Mediterranean, the main drivers of extinctions were climate change, overexploitation, and pollution, driving extinct predominantly Molluscs and Fish. Half of the extinctions globally were of species not assessed by the IUCN Red List, and 16% were species in threatened categories reported by studies with high temporal coverage. Local or regional extinctions can be an omen to global extinctions. It is thus essential to identify them based on the precautionary principle aiming toward scientific scrutiny and effective conservation measures.

Keywords: Marine extinctions, local extinctions, range contractions, population collapses

Implementing the Action Plan for the conservation of the Karpathos Marsh frog

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In 2020, the final version of the National Action Plan for the conservation of the Karpathos Marsh frog (*Pelophylax cerigensis*) was published. Within the same year, the Hellenic Herpetological Society undertook the task of the implementation of the project. Two years later, the first goals have been achieved. We collected detailed data on the population densities from five different localities. We failed to spot any individual at Nati river, a place historically known for hosting a small population, a fact suggesting that this population might have become extinct. We made interesting new ecological observations in the field regarding the aggregation behavior of the frog during the summer, predation incidents from different predators (freshwater crabs, beech martens, dragonflies' larvae) and reproductive activity. We surveyed alterative possible artificial ponds where the frog could be introduced (50 in total throughout the island) and measured their particular biotic and abiotic parameters. We also spotted several places to build new artificial ponds (fall 2021-summer 2022) along the banks of the main biotopes. Finally, we analyzed the whole mitochondrial genome and compared the populations within Karpathos and from Rhodes, clarifying the phylogeny of the species.

This work is part of the project "Implementation of the National Plan for the Conservation of the Karpathos Marsh frog" which is fully supported by the Green Fund.

***Keywords*:** Frogs, island endemics, conservation measures

New data on the occurrence and habitat preference of dormice (Rodentia, Gliridae) in protected areas of Northern Peloponnese

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Dormice have been extensively studied in much of Europe. In Greece however, current knowledge of dormice remains poor. For example, very little information exists on the distribution and ecology of the dormice *Glis glis*, *Dryomys nitedula* and *Muscardinus avellanarius* in areas under the jurisdiction of the Management Unit (MU) of Chelmos – Vouraikos National Park and Protected Areas of the Northern Peloponnese. We present preliminary results from an autumn 2021 and summer 2022 survey for dormice in eight Natura 2000 sites of the MU. We placed fifteen track tunnels (metal plates covered with soot) at thirteen sites, representing the five most suitable habitat types (91M0, 9260, 934A, 92A0, 92C0) for dormice. The track tunnels were collected after 1.5 – 2 months and examined for tracks. We recorded numerous parameters, such as coordinates, tree height and species for each track tunnel, and used MaxEnt software to model the habitat preference of the dormice species for which sufficient data were collected using topographical (elevation, slope) and ecological (forest density, height and type) information extracted from pan-European available GIS layers. Despite the unusually wet weather that affected the retrieved data, our results show that *D. nitedula*, detected in almost all surveyed sites, is much more common than previously assumed, followed by *G. glis*. *M. avellanarius* presence remains to be confirmed. These findings are part of an ongoing research, funded by the Natural Environment and Climate Change Agency, in the framework of the project "Transport Infrastructure, Environment & Sustainable Development O.P. 2014-2020", MIS 5033267.

Keywords: Track tunnel, *Glis glis, Dryomys nitedula, Muscardinus avellanarius,* MaxEnt

An algorithm for inferring phylogenetic trees of languages using morphosyntactic feature data that are congruent to the gold standard reference phylogenies

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Natural languages exhibit evolutionary processes that are similar to those of biological organisms. Language evolution is described by evolutionary trees, analogous to species level phylogenies.. Language trees can be inferred using distinct features of natural languages as input data. To date, the most accurate phylogenies inferred on cognate data, that is homologous word forms inherited from the common ancestor of languages, are being considered as the gold standard. A cognate input data matrix contains binary entries denoting the presence or absence of a cognate. However, languages are not only characterized by words. Thus, using morphosyntactic feature data may constitute a valuable alternative or supplementary source of data since they are key properties of linguistic systems, are transmitted across generations and can establish genealogical relationships reflecting common ancestry, in a way analogous to cognate data. At present, phylogenies inferred on morphosyntactic features are not considered as being as accurate as cognate trees, especially regarding their ability to recover the historical relationship between languages. Here, we introduce an algorithm to identify those morphosyntactic features of an alignment (i.e., alignment columns/sites) that support a given gold standard tree . In other words, given a target tree topology T of n taxa, and a morphosyntactic alignment M, our goal is to find a site subset S of M that when conducting a de novo tree inference on S will yield a tree TS that minimizes the topological Robinson-Foulds distance (RF) with respect to T.

Keywords: Phylogeny, languages, evolution

Inter- and intra- specific morphological variation in *Phlebotomus* species (Diptera: Psychodidae) from Greek Aegean islands

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The genus *Phlebotomus* comprises a group of small dipteran insects whose morphological separation is usually carried out using outdated identification keys. Comprehensive morphological studies on the Greek sand fly fauna are limited, and the existing morphological variation amongst the local sand fly species is poorly studied. Thus, the aim of this study was to investigate the interspecific morphological differentiation of 14 local sand fly species and the intraspecific variation of *P. neglectus* from Greek Aegean islands. To accomplish these, morphological and phylogenetic analyses were performed on several morphological characters (47 sizes, 44 ratios and 9 categorical). The interspecific variation that was found in the local species was mostly in agreement with the identification keys and other morphological research studies. *Phlebotomus* cf. *major* had significant morphological differentiation from its sister species *P. neglectus*. At the same time, the closely related species *P. sergenti* and *P. similis* had minor morphological differences, hence, their morphological separation remains extremely difficult. *Phlebotomus neglectus* was revealed to have a strong intraspecific morphological variation, since the sand fly populations in Ikaria and Andros presented significant differentiation from all the other populations. The morphological phylogenetic analyses indicated 3 major groups within the genus Phlebotomus: 1) subgenera *Artemievus*, *Paraphlebotomus* and *Phlebotomus*; 2) subgenera *Transphlebotomus* and *Adlerius*; 3) subgenus *Larroussius*. Consequently, the results of the present study stress out the need for new updated identification keys, incorporating new morphological characters and more sand fly populations of each species.

Keywords: Sand flies, morphological characters, *Phlebotomus neglectus*

Spring migration of *Sylvia* species over the southernmost point of Europe Gavdos Island (Crete, Greece)

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The island of Gavdos, situated only 250 km north of the African coast, is the first land birds reach flying across a long stretch of the open sea in spring and acts both as a refuelling as well as an emergency landing site for northward bound migrants. We report here patterns of the spring migration of the genus *Sylvia* trapped on Gavdos in mist-netting surveys conducted in three successive springs in the period 2002-2004, and in 2022. Out of a total of 7983 individuals of 17 genera and 74 species ringed across the four years, there were 2211 individuals of eight *Sylvia* species, making up to 30.7% of the total catch per season. *S. borin* was the most commonly trapped species among the nine (*S. atricapila, S. borin, S. cantillans, S. communis, S. curruca, S. melanocephala, S. nana, S. rueppelli, S. nisoria*), accounting for 62.2% of the total *Sylvia* catch. The longest mist-netting period covering 75 spring passage days carried out in 2022 in which seven *Sylvia* species were trapped, including *Sylvia melanocephala* (N=7) trapped for the first time on Gavdos. Differences were also observed in the phenology of the passage, albeit not for all species. The late onset of the passage is most likely attributable to an unusually cold spring with long periods of strong, opposing north-westerly winds rather than an actual shift in the spring passage timing.

Keywords: Bird migration, phenology, *Sylvia*, spring passage

Ecorichness: Beyond Species-Area Relationships

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Common applications of species-area relationships use data on species presence-absence for whole communities, endemics, and/or guild-based richness. All these applications view species as equivalent, not considering differences in their ecological roles. Recently, we proposed an alternative approach based on an estimation of habitat range exploitation by different species. The new metric so produced has been named 'ecorichness' and expresses community-level ecological divergence of species per island, found to exhibit a unimodal response to area. Herein we explore this relationship further on additional datasets. A unimodal response is expected when specialists, with narrow habitat ranges, are mostly added in larger island communities. When habitat heterogeneity is the major driver of diversity, this effect should be stronger, whereas when 'area per se' or passive sampling are the main drivers, such an effect might be weaker or absent. This is because specialization does not necessarily show a strong linear relationship with species abundance which is central in the passive sampling and 'area per se' hypotheses. Ecorichness can be considered as a general approach able to encompass a variety of metrics that capture ecological specialization and is expected to offer new insights into community assembly. Beyond insular systems, we might expect that nested systems should also show a unimodal ecorichness response to area, since specialist richness should increase at higher rates as area increases in such systems too. We suggest that Ecorichness-Area Relationships (ECARs) should be evaluated in combination with common SARs in order to improve understanding of processes shaping diversity patterns.

Keywords**:** Community assembly, generalists, island biogeography, specialists, species diversity

Black Kites wintering in Europe: estimated number, subspecies status, and behaviour of a bird wintering on Crete and Turkey

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Black Kites of the nominal subspecies *Milvus migrans migrans* breed in Europe and winter regularly in sub-Saharan Africa and the Middle East. As a new phenomenon, Black Kites with morphological characteristics of the subspecies *Milvus migrans lineatus* are observed in Europe. Based on observations of Black Kites in winter 2020/2021 and based on other recent reports about wintering Black Kites in Europe, we concluded that hundreds to thousands of Black Kites are now regularly wintering in south of Europe and less number of Black Kites winter in western, central and southeastern Europe as well as in north Africa. The growing number of wintering Black Kites in Europe is supposedly caused by members of the population from a hybrid zone between *M. m. migrans* and M*. m. lineatus* breeding in eastern Europe east of the Urals, i.e. from the area of the European part of Russia. This is consistent with the hypothesis of the spreading of *M. m. lineatus* and a subsequent hybridization zone between *M. m. migrans* and *M. m. lineatus* in a westerly direction from Siberia across continental Europe. It seems that an adaptation to food sources provided by municipal waste landfills is important for Black Kites wintering in Europe. The juvenile Black Kite tagged on Crete and telemetrically tracked during the next two years, moved to the southwestern part of Russia during the next two summers, but did not breed. It spent the following two winters at the same landfill in southwestern Turkey.

Keywords**:** *Milvus migrans*, hybrids, winter census, telemetry, raptors, landfill

Opportunity for pre-copulatory sexual selection in populations of the land snail *Cornu aspersum*

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Sexual selection is considered a pervasive evolutionary agent across the animal tree of life acting along pre-copulatory and post-copulatory episodes of selection The intensity of sexual selection, which depends upon the degree of polygamy, is a fundamental parameter in animal populations influenced by the impact of local climatic conditions upon 'environmental potential for polygamy'. We tried to quantify opportunity for pre-copulatory sexual selection in a number of populations of the land snail *Cornu aspersum* in a laboratory common garden experiment. The populations sampled, came from mainland and island regions of Greece and habitats of varying climatic regimes. The snails were kept in glass containers under laboratory conditions considered as optimal for this species. Temperature and photoperiod simulated autumnal conditions in the field (reproduction period for the species) and density in the containers approximated field population densities. Snails were marked individually, allowed to mate freely and their mating behavior was observed at regular intervals throughout their reproductive period. Behavioral recordings included, among others, the number of copulations and the number of partners for each snail. We used these data to compute the standardized variance in mating success as a measure of the opportunity for sexual selection (*Is*). Following this definition, *Is* provides a reliable estimate for the upper limit of the strength of pre-copulatory sexual selection. Our results showed that the opportunity for pre-copulatory sexual selection differed significantly among the populations tested.

Keywords**:** *Cornu aspersum*, sexual selection

Gastrointestinal parasites of brown bear (*Ursus arctos*) in an East Mediterranean population

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Parasites are a potential threat to endangered large carnivore species. However, only a few studies are focused on parasite fauna of brown bears in Europe, its impact on the species' conservation status and the possible implications on sympatric domestic animals and humans. The aim of this ongoing research is to record the gastrointestinal parasites of brown bears in Greece and investigate any associations of parasitism with the species ecology. This is the first extensive survey of gastrointestinal parasites of brown bears in Greece. Over 2 years (2020-2022), 662 faecal samples were collected from 3 localities of bear's permanent activity range (~24.000 km^2). The samples were examined using two classical parasitological methods: $ZnSO_4$ flotation and formalin sedimentation. Positive samples were additionally examined by the modified McMaster method to quantify the parasites eggs per gram of faeces, (EPG). Ten taxa of parasites were detected in 373 (56.3%) samples. The taxa found were: *Baylisascaris* sp. (40%), *Uncinaria* sp. (19%), *Dicrocoelium dentriticum* (15%), *Capillaria aerophila* (2%), *Crenosoma* sp. (1%), *Sarcocystis* sp. (0.70%), *Toxascaris* sp. (0.60%), *Eimeria* sp. (0.4%), *Linguatulla serrata* (0.15%) *Taenia* sp. (0.15%). Mixed infections were detected in 132 (20%) samples. A binomial GLM model was fitted to the data using R software to identify factors that relate to the presence or absence of parasites of any species in faecal samples. Positive faecal samples were strongly correlated with season. More specifically there is a gradual increase in positive samples starting in emergence season (March-April) and peaking in late hyperphagia season (October-December).

***Keywords*:** Greece, endoparasites, large carnivores

Occurrence and dietary habits of the Eurasian Otter (*Lutra lutra*) in protected areas of NW-W Peloponnese

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We present data on the occurrence and dietary habits of *Lutra lutra* (Carnivora, Mustelidae), in relation to available ichthyofauna, in areas under the jurisdiction of the Management Unit of Strofylia Wetlands National Park and Protected Areas of Western Peloponnese. Despite the extensive network of wetlands particularly characterizing the National Park of Strofylia Wetlands, relatively little data was available until now on the distribution and status of the otter (ca. 10 known localities of presence), and no information on its diet. Therefore, following standard protocols, 97 sampling sites were surveyed for otter presence (summer 2021-summer 2022), based on biondicative signs (spraints, footprints). All encountered spraints were collected, and in the lab thousands of skeletal/body parts (bone fragments, teeth, scales etc.) were meticulously isolated and studied for prey identification. Also, habitat assessment and characteristics were recorded for further analysis. Our study showed that otter presence was verified on most previous sites and recorded in 43 new ones, the relative population abundance calculated between 46 and 67%. Spraint analysis showed that fish, particularly of Mugilidae and Leuciscinae, were found to be the most important food prey item for the otter, in good agreement with surveyed ichthyofauna, followed by anurans (Ranidae), snakes (*Natrix* sp.) and aquatic arthropods. Interesting differences in diet contents were recorded among study sites and are presented. These findings are part of an ongoing research, funded by the Natural Environment and Climate Change Agency, in the framework of the project "Transport Infrastructure, Environment & Sustainable Development O.P. 2014-2020", MIS 5033024.

Keywords: Spraint analysis, ichthyofauna, management, biondicative signs, wetlands

Human genomes from Ancient Amvrakia, Epirus, north-western Greece

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Ancient DNA analysis has revolutionized archaeological and anthropological research bridging two phenomenally distinct fields of science, biology and archaeology, while its potential has unraveled mainly through the advancement of high-throughput sequencing. Archaeogenomic research on present-day Greece has focused predominately on prehistoric times, while the Classical and Hellenistic periods are understudied at the genetic level. Here, we report human genomic data from the Western Necropolis of Ancient Amvrakia, founded at 625 BCE (present-day city of Arta), analyzing the genetic characteristics of the individuals and their genetic relationships and background. All experiments were performed in the cleanroom facilities of the Ancient DNA Lab at IMBB-FORTH. In total, 29 individuals (12 bones and 20 teeth) were analyzed using dedicated protocols for ancient DNA and utilizing high-throughput "shotgun" sequencing. Our preliminary results showed that most of the samples had satisfactory amount of endogenous human DNA, while all samples were characterized by an authentic post-mortem DNA damage profile and the contamination was low. Individual genetic analyses showed that five individuals were males, 16 were females, and eight were data-deficient. The most frequent major haplogroups were H (mitochondrial - matrilineal) and R1 (Y-chromosome - patrilineal). In some individuals, we were able to detect specific alleles associated with phenotypes. Metagenomic analyses reported absence of pathogenic microbial DNA. Finally, population genomics analyses showed that the Classic-Hellenistic Ancient Amvrakia population carried all three major ancestry genomic components that were present in prehistoric Greek populations: local hunters-gatherers-like, Anatolian farmers-like, and steppe nomads-like.

Keywords: Ancestry genomic components, Ancient DNA, Classical period, Hellenistic period, High-Throughput Sequencing

Admission trends and treatment outcomes from a wildlife rehabilitation centre in Greece

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Wildlife rehabilitation centres receive and care for wild animals with the ultimate goal of releasing them back into the wild. The data collected in this process can be an invaluable resource and act as a proxy to measure the impact of anthropogenic activity on wild populations, and propose measures to reduce the pressure on wild populations. In the current study, we analysed the records of ANIMA, a prominent wildlife rehabilitation centre in Athens, Greece over a 17-year study period. Using a database of 54.445 animals representing 353 species from 104 families, we can draw some connections between the magnitude of admission reasons and their predicted outcomes based on the animals admitted. We found that while many animals that are admitted as orphans or after living in captivity have good chances of being released, that is not the case for victims of electrocution or domestic animal attacks. Illegal hunting and poaching are clearly present in this case study and seem to also negatively affect wild populations. With this analysis, we highlight the importance of wildlife rehabilitation centre data and the impact that human-induced changes can have on wild animals. We also urge for more population monitoring field studies so that admission data can be used to make accurate predictions on the status of wild populations

Keywords: Human-wildlife conflict, Conservation, Monitoring, Animal Welfare

Should I stay or should I go now? Combining eye surface temperature and behavioural aspects of rodents as a response to recapture probability after handling

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Rodents can exhibit a wide range of defensive behaviours to prevent predator attacks and to develop mechanisms that may lead to the most appropriate response based on the stressful stimulus they receive. In terms of their physiology, a quite common physiological response to emotions experienced during stressful stimuli is emotional fever, characterized by elevated core body temperature resulting from the activation of the autonomic nervous system in response to a stress factor. This emotional state both behaviourally and physiologically can be estimated non-invasively, using infrared thermography. In particular, the appearance of high eye temperature and abnormal behavioural patterns in a potentially stressful environment can be considered stress indicators. In this study, we investigated, in field conditions, the recapture probability of two wild rodent species *Apodemus sylvaticus* and *Apodemus mystacinus*, in response to the stressful stimulus of handling. For this purpose, we obtain rodents' eye temperature values during both the handling procedure and an initial five-minute placement into a short-stay container as well as behavioural activity patterns before their final release. Results showed that (a) individuals with higher emotional fever and lower body mass on the first capture are less likely to be recaptured, presumably due to handling stress, and (b) common behavioural patterns for those who were recaptured in contrast with those who they were never recaptured. This study provides an assessment of the importance of eye surface temperature and behavioural adaptability of rodents in the field.

Keywords: Rodents, infrared thermography, behavioural patterns, physiological state, stress

POSTER PRESENTATION ABSTRACTS

Battle of the Shrews: Species distribution modelling of *Crocidura zimmermanni* and *Crocidura suaveolens* in Crete

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The Cretan shrew *Crocidura zimmermanni* Wettstein 1953 (Eulipotyphla, Soricidae) is the only endemic mammal of Greece. It is restricted to the island of Crete and is mainly found in the highlands (Lefka Ori, Mt. Psiloritis and Mt. Dikti) forming three respective populations. *Crocidura zimmermanni* is a species present since early Pleistocene. The prevailing hypothesis on its current distribution is that the introduction of *Crocidura suaveolens* in Minoan times (ca. 2,500 to 1,500 BC) may have forced *Crocidura zimmermanni* into a restricted range at higher altitudes. The aim of this study is to predict the current distribution of the species and to investigate the interspecific relations with *Crocidura suaveolens* through species distribution modeling. Modeling was implemented using the package "biomod2" in the programming language R. Occurrence data (mainly traps and pitfalls) were derived from the collection of the Natural History Museum of Crete. We used land cover and topographic data with a 100m x 100m resolution to fit the low mobility of shrews. Various algorithms were used and we present selected models for both species mentioned, as well as the importance of the variables implemented. Our models support the negative correlation of distributions of the two species. These models will inform further investigation of undiscovered population of the species *Crocidura zimmermanni* and they will be used in combination with genetic data to exam the fragmentation of the population.

Keywords: Eulipotyphla, machine learning

Kos Island (Dodecanese, Greece) as a potential hotspot for highly threatened demersal elasmobranchs in the Mediterranean Sea

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Greece, recently produced a chondrichthyans checklist, including 34 sharks, 26 batoids and 1 chimaera. However, the conservation status of most species is relatively unknown due to the lack of data. Here, we collect data with the goal of assessing the conservation status for 6 highly threatened species, *Glaucostegus cemiculus*, *Gymnura altavela, Rhinobatos rhinobatos, Squatina aculeata, Squatina oculate* and *Squatina squatina*. All these species have been assessed as "Not Evaluated" in the Greek Red Book. Kos Island is part of the Dodecanese complex in the East Aegean Sea and through the project M.E.C.O. (Mediterranean Elasmobranchs Citizen Observations) has been identified as a potential hotspot for these species. A variety of methods were used to quantify relative abundance, including Underwater Visual Census (UVC), Baited Remote Underwater Video Systems (BRUVS), Local Ecological Knowledge (LEK) and Citizen Science (CS). A total of 24 questionnaires, 18 UCV transects, and 18 BRUVS samplings were recorded between 2020 and 2021, while CS enabled us to collect an additional 12 observations. None of the species were observed during UVS and BRUVS surveys, potentially indicative of very low abundance in the area. However, from the obtained data, provided us an initial understanding about the species' current presence and niche, resulting in maps which suggest a spatial segregation supported by the already acquired knowledge specific to the Mediterranean Sea. Kos has historically been an important area for these species; however, more intense surveying is required to assess if current populations are indeed at very low levels.

Keywords: Sharks, rays, local ecological knowledge, citizen science, underwater visual census, baited remote underwater video systems

Barn Owl diet in Lemnos Isl. NE Aegean, based on pellet analysis

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Lemnos Isl., a large NE Aegean island of Greece, remains poorly studied in several aspects of its biodiversity, particularly its mammals. Therefore, this study based on owl pellets, is part of an ongoing effort to fill this knowledge gap. Pellet analysis as a means to determine feeding habits of birds of prey, constitutes a useful, non-invasive tool for local animal biodiversity studies. Our analysis was based on more than 200 pellets of the Barn Owl (*Tyto alba*), collected from four geographically representative regions of Lemnos Isl. Pellets from each locality were carefully treated, in order to isolate all skeletal remains to be used for prey identification. Both cranial and post-cranial skeletal elements, amounting to several thousands of fragments, were studied. With the aid of identification keys and comparative skeletal material, prey individuals were identified to the lowest possible taxonomic level, and MNI (Minimum Number of Individuals) values and bone fragmentation levels were calculated. Thus, five taxa of small mammals were recorded for the first time in Lemnos Isl., belonging to the genera *Mus, Apodemus* (Rodentia) and *Crocidura* (Eulipotyphla). MNI per pellet ranged from 1 to 13. In all areas, small mammals were the prey of choice, ranging from ca. 67% to almost 100% of the total diet. Birds and amphibians were also present in pellets, but at a rather insignificant level. Finally, invertebrate representation in the diet differed remarkably among regions, in one case constituting roughly 1/3 of the total diet!

Keywords: *Tyto alba*, Eulipotyphla, Rodentia, Minimum Number of Individuals, biodiversity

Preliminary biodiversity assessment of burnt Mediterranean pine forests in Sithonia, Greece, using acoustic complexity indices

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Assessing the impact of natural disasters, such as fires, on the biodiversity of forest ecosystems, as well as monitoring its status over time, is important for the design and evaluation of post-disaster management practices. In recent years, acoustic indices are increasingly used as an affordable and rapid way to assess a site's biodiversity. These indices aim to capture meaningful information on local biodiversity by applying mathematical formulas to recordings of the site's soundscape. Despite the rapid growth of acoustic indicators' use across the world, there is need to test their suitability in Greek habitats. We present preliminary findings on the correlation between five commonly used acoustic indices (Normalized Difference Soundscape Index, Acoustic Complexity Index, Acoustic Diversity Index, Acoustic Evenness Index, Biodiversity Index) and avifauna calling activity (abundance and diversity) from recording made during Spring 2022 at Mediterranean pine forests in Sithonia peninsula, northern Greece, which had been burnt at different times (4, 13, 20, and >25 years ago) (n=4 sites, 2 to 3 acoustic stations per site, 2*10 min recordings per hour over 10 days). We describe how the acoustic indices and avifauna calls differ across sites, discuss the potential value of acoustic indices as a tool for rapid post-fire biodiversity assessment in pine forests, and suggest future studies for further assessing the suitability of acoustic indices use in Greece.

Keywords: Passive acoustic monitoring, soundscape, acoustic complexity indices, post-fire wildlife diversity recovery, rapid biodiversity assessment, Mediterranean pine forests

Molecular Evolution of Cytochrome P450s in Tephritidae

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Cytochrome P450s (CYPs) comprise an enzyme superfamily with multiple functions, ranging from core physiological processes to detoxification of xenobiotics. Tephritidae is a diverse family of frugivorous flies which lay their eggs into fruits, where the emerging larvae feed and develop, until they fall into the soil and reach pupation. Due to the high adaptability and their capacity to attack economically important fruit and vegetable crops, Tephritidae are among the most notorious groups of agricultural pests worldwide. Here we describe the manual curation and phylogenetic analysis of CYP gene repertoires (CYPomes) from five tephritid species with varying numbers of larval hosts. We report that all five Tephritidae species have higher number of CYP genes compared to Drosophila melanogaster, mainly attributed to expansions in the CYP6 (CYP3 clan) and CYP12 (MITO clan) families. These expansions are localized in genomic clusters that are conserved within Tephritidae and are possibly associated with general aspects of tephritid physiology, including adaptations to the frugivorous lifestyle. Between tephritids, CYP gene diversity is mostly caused by species-specific duplications occurring in the CYP6 and CYP12 clusters. Furthermore, we investigated CYP expression across multiple developmental stages and identified sets of genes with stage-enriched expression. Interestingly, we found that many of the CYP genes with larvae-enriched expression belong to the expanded CYP6 and CYP12 families. Furthermore, some of these genes commonly have larvae-enriched expression in different tephritid species. These CYPs could have a conserved role in tephritid larval growth, by contributing to detoxification of secondary metabolites and toxins present in host fruits. Overall, this study aims to identify candidate CYP genes which are involved in conserved as well as species-specific physiological adaptations in tephritid flies. In addition, this work has generated an extensive catalog of manually curated CYP genes in four Tephritidae species, thus providing a rich resource for future studies.

Keywords: Tephritidae, phylogenetic analysis, CYP gene repertoires

Ocean warming reveals hotspots of risk for the threatened marine fauna

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Warming ocean is putting threatened marine biodiversity at peril, with some species and habitats being more vulnerable than others. In order to translate predictions and risk to climate change into concrete targets, we need to identify marine areas that host organisms subjected to higher conservation risk. Herein, we aimed to map important areas of elevated risk to climate change in the Mediterranean Sea and assess their overlap with marine protected areas. To this direction, we investigated the spatial distribution of the most threatened marine species of the Mediterranean, based on their IUCN classification. Next, we determined their risk to ocean warming following a multi-criterial trait-based assessment. Our analysis revealed that the majority of high climate risk areas are located in the west Mediterranean, with Alboran Sea and western Mediterranean hosting the distribution of 90% of the high-risk threatened species. On the contrary, we identified fewer high-risk threatened species in the eastern Mediterranean (e.g. Levantine & Tunisian plateau; 52%), with the exception of the hotspots of the Aegean and Adriatic sea, which account for 86% and 67% of high-risk species, respectively. We found that all marine protected areas host at least one (up to 18) high climate risk species, further highlighting the need to adopt conservation and management plans that consider aspects of climate change. Focusing on areas of climatic risk could support long term conservation efforts and offer opportunities either in space and time towards monitoring and safeguarding marine biodiversity.

Keywords: Sensitivity, risk assessment, adaptive capacity, spatial planning, Mediterranean, climate change

Investigation of herpetofauna roadkill mortality in a river catchment area: The case of Spercheios River, Greece

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Spercheios River, a major river in the eastern part of Central Greece, has a particular ecological interest due to its designation as a Site of Community Interest and as a Special Protection Zone of the NATURA 2000 network. In recent years, the river's catchment area and delta has faced several pressures caused mainly by anthropogenic activities, such as land use/cover change and extensive road construction or modification of the existing road network. This has promoted a heavier traffic load resulting in frequent roadkill incidents involving mainly reptiles and amphibians. After all, herpetofauna, due to its slow movement and high dependence on specific habitat types as well as its road usage for thermoregulation purposes, is considered to be the most vulnerable group of vertebrates. In this study, the most affected herpetofauna species by road accidents as well as the geographical distribution of the roadkills across the river catchment area during the years 1997-2021, were examined and analyzed, using spatial statistical methods. A relative road mortality index was estimated, while in determining herpetofauna roadkill significant clusters, hot spot analysis and the Kernel Density were used. A total of 544 roadkills concerning 23 species were recorded; the highest road mortality index involved the eastern Montpellier snake, the European grass snake, the Caspian whipsnake, and the European glass lizard. The spatial statistical analysis showed that statistically significant clusters of roadkills were intensified in the spring season. Continuous monitoring and mapping of herpetofauna road mortality will lead to management actions to mitigate the effects of this phenomenon in the road network of the Spercheios River.

Keywords: Reptiles, amphibians, road ecology, spatial statistics, central Greece

Reflections of habitat type on body morphometrics: the case study of marsh frogs

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Organisms adapt to their environment by adopting appropriate shifts in morphological, physiological or behavioral features. Water-dependent species, such as amphibians, are largely affected by the overall quality of water bodies. Low-elevation wetlands near big cities and areas with intense human activities receive stronger pressures than less populated areas and, possibly, may affect amphibian populations. To assess the alleged impact of wetlands condition on amphibians, we collected Balkan frogs (*Pelophylax kurtmuelleri*) from different sites in central Greece (Spercheios River, Karla-Mavrovouni and Attica) vary in their general condition. During fieldwork we recorded 15 different body measurements and individual characteristics of each frog and characteristics and parameters of the sampling areas. We collected 15 individuals from each of the 13 sampling station we visited (195 individuals in total). We used one-way ANOVA to test whether body measurements differ between field stations, habitats, and land use. The following means differ significantly among geographical locations: head width ($F=9.38$, $p < 0.001$), head length ($F=7.65$, $p < 0.001$), interorbital distance ($F=14.26$, $p <0.001$), and eye–nostril distance ($F=9.16$, $p < 0.001$). Habitat type affected the following features: body weight ($F= 4.57$, $p < 0.001$), tympanum diameter ($F=5.57$, $p < 0.001$), eye diameter ($F=6.19$,$p < 0.001$), hand length ($F=3.30$, $p < 0.001$), forearm length ($F=5.49$, $p < 0.001$), foot length ($F= 4.40$, $p < 0.001$), tarsus length ($F=4.62$, $p < 0.001$), eye–nostril distance ($F=4.08$, $p < 0.001$), SL (4.25, $p=0.001$) and head length ($F=5.23$, $p < 0.001$). Analysis didn't yield any effect of land use on mean values of body morphometrics. To summarize, the findings indicate that habitat types have a significant effect on body measurements.

Keywords: Morphometry, adaptations, *Pelophylax kurtmuelleri*, aquatic ecosystems, land use

A WedGIS application on the Birds of Crete

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With more than 300 bird species (almost 65% of Greece's bird fauna) recorded in an area of less than 8.500 km^2 (about 6% of Greece's total area), the island of Crete, is an avifauna hotspot, with birds being the most numerous group of vertebrates on the island. Factors that seem to play an important role for this are its geographical position, since it is included in the migratory corridor from and to Africa and environmental factors such as climate, geomorphology and numerous habitat and land cover types. Therefore, the need to inform the public about the presence and diversity of birds throughout Crete seems imperative. A direct and effective way of transmitting this information can be achieved by the spatial mapping of ornithological data, inside and outside Natura 2000 areas, as well as other avifauna-related cartographic data such as land cover and habitat types, topography, and others. The tool used in the present project in order to display all of the above is a WebGIS application, which is both practical and powerful, with the ability to present spatial and qualitative data in an understandable, illustrative and user-friendly way. The creation of such an application contributes (1) to informing the public, (2) to educating, through the demonstration of the application to students, but also (3) to informing stakeholders and authorities who may not have knowledge about biodiversity but whose decisions may significantly affect it.

Keywords: Bird fauna, Biodiversity, Web mapping, Geospatial technology, Natura 2000, land cover

The soil fauna of three families of Coleoptera in olive orchards, in Messara, Crete, Greece

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The Arthropod soil fauna of conventional vs. organic olive orchards was surveyed in Messara plain, South Crete, Greece, in twelve olive orchards located in six different sites, with a pair of neighbouring conventional and organic orchards. Three sites were located in the hilly and another three in the plain agroecological zone. Monthly samplings (from October 2021 to May 2022) were carried out, with the use of 5 pitfall traps per olive orchard containing propylene-glycol. The present research aimed to clarify differences or similarities between conventional and organic orchards, based primarily on specific attributes of the Coleoptera species assemblages in the studied orchards, i.e. species abundance fluctuations in each site, diversity indices per site, etc. The dominant beetle families in the soil surface of olive orchards were: Carabidae (represented by 12 species), Scarabaeidae (4 species) and Tenebrionidae (9 species). Among the most abundant Carabidae species found, *Carabus banoni* and *Tapinopterus creticus* were the most numerous, while *Elaphocera cretica* (Scarabaeidae), *Eutagenia smyrnensis* and *Dailognatha quadricollis* (Tenebrionidae) were the dominant ones in the orchards.

The present work was implemented in the context of the E.U. funded project Life IGIC "Improvement of Green Infrastructure in agroecosystems: reconnecting natural areas by countering habitat fragmentation" (LIFE16 NAT/GR/000575), cofounded by the EU LIFE programme and the Green Fund, Greece.

Keywords: Carabidae, Scarabaeidae, Tenebrionidae, conventional, organic.

New insights into the phylogeny and biogeography of a priority species (ANNEX II, 92/43), *Triturus macedonicus* (Amphibia, Urodela), from Northern Pindos National Park, Epirus, Greece.

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The Macedonian crested newt, *Triturus macedonicus* (Karaman, 1922), is a priority species (ANNEX II, 92/43/EEC) in need of protection. The aim of this study was to investigate the phylogenetic position and the demographic history of the species' populations in Northern Pindos National Park based on mitochondrial DNA sequences. The phylogenetic analysis identified 34 haplotypes, of which four were new to the literature. Populations from Northern Pindos National Park fall within two of the three currently recognized Clades. Eastern populations all belong to Clade 1 ("Northern Clade") while western ones all belong to Clade 2 ("Zagori's Clade"). Two Sub-clades were recognized for Clade 2. The genetic distance between the Clades was found to be considerably high (2,8%). However, in contrast with results from previous studies, the phylogenetic analysis supported the monophyly of Clade 2, which turned out to be the ancestral Clade of the species. Furthermore, the demographic history of Clades 2 and 3 ("Olympus' Clade") was characterized by demographic stability, while the expansion of Clade 1 seems to have begun during earlier interglacial periods of the Pleistocene. The results support the existence of multiple refugia in the Balkan Peninsula following the "refugia-within-refugia" hypothesis, while all Clades can be considered as distinct Evolutionary Significant Units deserving separate conservation priorities.

Keywords: Mitochondrial DNA, bayesian inference, demography, "refugia-within-refugia" hypothesis, Evolutionary Significant Units

Alien ants on a quest to conquer Greece

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Biological invasions represent one of the main drivers of biodiversity loss with adverse impacts on human societies, economies and public health. More than 500 ant species have been transported outside their native range with the help of humans, with the majority of them having managed to establish viable populations in the wild. Nevertheless, data from the Mediterranean region suggest that most alien ants occupy anthropogenic habitats with little spread in semi-natural and natural habitats. Research on biological invasions of ants in Greece had previously identified a total of 15 alien ant species. However, an extensive literature investigation and material examination provide a revised checklist of the alien myrmecofauna of Greece, currently holding 14 species. Records of seven previously reported species have been deemed dubious or prooved to be native. The presence and distribution of alien ants within Greek administrative divisions, NATURA 2000 sites and Corine Land Cover types are analysed and presented. In particular, the species richness of alien ants seems to be highest in the Aegean Archipelago (Crete and Southern Aegean Islands) probably due to uneven collecting efforts and increased climatic suitability. Alien ant species are mostly associated with anthropogenic habitats including urban and agricultural areas, although a significant percentage has managed to spread into forest and semi-natural areas, including protected NATURA 2000 sites. Future research directions enhancing the monitoring of alien ants and their impacts are indicated in order to safeguard native ant biodiversity and conservation efforts of rare and endemic taxa.

Keywords: Alien species, biological invasions, Formicidae, invasive alien species, tramp species

A big threat for the smallest Rodent: Present and future distribution modelling of *Micromys minutus.*

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Micromys minutus is a micromammal with a wide Palearctic distribution, found in a variety of habitats, yet this distribution faces various threats while the species is considered vulnerable in the Red Book of Greece. Greece is the southernmost limit of its European distribution. The aim of our study is to predict the present (western) distribution of the species as well as the effect of climate change with species distribution modelling. We derived presence data of the species for Greece from the pellet collection of the Natural History Museum of Crete, and for Europe from the Global Biodiversity Information Facility (GBIF). We used the Maxent algorithm, with two different sets of environmental variables, one with topographic, landcover and climatic data and one only with climatic data that was used to model the future distribution. Climate data gathered from Climatologies at High Resolution for the Earth's Land Surface Areas (CHELSA), as it offers future high-resolution data (30arc second). These data gathered for the periods 1980-2010 and 2041-2070 for the climate scenario IPSL-CM6-Low Resolution/ SSP5.85. Our models show very good performance. Our full model scored 0.87 AUC and the climatic-only 0.86 AUC. We present 3 maps of its distribution, one for each model in the present as well as the future distribution as projected by our climatic model. Our models predict a similar distribution, with the full model discriminating potential habitats at higher resolution. Our projection into the future predicts habitat losses in the Balkans.

Keywords: Maxent, climate change

Habitat types and bird diversity and abundance at mountainous central Kefalonia island, Ionian Sea, Greece

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The aim of this study is to investigate the bird diversity and abundance at different habitat types at mountainous central Kefalonia. The habitat types studied are: garrigue & pseudosteppe, rocky, *Quercus coccifera*, maquis, and olive groves. Fieldwork took place during 2011 - 2013, and 2017 - 2020. Seventy two bird species were observed, ten of them are included in a threat category of the Red Data Book (*Circus aeruginosus, C. pygargus, Buteo rufinus, Aquila chrysaetos, A. fasciata, Milvus migrans, Falco naumanni, F. biarmicus, F. cherrug, Melanocorypha calandra*). Greater number of species were observed at the rocky habitat (58 species), followed by maquis (47 species) and then by garrigue & pseudostepe (46 species). Most birds were recorded in the rocky habitat (33.3 % of total ind), followed by *Q. coccifera* habitat (31.3 %), and then by maquis (20.7 %). Most species of Passeriformes were observed in rocky habitat (37 species) followed by garrigue & pseudostepe (31 species) and then by maquis (30 species). Most individuals of Passeriformes were observed in *Q. coccifera* habitat (35.3 %), followed by maquis (24.4 %) and rocky habitat (24.4 %). During the study period the number of birds observed per 10 hours of fieldwork was stable, with the exception of the first year (2011) when the greater number of birds was observed. The total number of species observed was also stable with the exception of the year 2013, when we observed few species, most likely due to the limited fieldwork time. The commonest species, observed almost every year in good numbers, were: *Fringilla coelebs, Garrulus glandarius, Corvus cornix, Oenanthe oenanthe, Parus major, Buteo buteo, Cyanistes caereuleus, Corvus corax, and Lulula arborea.* In some of the common species we observed a decrease in numbers: *Garrulus glandarius* and *Falco tinnunculus.* Some species show more or less, stable numbers: *B. buteo, F. coelebs, C. cornix* and *L. arborea. O. oenanthe* shows an increase in numbers since 2017 and *C. corax* since 2013.

Keywords: Habitat types, bird diversity, abundance, Kefalonia island

Metastrongyloid parasites of felines in naturally infected gastropods in Greece

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Various terrestrial gastropods are intermediate hosts of metastrongyloid nematodes that affect the cardiopulmonary system of felids. The aim of the present study was to investigate the species of gastropods which can act as intermediate hosts of feline metastrongyloids in Greece. A total of 1208 terrestrial gastropods (850 snails and 358 slugs) were collected from 20 geographical regions and processed by artificial digestion for nematode detection. The gastropods and the retrieved larvae were identified by morphology and molecular methods. A total of 140 (11.6%) gastropods, i.e. 50 (5.9%) snails and 90 (25.1%) slugs were infected with metastrongyloids. *Aelurostrongylus abstrusus* was found in *Eobania vermiculata* (n=3), *Cornu aspersum* (n=15), *Helix lucorum* (n=1), *Limacus flavus* (n=36), *Derocercas* spp. (n=3), *Tandonia sowerbyi* (n=1), *Limax conemenosi* (n=1), and *Lehmania valentiana* (n=1), *Troglostrongylus brevior* in *C. aspersum* (n=15), *L. conemenosi* (n=1) and *L. flavus* (n=49) and *T. sowerbyi* (n=2), and *Angiostrongylus chabaudi* in *Zebrina detrita* (n=1), *H. lucorum* (n=6), *Helix philibinensis* (n=1), *E. vermiculata* (n=9), *Caucasotachea vindobonensis* (n=1), *L. conemenosi* (n=2), *T. sowerbyi* (n=1), *Limax* sp. (n=1), and *L. flavus* (n=1). Co-infections were recorded in *C. aspersum* (*A. abstrusus-T. brevior*, n=4), *L. conemenosi* (*A. abstrusus-A. chabaudi*, n=2), *L. flavus* (*A. abstrusus-T. brevior*, n=19, *T. brevior-A. chabaudi,* n=1), *Derocercas* sp. (*T. brevior-A. chabaudi,* n=1), and *T. sowerbyi* (*A. abstrusus-T. brevior-A. chabaudi*, n=1). The presence of third stage larvae (infectious stage for felids) in wild-caught gastropods is strong evidence of their role as intermediate hosts. Most of the infected gastropods reported herein represent new potential intermediate host species of felid metastrongyloids.

Keywords: Feline metastrongyloids, gastropods, Greece

Food web structure and functioning in an invaded ecosystem of the South Aegean Sea: Insights gained with Ecopath ecosystem modelling

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Assessing the impacts of alien species on invaded marine ecosystems' structure and functioning and their interactions with human activities is a central goal of invasion ecology and a prerequisite for their efficient management. In this study, the first Ecopath static, mass-balanced ecosystem model of the coastal shelf of the Dodecanese islands was developed. A wide array of physical, biological, ecological and fisheries information was collected from diverse sources and harmonized to be used as input data. The model was used to describe characteristics of the structure and functioning of the study ecosystem during 2014 – 2016, the ecological roles of the alien and native species functional groups, and the interactions of local fisheries with the native food web and the alien species. Our model presented several similarities, as well as some key differences, with other ecosystem models developed in the region regarding attributes of the functional groups or ecosystem metrics, highlighting thus the influence of geographic distance and productivity gradients in the Eastern Mediterranean. The alien pufferfishes, the cornetfish and the siganids were among the most important alien species regarding their impacts on the study ecosystem. However, the alien species' shares of the total fish biomass and catches and their impacts were in general much lower than in related models developed for other areas in the Levantine, reflecting the fact that the South Aegean Sea is presently a boundary zone for the distributions of many of the thermophilic Indo-Pacific alien species in the region.

Keywords: *Alien species, marine invasions, marine fisheries, Dodecanese islands*

Alien species, fisheries and global climate change: Forecasting their cumulative impacts in the South Aegean Sea with ecosystem modeling

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Understanding the potential impacts of alien species on invaded marine ecosystems' structure and functioning as they interact with native species, human activities and global climate change is a central goal of invasion ecology and a prerequisite for their efficient management. In this study, the first time-dynamic Ecosim model of the coastal shelf of the Dodecanese islands was developed with the aim to make predictions of potential future impacts on the food web of scenarios for alien species biomasses, fishing effort, and sea warming. A previously developed Ecopath model was used for initializing the time-dynamic simulations. Under the worst-case IPCC AR5 scenario (RCP 8.5) the simulated impacts of sea warming were considerable, as alien species were selectively favored and several native species experienced biomass reductions. The reductions in forage and predatory fish biomasses and total catch were not compensated by the predicted biomass increases of the alien species. Trophic interactions (e.g., predation release, indirect trophic interactions) and differential responses of the species to sea warming were implicated in the forecasted ecosystem change. The effects of the simulated small-scale coastal fisheries fishing effort decrease resulted in benefits for several functional groups, despite parallel recoveries of many of their predators, underscoring the positive effects that reducing fisheries pressure may have on ecosystem state. The results of the cumulative scenarios simulations highlighted that the effects of fishing effort decrease dominated over the impacts of moderate sea warming (RCP 4.5) or the forced biomass increases of lionfish or alien pufferfishes.

Keywords: Marine invasions, Ecosim, time-dynamic model, IPCC scenarios, Dodecanese islands

Assessment of the impacts of treated wastewater discharge on assemblages of benthic macrofauna in the N. Aegean Sea

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Assessments of the impacts of organic pollution on the marine environment are often based on the characteristics of the assemblages of benthic macrofauna. The aim of this study was to assess the impacts of the discharge of treated domestic wastewater of Kavala and Palio on the marine areas adjacent to the points of discharge in the N. Aegean Sea. To this end, samplings of bottom sediment were conducted at three stations in each study area and one reference station (two replicate samples per station) with a Van Veen grab sampler (0.025 m^2). The estimation of the ecological quality status was carried out with the "Benthic Quality Index - family level (BQI-family)" biotic index. We found that the dominant benthic macrofaunal taxa belonged to the polychaete families Cirratulidae, Lumbrineridae, Magelonidae, and Paraonidae, and also to nemertean worms (Nemertea). The dominance of deposit feeders could be associated with the high concentrations of organic matter measured in the surface sediment at all stations. However, ecological quality status was classified at all stations as "Good". The non-significant differentiation of the two study areas and the reference station pertaining to the concentrations of sediment organic matter and the response of the benthic macrofauna could indicate that the underlying causal process was not organic pollution due to wastewater discharge. A potential alternative explanation could be that the observed biotic patterns were significantly influenced by the organic matter produced by the extensive plankton bloom that took place in the spring of 2021 in the N. Aegean Sea.

Keywords: Ecological quality status, benthic biotic index, BQI-family, polychaetes, organic pollution, plankton bloom

Alien land snails and slugs in Greece: current status and distribution

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Alien species, i.e. species that have been introduced on purpose or by accident to an ecosystem that they do not naturally occur, may cause serious damages to their new environment. Among others, alien species may be responsible for local biodiversity decline, e.g. through competition, predation or transmission of pathogens, and inevitably affect economy and human health. Our knowledge of alien land snails and slugs in Greece is limited. So far, five species are known to occur in Greece: *Boettgerilla pallens* Simroth, 1912, *Deroceras invadens* Reise, Hutchinson, Schunack & Schlitt, 2011, *Ambigolimax valentianus* (Férussac, 1821), *Hawaiia minuscula* (A. Binney, 1841) and *Zonitoides nitidus* (Müller, 1774). We performed a survey of the literature published on Greek land snails and slugs since 2000 and recorded all occurrences of alien species. Data on collection dates, habitats and other information relevant to the species ecology were gathered. Our results indicate the presence of alien land snails and slugs throughout Greece, as well as, the presence of other possibly introduced species than we already know. Alien species were found in natural, semi-natural and disturbed habitats. One species was found in a plant nursery. We propose that a systematic search for alien land snails and slugs in Greece is pressing. Greenhouses, botanical gardens, cultivated land, plant nurseries and heavily disturbed habitats should be searched with priority. Under the light of climate change, habitat loss and increasing pressure on natural habitats, it is imperative to detect, monitor and, if needed, prevent the establishment of/eradicate aliens species.

Keywords: Terrestrial gastropods, slugs, invasive species, alien species, greenhouse, species distribution

The hipparion species from the Vallesian locality Nesebar and their implication for the hipparion taxonomy

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The hipparion materials from Nesebar have been described in 1962 by Nikolov and Bakalov as *H*. *mediterraneum* and *H*. *nesebricum*. Later on the base of the material assigned to *H*. *medirerraneum* Nikolov erected a new taxon, *H*. *praesulcatum*. All Nesebar crania have deep preorbital fossa (POF), deep posterior pocket (PP), richly plicated teeth, resembling hipparions from the so called "Group 1". The revision of the sample reveal that there are two type of POF shapes among the crania: a subtriangular one, with PP situated at the dorsal half of the posterior border (similar to that of *Hippotherium primigentium* and the specimens are assigned to this taxon), and an ovoid POF (tear-dropped), with the PP situated at the middle of the posterior border (the specimens are assigned to "*Hipparion*" *nesebricum*). Observations of different *Hippotherium* samples show that these variations of the POF outlines exceeded the limits of the intraspecific variation. Such differences of the POF shapes could be observed also in some other Eastern Mediterranean Vallesian hipparions of "Group 1": "*H"*. *garedzicum* (Udabno) has POF shape similar to "*H"*. *nesebricum*, while *H*. *primigenium* (Nesebar) and *H*. *giganteum* (Grebeniki) have the shape similar to *H*. *primigenium* (Höwenegg). It appears that two POF shapes can be observed also in Vallesian hipparions with less expressed POF and weak anterior borders: an ovoid shape as in "*H"*. *sebastopolitanum* (Sevastopol), "*H"*. cf. *sebastopolitanum* (Pentalophus), "*H"*. *gettyi* and subtriangular POF as *H*. aff. *giganteum* (Nikiti 1), "*H"*. *sarmaticum*.

Keywords: Hipparion species, Taxonomy, Vallesian locality Nesebar

Spring migration at the southmost stop-over site in Europe, the Gavdos Island (Crete, Greece)

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The island of Gavdos, located south of Crete and only 250km north of African coast plays an important role for migratory birds in spring being the first land where birds can re-fuel and rest after the long open-sea crossing. Bird ringing surveys conducted in spring of 2002-2004 revealed that the island funnels migrants from a very wide range of Eurasia, probably reaching east to Siberia. The survey was initiated again after 18 years in early June 2021, and carried out in full intensity in spring 2022, with 500m of mist nets used for 75 days from mid-March to end of May. The nets were opened from 06:00-19:00 at two ringing sites on the island, covering all the major habitats for birds on passage, excluding the shore. A total of 3103 individuals of 63 species were ringed, with 49 individuals of 19 species re-trapped, and a single foreign recovery (Germany) obtained. The most trapped species was *Hirundo rustica* (15.5%), followed by *Sylvia borin* (14.44%) and *Motacilla flava* (8.5%). A notable number of *Sylvia communis* (7%), *Muscicapa striata (*6.9%*), Anthus trivialis* (4%) and *Ficedula hypoleuca* (4.16%) were also trapped. Noteworthy were also the records of *Merops persicus* (N=2), and *Sylvia ruepelli* (N=7). *Sylvia* species were the most common genus trapped (28%). These results call for an intensification of mist-netting of birds at Gavdos, as the study of migratory patterns on this remote island can provide a unique window into the bird migration across the central Aegean migratory corridor.

Keywords: Bird migration, Gavdos, spring passage

Bat diversity in monumental forests of three Ionian islands

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In the framework of the project "PANAS - The monumental forests of the Ionian Sea as hotspots of biodiversity and high biopharmaceutical value of macrofruits" we conducted bat surveys in six selected monumental forests on the islands of Kerkyra, Lefkada and Zakynthos. To acoustically evaluate bat diversity and activity, transect recordings on predefined routes were made in each forest using an ultrasound detector. In addition, 3 to 5 five-minute point recordings were included in each route. Species or groups of species were identified by analysis of recordings and their number was used as a measure of bat diversity, while the magnitude of their flight activity, measured as numbers of bat passes, was used to estimate their relative abundance. Moreover, roosts surveys were conducted in buildings existing within the studied area. A total of 9 species and 6 groups of species were recorded. The highest bat diversity was recorded in the old growth oak forest of Skaros, Lefkada, as well as in Arkoudilas forest, Kerkyra. *Pipistrellus kuhlii*/*Pipistrellus nathusii* was the most frequently recorded bat group (71,1% of the total recordings), followed by *Pipistrellus pygmaeus* (6,6%), *Tadarida teniotis* (4,4%) and *Myotis* spp. (2,6%). Few individuals of *Rhinolophus hipposideros* and *Rhinolophus ferrumequinum* were spotted in an abandoned house in Arkoudilas forest. During our study, bats were recorded for the first time in these forests and our results highlight the importance of old growth forests of the Ionian Islands for bat diversity, especially those with tall oak trees, low density and forest clearings.

Keywords: Acoustic surveys, Chiroptera, woodlands, forest biodiversity, PANAS, Greece

Insights from the Cave of the Lakes to the roosting ecology of Schreiber's bent-winged bat (*Miniopterus schreibersii)* in Greece

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The "Cave of the Lakes'' in Kastria, Achaia Pref., although accessible to visitors as a touristic attraction, hosts the biggest known colony of bats in Greece. The bent-winged bat, *Miniopterus schreibersii,* is present all year round and it had been observed forming enormous clusters, totaling ca 18000 individuals during winter 2018-2019. Nine more bat species are roosting in this cave, many of them also breeding in it. In order to understand the seasonal dynamics of the bent-winged bat colony and to identify conservation needs, we performed systematic visits to the cave during the period July 2021 – September 2022, in the framework of an ongoing project funded by the Natural Environment and Climate Change Agency (N.E.C.C.A.), in the framework of the project "Transport Infrastructure, Environment & Sustainable Development O.P. 2014-2020" MIS 5033267. Species identification of observed bats was based on visual cues and on the characteristics of recorded echolocation calls. Big clusters were photographed and individuals were counted with the aid of ImageJ. Additionally, automatic ultrasound detectors were set in different locations inside the cave and the emerging activity of bats was recorded. Our visual observations and photograph and sound recording analyses verified that several thousands of bent-winged bats consistently roost inside the cave until mid-spring, and their activity is affected by weather conditions in the broader area. These results reinforce the earlier findings on the importance of the Cave of the Lakes as a bat roost of extremely high scientific and conservation value and stress the need for proper management.

Keywords: Chiroptera, seasonal dynamics, roost, winter activity, emerging activity, acoustic monitoring

Small mammal assemblages in the urban habitats of Thessaloniki, Greece

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Terrestrial small mammals form an important component of natural and urban environments, as they represent a significant part of the trophic chain and contribute to the regeneration of forests through seed dissemination. Moreover, their strong and flexible population dynamics in response to environmental changes render them suitable indices of the level of disturbance of different habitats. The purpose of this study was to compare the terrestrial small mammal assemblages in four urban habitats (bushes, meadow, pine forest, and acacia forest) in Vassilika (N 40.510°, E 23.079°), Thessaloniki, Greece. Fieldwork occurred between July 2021 and April 2022 and our sampling effort of 2,104 trap-nights resulted in 401 captures of small mammals, belonging to 5 species. The dominant species in all habitats and all seasons were *Apodemus sylvaticus* and, secondarily, *Apodemus flavicollis* (Muridae, Rodentia). In terms of habitats, the meadow and the acacia forest showed the highest species richness. On the other hand, the bushes displayed the highest species diversity and evenness and was most similar (Jaccard index) to the pine forest. Regarding seasonal variation, summer was characterized by the highest species richness. Interestingly, winter displayed the highest species diversity and evenness. Diversity differed slightly from that of the summer, which was distinct (Jaccard index) from all other seasons. Our results demonstrate that urban temperate habitats display relatively low small mammal richness and are characterized by the dominance of generalist species. These patterns indicate that the protection of the variety of urban habitats is crucial for the conservation of small mammal assemblages.

Keywords: Central Macedonia, conservation, diversity, evenness, Rodentia, similarity

Locomotor evolution of Late Miocene *Mesopithecus* (Primates: Cercopithecidae: Colobinae) as reflected in the fossil femora from Hadjidimovo (Bulgaria)

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Mesopithecus is the only Late Miocene monkey of Europe, and its taxonomy and ecology have been widely debated and remain controversial. The paleoecology of the most primitive species *M. delsoni* is of particular interest in view of the evolution of colobines out of Africa and subsequent dispersal to Eurasia. The present study examines qualitatively and quantitatively functional aspects of 10 fossil femora of *M. delsoni* from Hadjidimovo, Bulgaria to reconstruct its locomotor behavior and paleoecology. In the proximal femur, the relatively high projection of the greater trochanter, hemispherical femoral head shape, posteroinferiorly located and ellipsoidal fovea capitis, posteriorly located lesser trochanter, and strongly developed linea aspera are indicative of terrestrial tendencies. In the distal femur, the relative depth and the shape of the patellar groove, and the long and ellipsoid femoral condyles also suggest more terrestrial activities. Compared to the more recent species (*M. pentelicus* and *M. monspessulanus*), the more primitive *M. delsoni* appears to have effectively exploited the floor and the lower layers of the dominant savanna-woodland habitats in the southern Balkans, via habitual walking and running. Subsequent climatic changes towards more closed environments, promoted a more generalized semi-terrestrial locomotor profile in the more recent species, enabling the dispersal of the genus to western Europe and to eastern Asia.

Keywords: Balkans, positional behavior, paleoecology, Turolian

How climate influences migratory passerine birds in different phases of the annual cycle?

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Migratory birds are vulnerable to climate change due to the large migrating distances across varying climates and environments. In this study, we examine five long-distance migratory passerine birds that breed mostly in the temperate zone of Eurasia, while they overwinter in Africa (*Phylloscopus sibilatrix, Acrocephalus schoenobaenus, Acrocephalus arundinaceus, Sylvia borin, Luscinia megarhynchos*). We combined data obtained since 2007 at the stopover site of the island of Antikythira in Greece during spring migration and occurrence data from citizen science at wintering grounds. We used species distribution modeling to i) map the potential distribution of the species in Africa and ii) investigate the bioclimatic and land use variables that determine habitat suitability. We used fuel load at the stopover site as a proxy of bird condition and examined the influence of large climatic indices (NAOI, SOI, IOD) on fuel load variation using GAMMs. Our results suggest that most of these species are influenced in similar ways by climatic conditions. Most remarkable is the link between *Acrocephalus arundinaceus* and *Sylvia borin* for which: 1. Overwinter habitat suitability depends on the same variables (maximum temperature of the warmest month and precipitation of the wettest month), 2. Fuel load at the stopover site is strongly cross-correlated (0.85), and 3. Fuel load variation overtime is explained by NAOI and SOI variation in an identical way for both species. Further investigation is needed to reveal the influence of species persistence in the face of global changes.

Keywords: Stopover, Fuel load, Species Distribution modeling, Citizen Science

Investigation of factors affecting the arthropod communities in abandoned marble quarries

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Quarry mining results in the destruction of ecosystems and transformation of the terrain of the area. Arthropods play an important role in ecosystems, as many species are pollinators, others are decomposers, and they are generally contributed to a wide range of ecosystem functions. Thus, it was considered important to study the re-establishment of arthropods, as restoration indicators, in disturbed quarry areas after mining operations have ceased. For this purpose, six marble quarries of the eastern Macedonian region were used as sampling stations; these differed in the time interval since the cessation of the mining operations and in the implementation or not of post-completion restoration. The abundance and diversity of arthropods were sampled using 75 pan-traps. The collected arthropods were identified down to family level and recorded in body-length categories. Differences in the total number of arthropods, number of families, Shannon diversity index, and biomass index with respect to each individual quarry since the cessation of mining, and implementation or not of restoration, were examined. A total of 31310 individuals belonging to 85 families were identified. A statistically significant difference was found for biomass index with respect to restoration measures, with much higher values of biomass index for quarries restored with a layer of soil on the base-rock surface of the abandoned mine. The number of families was also found to be statistically significantly different depending on the time interval since the cessation of mining.

Keywords: Arthropods, pan-traps, eastern Macedonia, quarry, biodiversity

New inland invertebrate records from Zakynthos island

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Although the Ionian islands have caught the attention of many zoologists and other fauna researchers since many decades ago, the faunal biodiversity of Zakynthos island is not well studied. One of the most important papers on the subject is from Scheerpeltz (1941) in which he and his colleagues recorded 17 species of terrestrial vertebrates, 813 species of terrestrial invertebrates and 69 species of marine invertebrates from Zakynthos island. Several papers that showcase the island's fauna have since been published, but the majority of them focus on the presence of only a few species or taxonomic groups. Current research by the Environmental Management and Sustainable Development Lab between October 2021 and September 2022 aiming to record and document the island's inland invertebrate taxa, has revealed many previously unknown species for the island, indicating that more field research is needed to better understand the biodiversity of Zakynthos. A metal pair of pincers was used to collect ground dwelling species, and nets were used to collect aquatic or flying invertebrates. The specimens were photographed against a white background, preserved in pure ethanol (95°) or dried if necessary and then stored with their complete collection data. Specifically, the research revealed approximately 50 taxonomic groups and 122 previously unknown species from the island, with 2 of them being endemic to Greece, 14 endemic to the Mediterranean area, 17 cosmopolitan, 3 invasive and 55 having a wider distribution across the Palearctic.

Keywords: Invertebrates, new records, Zakynthos

MedOBIS: a Marine Biodiversity Data Repository for the Mediterranean Sea

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Europe's marine biodiversity data and associated meta-data have traditionally been collected by many entities, and thus, they are often scattered throughout unconnected databases and repositories. Even when data are available, they are often not compatible, making the sharing of the information and data aggregation particularly challenging. MedOBIS, is the Mediterranean node of OBIS, hosted by the Institute of Marine Biology, Biotechnology and Aquaculture (IMBBC) of the Hellenic Centre for Marine Research (HCMR) in Crete (Greece). MedOBIS mission is to rescue information hidden in literature and at the same time to offer a support service to assist scientists in releasing their data through an open and FAIR compliant Data Repository for the Mediterranean Sea. The increased need for quality controlled marine biodiversity data along with the strong technological development, led MedOBIS to act as a Marine Research Repository for both historical and modern scientific datasets, on which the principles of FAIR and Open data are applied. MedOBIS can accept data files in any format. It publishes these data after a specific standardized and quality control procedure on its Integrated Publishing Toolkit, which is a free, open-source software tool used to publish and share biodiversity datasets through the GBIF network. MedOBIS currently hosts 61 datasets, covering the period 1841 to 2021, with over 77,000 occurrence records accompanied with taxonomical, trait, geographical and environmental information. The value of marine data is exponentially magnified when they are stored in contemporary databases and open access repositories.

Keywords: Marine data, marine research, historical data, FAIR data, OBIS node, GBIF network

Genetic characterization of the invasive blue crab (*Callinectes sapidus*) populations in Greece

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The blue crab (*Callinectes sapidus* Rathbun, 1896) is a cosmopolitan species originating from the West Atlantic. It has invaded Europe in 1900s and since then it has spread rapidly. In Greece, it was first recorded in Thermaikos Gulf, in 1935. Recently, its populations' rapid increase created concerns not only due to competition with native species but also due to problems created to fisheries. The aim of the present study was to genetically characterize for the first time the blue crab populations in Greece, using mitochondrial and microsatellite markers and define the origin of these populations. Specimens from both Aegean and Ionian Seas were collected, and DNA was extracted from muscle tissue. A fragment of 661bp of mitochondrial COI gene was amplified and sequenced. Phylogenetic analysis of our mitochondrial data combined with sequences from GenBank, revealed the absence of geographical structure in the studied Greek populations, as our sequences clustered with those from Northwest Atlantic Ocean and the Levantine and Black Seas. Additionally, 5 microsatellite loci were analyzed, identifying 33 alleles in total (4–11 alleles for each locus studied). Cluster analysis (UPGMA) based on the allele binary data, as well as Principal Coordinate Analysis (PCoA) revealed, once more, no clear geographical structure concerning the populations studied. The long-distance dispersal ability of the species corroborates with the low levels of genetic differentiation among the Greek blue crab populations examined, suggesting that it might constitute a panmictic population within this region. This research is funded by the Greek Operational Programme "FISHERIES AND MARITIME 2014–2020".

Keywords: Blue crab, invasive species, genetic diversity, mitochondrial DNA, microsatellites, population genetics

Butterflies in the parks of Thessaloniki: body size, time and height of flight

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Butterfly populations were studied in six parks of Thessaloniki for a 9-month period. Emphasis was given on possible correlation between butterfly body size and height of flight. At each site, transect sampling was conducted between 9.00-12.00 in the morning and 15.30-18.30 in the afternoon. Butterfly species were assigned in three size-classes based on their wingspan: small (less than 40mm), intermediate (40-60mm) and large (more than 60mm). The height of flight for each individual was recorded using an arbitrary scale: low (less than 0.5m), intermediate (0.5-1.5m) and high (more than 1.5m). Sixteen butterfly species were recorded, all common in Europe and non-specialists regarding their food preferences. To reveal the effects of height and time of flight (morning *vs* afternoon) on the formation of the butterfly assemblages, PERMANOVA was performed either on a single variable, namely total butterfly abundance, or on multiple-variable dataset, namely the entire species ensemble. The size of the butterflies was positively correlated to the height of their flight, with larger butterfly species flying higher than smaller ones. More butterfly individuals were recorded in the morning rather than in the afternoon samplings, but this difference was significant only for species flying at low height. Changes in the patterns of flight during the year or across sites were also examined.

Keywords: Butterfly populations, Thessaloniki

DNA barcoding identification of bat species from Greece and Bulgaria

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Bats form a diverse order of mammals with a crucial ecological role in ecosystem control. Bat populations appear to be declining because of human-induced environmental stress. For effective conservation programs, it is crucial to study the species' diversity. Our study aimed to examine the genetic diversity of bats in the Rhodopi Mountain Range, based on DNA Barcoding. Bat samples were collected within the catchment area of Nestos (Mesta) River and from caves in the region of Momchilgrad – Komotini. In total, 228 of the 252 samples, were successfully amplified based on the 650-bases fragment of COI gene. Individuals were classified into 9 genera and 21 species. Morphological and genetic identification converge greatly, except for the cases of *Myotis* species complex. For the construction of phylogenetic trees, 546 additional sequences from BOLD were recovered. Most of the samples in the present study were grouped with other European samples and there was no specific geographic distribution of haplotypes, except for *Barbastella barbastellus* and *Hypsugo savii*. The results significantly support bat management efforts, providing valuable insights into their diversity in Greece and Bulgaria and highlighting the importance of the Balkan Peninsula for the order Chiroptera. This project was funded by the INTERREG V-A "Greece – Bulgaria 2014 – 2020" Cooperation Programme, Project "Sustainable bats conservation in the cross-border area", BATSCONSERVE.

Keywords: COI gene, Chiroptera, genetic diversity, Rhodopi Mountain Range, Balkan Peninsula

First indication of a late migration period of the cosmopolitan butterfly *Vanessa cardui* in the Mediterranean

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Vanessa cardui (Linnaeus, 1758) or Painted lady, is a rather cosmopolitan butterfly species. It occurs throughout the Mediterranean including many of the Aegean islands, a spring stopover along its migration route from Africa to Europe and the opposite route later on during autumn. The idea of this study was stimulated by an observed anomaly in year 2022 when, during our scheduled fieldwork on Chios Island regarding plant–pollinator interactions, we recorded a huge number of specimens feeding on flowers compared to other fieldwork years (2013-15, 2021). In fact, *Vanessa cardui* is one of the 34 taxa of pollinating Lepidoptera that have been recorded on the island (Petanidou et al. unpublished data). The observations were carried out late in the main flowering season (June-July), thus all recorded individuals were found to feed on the most common summer plants, chaste tree (*Vitex agnus-castus L.*) and conehead thyme (*Thymbra capitata (L.) Cav*.). *Vanessa cardui* populations are known to show huge year-to-year fluctuations in their abundance due to climatic conditions and/or food resources available in their breeding regions. The migration observed on Chios is considered a delayed one and is hypothesized to be attributed to a relatively favorable growing period as to available food resources in North Africa.

Keywords: Migration, Lepidoptera, Pollination, Mediterranean ecosystems

Estimation of Roe deer (*Capreolus capreolus*) population density on Mountain Kallidromo

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The European roe deer is assessed as Vulnerable in Greece. Despite its considerable range in the country, roe deer populations display relatively low densities and they are highly fragmented. The conservation management of the species requires the application of an effective methodology for the estimation of density and abundance, which will allow the systematic monitoring of roe deer populations over time and space. The aim of this study was to estimate the roe deer population density in the protected area of Mountain Kallidromo in Central Greece (a region of about 67 km^2) using the Faecal Standing Crop (FSC) method. The survey was based on a random systematic and stratified distance sampling of roe deer faeces across line transects, with proportionate representation of each of the 3 main habitats of the species (forest, shrubland and open areas). In total 27 line transects (4599 meters long) were surveyed, during May 2020. The average estimated density was 7,54 animals/km^2 which is the highest reported density in the country. The results indicate that Mt Kallidromo hosts a robust roe deer population, which nevertheless does not reach the reported densities of other roe deer populations in the rest of Europe. This study was the first attempt to estimate roe deer population in Mt Kallidromo and one of the very few systematic surveys of the species' population parameters in Greece**.** We recommend that the FSC method can be used as a reliable and feasible alternative for the monitoring of roe deer populations in our country.

Keywords: FSC method, faeces, distance sampling

Species composition and variation among different depth zones in North Aegean Sea

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The fish fauna composition and their benthic distribution were determined for the North Aegean Sea (GSA 22) using the faunal species abundance index (N/km^2). The data were collected during 2019–2021 from 65 hauls using an otter trawl (Medits handbook v9, 2017) within the framework of the International Bottom Trawl Survey in the Mediterranean (MEDITS). A total of 261 records were identified at species level and 14 records at genus level. Bray-Curtis similarity indices were calculated between hauls. The PERMANOVA statistical analysis was performed to test any statistical difference among the examined years and the five MEDITS depth zones (10-50m, 50-100m, 100-200m, 200-500m and 500-800m). Statistical analysis indicated that there is no interaction between the factors' "year" and "depth zone" ($p=0.991$). In addition, the abundance indices showed significant differences between depth zones ($p<0.001$), while no statistical difference appeared amongst the years ($p=0.106$). PAIR-WISE TESTS between all depth zones showed significant differences in species composition ($p<0.001$). SIMPER analysis depicted that in the shallowest zone (total of 103 species and 4 genera) the main indicator species were *Sardina pilchardus*, *Diplodus annularis*, *Serranus hepatus* and *Mullus barbatus*. For the "50-100m" zone (total of 115 species and 7 genera) the main indicator species were *Engraulis encrasicolus*, *Trachurus trachurus* and *Illex coindetii*. For the last zone of the continental shelf, a total of 141 species and 8 genera were recorded and the most indicative species were *T. trachurus*, *I. coindetii*, *Capros aper*, *Macroramphosus scolopax* and *Merluccius merluccius*. In the continental slope, we identified the most diverse zone "200-500m" with 168 species and 9 genera (main indicator species: *Parapeneaus longirostris*, *Gadiculus argenteus*, *M. merluccius* and *Plesionika heterocarpus*) and the less diverse "500-800m" with 88 species and 4 genera records (main indicator species: *Coelorinchus caelorhincus*, *Hoplostethus mediterraneus*, *Plesionika martia*, *Phycis blennoides*, *Nezumia sclerorhynchus* and *Galeus melastomus*). These records could be a valuable tool in the description and assessment of the local marine communities' biodiversity.

Keywords: MEDITS, species composition, depth zone, PERMANOVA

Genome-wide assessment of local Greek goats' diversity and comparison with global domestic breeds

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Goats are of major importance for the livestock sector in Greece. The national herd consists of two breeds, the Eghoria and Skopelos. We studied the genome-wide structure, the inbreeding and genetic diversity levels of these two Greek breeds using the GoatSNP50 BeadChip (70 and 289 genotyped samples respectively). We characterized the homozygosity and heterozygosity patterns (ROH/ROHet) of the Greek goat genome, and we detected ROH/ROHet hotspots potentially representing candidate signatures of selection. Principal component analysis of Greek goats in comparison to 21 global goat breeds from the AdaptMap project showed breed and farm level genetic differentiation and revealed Greek goat genetic relatedness mostly with the Italian goats (Garganica, Maltesse), other Mediterranean and the African Toggenburg breed. High levels of average expected (H_e= 0.395-0.423) and observed (H_o= 0.391-0.4203) heterozygosity were estimated for Greek national goat herd. We identified a common ROH region (~0.7 Mb) in Greek goats on chromosome 18 associated with immune response while higher number of ROH estimated in total for Skopelos compared to Eghoria goat genome. We also found 4 ROHet islands for Skopelos and 6 for Eghoria goat, where 80 and 103 genes were located respectively. An annotation analysis detected biological processes related to metabolic and immune responses. This study presents a genome-wide extensive analysis of the Greek goat and reveals their genetic relatedness and differences with previously studied worldwide breeds. Inbreeding estimation and characterization of homozygosity/heterozygosity status can contribute to future genetic improvement schemes and conservation practices. This work was funded by SMARTER Horizon 2020 project.

Keywords: Greek indigenous goats, Genome-wide structure, Runs of Homozygosity, Runs of Heterozygosity, potential selection signatures, livestock genetic resources

The diet of the Tawny Owl (*Strix aluco*) on Mt. Menoikio, Dram Pref., based on owl pellet analysis

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Owl pellets are non-digestible food remains (bones, hair etc.), regurgitated by birds of prey. Pellet analysis is an efficient, non-invasive way to study dietary habits of these predators and, indirectly, the fauna in their hunting area. This work addressed the Tawny Owl's (*Strix aluco*: Strigiformes) diet, through the analysis of pellets collected in July 1992 on Mt. Menoikio (Drama Pref.). The study was based on 28, mostly intact, pellets, in order to determine the prey species hunted in the area by *Strix aluco* and assess the condition of the contained skeletal elements. Both cranial and post-cranial skeletal elements were isolated and identified, showing that the Tawny Owl's diet consisted mainly of small mammals (Rodentia, Eulipotyphla), followed by various arthropods. Murid rodents, mostly of the genus *Apodemus*, were by far the most common prey; the most interesting findings, however, were the few skeletal remains belonging to the Hazel dormouse (*Muscardinus avellanarius*) and the Snow vole (*Chionomys nivalis*). These two species are quite difficult to detect by other means (e.g. trapping), which demonstrates the value of this investigative approach. The percentage of rodents in the findings accounted for 88.73% of the total mammals found in the pellets, while the remaining percentage corresponded to Eulipotyphla taxa (*Crocidura leucodon*, *C. suaveolens* and *Talpa* sp). Non-mammalian findings included a few bones of birds and a single anuran mandible fragment. The number of consumed individuals was determined using the Minimum Number of Individuals (MNI) index and was found to vary from one to five per pellet.

Keywords: *Eulipotyphla, Rodentia,* Minimum Number of Individuals*, Chionomys nivalis, Muscardinus avellanarius, Apodemus* sp.

Pinna nobilis, in search for the surviving fan mussel populations in Greek seas

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Since the first confirmed records of mass mortality events (MME) of *Pinna nobilis* populations in the Aegean Sea in 2018, fan mussel populations have been decimated in Greek seas, and hence the search and protection of surviving healthy populations or individuals, is crucial to increase the chances of recovery. The present study attempted to assess the status of fan mussel populations in the Aegean and Ionian Seas by means of underwater visual surveys. In total 87 independent visual surveys were conducted between May and August 2022 in various locations and depths across the Greek coastline. Overall, 1742 *P. nobilis* individuals were recorded, among which 85.99% were dead and 4.01% were alive. The only surviving fan mussels were found in the semi - enclosed Gulfs of Amvrakikos in the Ionian Sea and Kalloni in the Aegean Sea. In Amvrakikos Gulf 241 alive individuals were recorded in 36 conducted surveys and the mortality rate was estimated at 51,8%, while in Kalloni gulf 3 alive individuals were recorded in 2 conducted surveys and the mortality rate was estimated at 96,62%. In addition to the MME several other pressures were also documented which pose major threats for fan mussel survival. Following the present study, further efforts to identify the remaining populations will be conducted as well as the implementation of protection measures and restoration actions needed in order to increase the chances for the survival of *P. nobilis* in Greek seas.

Keywords: *Pinna nobilis,* Mass Mortality Event, population assessment, surviving populations, resistant population, conservation status

A phylogeny-informed methodology for imputation of low coverage data

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The growth of Next Generation Sequencing (NGS) technologies has yielded huge amounts of data. Missing information in genomic datasets is a key issue, since it can limit and potentially bias downstream analyses. Especially, when working with ancient DNA (aDNA) samples, which are poorly preserved and highly damaged, the amount of missing information in sequencing is extremely high. Imputation is the process that can predict a missing value and the most common approach is by using a reference panel of sequences. However, this is not possible for non-model organisms, for which no reference sequences are available. Regarding aDNA, the use of a reference panel might not be optimal because it consists of modern populations, diverged for thousand years from the sequences we want to analyze. Here, we propose a methodology based on the maximum likelihood phylogenetic tree of the analyzed sequences to impute missing genotypes. In each missing site, every possible genotype is evaluated by calculating the likelihood across the tree using the Falsenstein's pruning algorithm. The imputed genotype is the one scoring the maximum likelihood. The method was tested in simulated data for the effect in downstream analyses of PCA and MDS. Comparison with prior reported machine learning based method of k Nearest Neighbors (kNN) and the commonly used imputation by mean was conducted. Both phylogeny-based and kNN approaches were efficient, while the strong bias introduced by the mean imputation was demonstrated.

Keywords: Phylogeny-informed Methodology, maximum likelihood phylogenetic tree of analyzed sequences

Case study: Beak deformity of a *Monticola solitarius* individual in Gavdos, Crete

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Beak deformities in the wild are a rare sight as the deformity reduces the individual's ability to feed, maintain the plumage and attract mates while increasing the susceptibility to infections, thus significantly impacting the individual's fitness. The etiology of a beak abnormality can be caused by anatomical maldevelopment, and/or a keratin disorder caused by nutritional deficiencies, infections (bacterial, viral, fungal, or parasitic) or exposure to environmental toxins, primarily agrochemicals. We report here the case of an extreme, debilitating crossbill deformity of a male blue rock thrush trapped on the island of Gavdos during a bird ringing survey in May 2022. The individual was estimated as being at least one year old based on its plumage and in a good body condition, with normally developed and maintained feathers. The survival of this individual, seemingly incapable of using its beak to manipulate food items is difficult to explain, especially since Gavdos does not provide soft easily manipulated food apart from olives and some berries and figs. The only other food that could provide sustenance on Gavdos are snails and possibly, bees and other insects. However, the extent of the deformity would severely impede preying on a hard-bodied prey such as snails or beetles, with preying on moving venomous prey that needs to be first stunned such as bees even less likely. The survival of this individual demonstrates a fascinating adaptive response to environmental conditions through problem solving, as well as the plasticity of the dietary niche capable of sustaining an individual.

Keywords: Beak deformity, plasticity, *Monticola solitarius*

Preliminary data about the sexual dimorphism in three species of *Ursus* (Bulgaria) expressed in the lower carnassial

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The sexual dimorphism in fossil and recent species of Ursidae is well known. This dimorphism is characterized by size differences between males and females and is more expressed in fossil species. Usually crania, mandibles, canine teeth and postcranial bones are used to determine the sex of the bear samples. The lower carnassial tooth of these bears shows weak dimorphism concerning the mean values of the length – the mean values of the male carnassial teeth are larger than the female ones. In the collection of NMNHS-BAS there are samples from three different bear species: two species of cave bears (*U. ingressus* from Magura and Bacho Kiro caves and *U. savini rossicus* from Mishin kamik cave) and the extant european brown bear (*U. arctos*, Bulgaria). Also data was included from the type sample of *U. savini* (Bacton). In two of the samples (*U. arctos* and *U. savini*) the mandibles (and m1 respectively) have been sexed on the base of the preserved canines. Analysis shows three measurements of m1 appeared to be reliable in estimation of the sexual dimorphism of the samples: maximal crown length (GL), trigonid width (WTR) and talonid width (WTAL). Conducted ANOVA tests in the sexed samples reveal that the most representative characters are GL and WTAL, while the least reliable is WTR.

Keywords: *Ursus*, morphometric characteristics, Bulgaria

Patterns of connectivity in the Mediterranean Sea: Evaluating the influence of sea currents for loggerhead sea turtles

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Sea currents are among the most influential oceanographic features, as they can affect connectivity for marine species among different habitats. Yet, the extent to which the organisms adapt their movement to current flow, minimizing the energetic cost of their movement, is not fully explored. Here, we developed a methodological framework to project optimal migration routes for marine species by minimizing the exposure to opposing sea currents. We applied this framework on the Mediterranean loggerhead sea turtles (*Caretta caretta*), considering potential connectivity patterns between breeding and foraging grounds. To explore whether optimal routes are associated with the actual species movement, we estimated overlap between projected paths and real migration tracks. We further investigated whether future climate-driven changes in ocean currents would affect the spatial configuration of the optimal routes. We found that the observed migration tracks overlap only partially with the optimal routes, while having on average 25% higher energetic cost. Future optimal routes differ marginally from the contemporary ones. The methodological framework developed here could be adapted for other marine species at different spatial scales, exploring potential impact of sea currents on movement patterns.

Keywords: Climate change; connectivity; energy balance; loggerhead turtle; migration; sea currents

Avifauna of the coastal wetlands of the wider region of Kalloni by autumnal migration

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Lesbos is one of the biggest islands of Mediterranean, close to the coasts of Asia Minor. It is characterized by varied terrain, great geodiversity, mild mediterranean climate, rich variety of ecosystems and ecological deposits, as well as huge floral and faunal richness. Also, 1/3 of the wetlands of all Aegean are located in Lesbos. The gulf of Kalloni, in particular, makes an ecosystem with great significance for the whole Europe, with its environment being composed by marine, terrestrial and coastal bioreserves, as well as special geological formations. Its impressing variety of bioreserves host many rare species of plants and animals. In concrete, it's characterized by an outstanding avifauna, with 333 of the 455 recorded in Greece, being present in the island, rendering it the 5th of top ten places for birdwatching, globally. In this research there took place weekly expeditions at Vouvaris River, Messa Wetlands, Kalloni Salt Pans, Tsiknias River, Skala Kalloni Marsh, Ennia Kamares Wetland, Metochi Lake, from early July to late December 2021. Every wetland was visited 23,6 times on average, between 8 and 10 a.m. The results of the records revealed factors affecting the precise dates of autumnal migration, like seasonal drying of wetlands and Autumn cold snaps, as well as additional, secondary events that influence numbers of certain species, just like the ebb of the tide for birds of the mud. Also, there was observed high congruency with bibliography, with only few deviations. Finally, there are proposed ways that could enhance background of ecotourism in Lesbos.

Keywords: Avifauna, birds, migration, autumn, wetlands, Kalloni

IoT-based Monitoring and Decision Support of Honeybees

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This work is about monitoring bioecological timeseries data from a beehive with a view to record habits of honeybees. An embedded system gathers data from CO_2 concentration (ppm), concentration of volatile compounds (ppb), temperature and humidity as well as bees counts of entering and exiting the hive. The platform also transmits exact sampling time, GPS coordinates and weight. These data constitute a multidimensional timeseries that can be analyzed by machine learning techniques to identify current trends in sensors' values, predict future outcomes and regions of confidence around them but most of all, identify atypical values that may relate to hazardous situations for the health of the beehive. In this work we present our optimized smart beehive, we comment on the multidimensional timeseries produced and we discuss ways machine learning techniques can be integrated to a Decision Support System that issues alert messages.

This research has been co-financed by the European Regional Development Fund of the European Union and Greek national funds through the Operational Program Competitiveness, Entrepreneurship and Innovation, under the call RESEARCH – CREATE – INNOVATE-BeeSense Project (project code: T2EDK -03157)

Keywords: Bees, Bioecological data, IoT

Ancient DNA confirms the presence of aurochs (*Bos primigenius*) in Neolithic Greece

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The aurochs (*Bos primigenius*) is considered the large-bodied progenitor of modern domesticated cattle. Its distribution was wide, with *B. p. primigenius* expanding in the entire Eurasia. It was part of the Pleistocene megafauna, one of the largest herbivores during the Holocene, and became extinct during the post-medieval times. According to the fossil record aurochs were present in Greece during the Holocene and while historical artifacts indicate its potential presence until the late Bronze Age, its extinction from the Greek territory remains unknown. The introduction of domesticated cattle (*Bos taurus*) from Anatolia during the neolithisation of Greece, and the subsequent potential hybridization between wild and domestics may obscure the extinction dating. Moreover, the identification of aurochs is based on morphological measurements, and according to morphometrics, aurochs in Greece were small in body size during the Middle Pleistocene, increased during the end of the Late Pleistocene, and decreased during the Holocene. This size fluctuation may bias the proper species identification; hence an independent method should also be used to confirm initial species assignments. Here, we performed ancient DNA analysis to a ~4000 BCE cattle tooth from the Kouveleiki B cave in Lakonia, southern Peloponnese, and conducted molecular species identification through mitochondrial DNA phylogenetic placement. This individual forms a monophyletic group together with other aurochs (haplogroup P), thus being distinct when compared to domesticated or hybrid cattle species. These results provide direct evidence of the presence of aurochs in continental Greece at least about 6000 years ago.

Keywords: Cattle, Extinct, Mitochondrial DNA, Molecular species identification, Phylogenetic Placement, Wild ancestor

Insights on elasmobranch biodiversity of the Ambracian Gulf through bycatch data of small-scale fisheries.

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Collaboration with small-scale fisheries of the Ambracian Gulf sheds light on the understudied elasmobranch diversity of the area. The Ambracian Gulf, a semi-closed embayment in northwestern Greece, is characterized by peculiar abiotic conditions including seasonal thermal shocks, eutrophic conditions, hypoxia and anoxia in depths below 15m in the eastern part, making it a very interesting area to monitor bottom-dwelling species like rays. Elasmobranch diversity and abundance in the area have never been studied extensively. Bycatch data and general questionnaires were gathered from 92 small-scale fishing vessels from February to August 2022 using a modified protocol of the General Fisheries Commission for the Mediterranean – GFCM. Preliminary results of this long-term study revealed the presence of 2 species of sharks and 8 species of rays. The Mediterranean populations of two of them (*Aetomylaeus bovinus; Gymnura altavela*) are listed as Critically Endangered in the IUCN Red List of Threatened Species with the first still not being protected. Professional fishers stated the regular presence of both these species in their catches. Half of the questioned fishers reported occasionally landing of large sized rays for self-consumption and sharks for sale in the local fish market. The systematic study of elasmobranchs interaction with fisheries of the Ambracian Gulf could help managing their populations and contributing to our knowledge on their biology and ecology. More work is required to understand the market motives in such an important area for elasmobranchs.

Keywords: Sharks, rays, questionnaires, landings

Insights on morbidity causes of Raptors in Greece through ANIMA rehabilitation center admitted cases

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A case study to understand morbidity causes of raptors in Greece sheds light to the main threats they are facing. ANIMA wildlife rehabilitation center receives over 7000 wild animals per year from central and southern Greece as well as Ionian and Aegean islands. The study focuses on raptor species admitted to ANIMA both diurnal and nocturnal including cases from 3 species of Accipitriformes, 25 species of Falconiformes and 7 species of Strigiformes. In total 4123 cases were examined. The goal of the study was to compare cases admitted to ANIMA with the population estimations of raptors in Greece in the form of cumulative incidences. The time period 2013-2020 was selected due to the homogeneity of the rate of raptor admissions and due to the quality of the available wild population estimations for this period. Wild population estimations from EIONET 2014-2018 were used. The reasons of admission of raptors included: Exhaustion, Toxicoses, Orphaned, Captivity, Disease and Trauma. The cause of Trauma was specified as: Buildings, Electrocution, Glue traps, Gunshot, Predation, Trapped in Oils, Road accidents and Unknown Trauma. Results on cumulative incidences show high electrocution rates in *Bubo bubo*, high gunshot rates on *Buteo buteo* and *Accipiter nisus*, while toxicoses remains a serious cause of morbidity for *Gyps fulvus*. We conclude that, further case studies of admissions from all wildlife rehabilitation centers in Greece as well as better estimations of populations of raptors could help in setting management goals for common and vulnerable species of raptors in Greece.

Keywords: Cumulative incidences, trauma

Observations on seasonality of *Eimeria* spp. faecal shedding intensity in *Spermophilus citellus* populations from Greece

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Parasitological studies in wild animals contribute to wildlife conservation and domestic animal and public health protection. Herein, we investigated the intensity of infection in the European Ground Squirrel (*Spermophilus citellus*), an endangered semifossorial rodent of central and southeastern Europe. Previous studies suggested that the most prevalent parasites of *S. citellus* were the coccidian protozoa of the genus *Eimeria*. Our goal was to study the seasonality of *Eimeria* spp. infection in the populations of *S. citellus* in order to assess possible effects on the animals during the active period. Faecal samples were collected from burrow entrances every 15 days during March-July 2022 in three populations in Greece. All faecal samples were examined using standard parasitological methods, while for the quantification of *Eimeria* spp. oocysts (Oocysts Per Gram of faeces, OPG) the modified McMaster test was used on pooled per population and per age (adults/juveniles) samples. Our results show an association between OPG and both age and season. Namely, higher OPG were observed in juveniles, probably due to their undeveloped immune system and in summer months, a result probably influenced by the presence of juveniles in the examined animals of this particular season. However, the relatively small sample size did not allow stronger correlations. Further research in this direction could elucidate the effects of high intensity of coccidian infection on the declining populations of *S. citellus*. Furthermore, this information would be valuable for designing suitable and effective conservation measures for threatened populations.

Keywords: Endangered species, rodent, endoparasites, coccidia, prevalence, conservation management

Preliminary analysis of peripheral white blood cells in wild rodent species from Greece: comparison of morphology and proportion

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The current work reports the first results of analyses on White Blood Cell (WBC) morphology and differential count in wild rodent species from Greece. This survey is a part of a wider study of wild rodents ectoparasites and the pathogens they bear, which can cause serious zoonotic diseases. To date, 69 animals belonging to the widespread species *Apodemus flavicollis*, *A. sylvaticus*, *A. epimelas* (Murinae) and *Microtus thomasi* (Arvicolinae) have been live-trapped from 15 localities in Greece. In addition, eight laboratory and twelve wild-caught mice (*Mus musculus domesticus*) have been included to the study. The animals were sedated and blood was collected from the saphenous vein, followed by immediate preparation of blood smears. Microscopic observation of prepared slides was performed, following Giemsa staining. Preliminary results highlight the variation of leukocyte types between the studied wild rodents and laboratory mice and the diversity of leukocyte count and proportion between the families Murinae and Arvicolinae. Specifically, most WBCs in laboratory mice were normal lymphocytes, while in wild mice a large number of reactive lymphocytes were observed. Furthermore, the total number of WBCs and the percentage of lymphocytes in *M. thomasi* were significantly lower compared to the other species, whereas the proportion of neutrophils was higher. Finally, an interesting observation. pending confirmation, was the detection of a special leucocyte, known as "azurocyte", in *M. thomasi* which is only reported so far in other *Microtus* species.

Keywords: *Apodemus, Microtus,* Mus, lymphocytes, neutrophils, blood smear

Selective interactions in the evolution of mitochondrial and nuclear genes in OXPHOS complexes

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Oxidative phosphorylation (OXPHOS) takes place in the inner membrane of mitochondria through five protein complexes. Four of these complexes contain proteins encoded by genes located both in nuclear and in mitochondrial DNA. The question on how these proteins closely collaborate in order to perform one of the most vital processes of eukaryotic cell, namely OXPHOS, despite their tremendously different genetic background, remains under investigation. In this study we used a + approach to investigated the role of selection and mutation on mito-nuclear interactions, by using the whole set of OXPHOS genes in organisms from a broad taxonomic scale. We found a negative correlation in the difference of mitochondrial and nuclear genes in the mutation rate relative to selection. The negative correlation seems to be maintained using different strategies among organisms. In most of them selection acts mainly on mtDNA genes. It is stricter on mtDNA genes when they are faster mutated than nuclear OXPHOS genes and more relaxed when they are lower mutated. In other organisms it seems that beneficial mutations happen in nuclear genes, in order to compensate the negative results of higher mutated mtDNA genes. Finally, we found that the functional supercomplexes that have been described before share similar patterns of mito-nuclear evolutionary interactions.

Keywords: Bioinformatics, Oxidative phosphorylation

Territorial overlap of sympatric eagle species on the island of Crete, Greece

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Aquila chrysaetos and *Aquila fasciata* are two eagle species that coexist on the island of Crete, Greece and are expected to compete due to similar nesting and feeding ecology. The objective of the current study is to estimate their carrying capacity on the island and highlight the areas of territorial overlap. Georeferenced data on the species' nesting locations were collected between 2000-2020 and ranging behavior within their territory was calculated using the PAT (Predicting Aquila Territory) model. We assumed that the species use excessively areas with specific terrain features around nest sites such as ridges and rocky outcrops and avoid others within their distribution range such as water bodies and urban areas. ArcGIS Pro (ESRI 2021) and R 4.1.1 (R Development Core Team 2021) software were used for spatial mapping and model construction respectively. In general terms, territories were well separated in space with low rates of interspecific overlap in the eastern part of the island. Partial overlap was predicted elsewhere, especially in Lefka Ori and Asterousia mountain ranges. The carrying capacity was estimated to be between 26-30 territories for *Aquila chrysaetos* and 17-22 territories for *Aquila fasciata*. The next step is to predict suitable nesting habitats for both species in Crete using species distribution modelling techniques and investigate bioclimatic and eco-geographical variables that provoke their niche partitioning.

Keywords: *Aquila* spp., interspecific competition, spatial mapping

First modelling attempt of the distribution of *Etrumeus golanii* in the Greek Seas and overlap with competitive native species

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Etrumeus golanii is a small, pelagic fish introduced to the Mediterranean through the Suez Canal and misidentified as the congeneric *Etrumeus teres* till recently. The main aim of the present study was to predict its distribution in the Greek Seas under current climatic conditions and assess habitat overlap with *Engaulis encrasicolus* and *Sardina pilchardus*, its native counterparts. Georeferenced observations of species' occurrences along the Eastern Mediterranean Sea, dating from 2010 to present, were modelled by means of Maximum Entropy modeling, using satellite-derived environmental predictors as explanatory variables. Derived habitat suitability maps were subsequently overlapped with respective habitat maps of *E. encrasicolus* and *S. pilchardus*. According to the results, *E. golanii* is predicted to expand its distribution towards the western coasts of Peloponnese and the Ionian Sea, but low probability of presence is predicted in the North Aegean Sea. As high environmental heterogeneity was calculated between training area and North Aegean Sea, the results should be inspected with caution there. High probability of presence was calculated for northern Crete, Cyclades plateau and the Dodecanese islands. Low to moderate habitat overlap was calculated between habitat suitability maps of *E. golanii* and *E. encrasicolus* or *S. pilchardus*. We propose that future studies with occurrence data of *E. golanii* over a wider area will further enlighten the habitat modeling for the species.

This work has been conducted within the framework of the project "4ALIEN: Biology and the potential economic exploitation of four alien species in the Hellenic Seas", funded by NRSF 2017-2020 (MIS: 5049511).

***Keywords*:** Alien, maximum entropy, anchovy, sardine, habitat suitability map

Status of the Bulgarian, the Balkan and the Mediterranean Brown bear

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Ursus arctos L. is endangered species in Bulgaria with main habitats in Rila-Rhodopes massif and Balkan Mountain (Spiridonov, Spassov 2015). Very recent investigations indicate a probable trend of decreasing numbers over the last thirty years and reaching no more than 500 individuals in recent times. Genetic studies show that two genetically distinct clades (= haplogroups) of the brown bear occur in Europe; one in southern Europe (clade 1) and the other in the vast northeastern part of the continent (clade 3) (Taberlet et al., 1994). Clade 1 is the only lineage in the European Mediterranean since the beginning of the Holocene (Ersmark et al. 2019) and the only one in Bulgaria since the end of the Pleistocene (Mizumachi et al. 2020), reaching Western Anatolia and the Caucasus (Hirata et al., 2014; Çilingir et al., 2015), where it hybridizes with other populations. The golden color is characteristic of female bears of the Mediterranean population (Spassov 1990, 2003; 2015), which was not noticed until recently. The Balkan-Apennine population is unique in its gene pool (clade 1b) (Mizumachi et al. 2020). The indicated differences between the Mediterranean bear and the bear from the rest of Europe give grounds for raising the conservation status of the southern European population (slightly more than 4,000 individuals). It has been established that only the nominate subspecies *U. arctos arctos* L. inhabits Europe (Wilson & Reeder 2005; Kitchener 2010). The above-mentioned gives, it seems, grounds for revision of this opinion (Spassov, 2003).

Keywords: *Ursus arctos*, Balkan bear

Eurasian African Bird Migration Atlas

Fernando Spina*, Stephen R. Baillie*, Franz Bairlein*, Wolfgang Fiedler, Kasper Thorup (eds)

The Eurasian African Bird Migration Atlas.
https://migrationatlas.org, EURING/CMS.

**Joint lead editors.*

The Eurasian African Bird Migration Atlas, developed by EURING, brings together data on the movements of individual birds collected by volunteer ringers and researchers from across Europe over more than 100 years. It provides interactive migration maps for 300 species based primarily on recoveries from the EURING databank. Movements are plotted for birds from eight regions of Europe using different map types. For over 100 species the online mapping tool overlays movement patterns based on ring recoveries, each of which documents only part of the migratory journey, with tracks from electronic devices, principally satellite transmitters, GPS-GSM tags or geolocators, providing the most complete information available on the migration routes of individual birds. The maps are accompanied by texts written by a team of experts and including appropriate references. The other main feature of this Atlas is the four research modules addressing different aspects of bird migration and relationships between birds and people. These research modules cover historical changes in migration patterns, intentional killing of birds by man, migration seasons of hunted species, and migratory connectivity within the European African migration system. Finally, the main findings and conservation conclusions are brought together in an Executive Summary.

Keywords: Bird ringing, bird tracking, migration strategies, migratory connectivity, flyway conservation, environmental change.

Understorey biodiversity management in olive cultivation for integrated management of natural enemies

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The management of natural enemies of perennial tree crops and especially insects is performed with pesticides, which can negatively impact the quality of products, natural resources and biodiversity as well as the health of producers and consumers. An emerging trend focuses alternatively on the use of less or no chemicals and the management of crop pests with natural means. This trend is being promoted by both the EU and the new CAP. Olive is one of the most important permanent crops in the Mediterranean area. The most important pest in olive groves is the olive fly [*Bactrocera oleae* (Rossi) (Diptera: Tephritidae)]. In this study we investigate the relationship between the fly population and plant and insect diversity in 15 fields on Lesvos Island during 2021. Specifically, we monitored the population of olive fly with McPhail traps and understorey insects with the use of pantraps and pitfall traps. We also recorded temperature and humidity in the tree canopy. We correlated these data with two different understorey treatments, undisturbed understorey with plant mixture or cleared by mechanical means. The first results indicate that olive groves with undisturbed understorey support higher insect diversity and abundance while at the same time the abundance of arthropods has a negative effect on the population of olive fly. The results will be used to formulate guidelines in the context of integrated olive grove management systems.

Keywords: *Bactrocera oleae*, biodiversity, dacus, olive, pest management, sustainable agriculture

Genetic diversity and population connectivity of the priority species *Triturus macedonicus* (Amphibia, Urodela) in Northern Pindos National Park

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The Macedonian crested newt, *Triturus macedonicus* (Karaman, 1922), is a priority species (Annex II, 92/43/EEC). The aim of the present study was to investigate patterns of genetic diversity, population structure, and functional connectivity of the species in the protected area of the Northern Pindos National Park, using seven microsatellite markers. The analyses revealed moderate genetic diversity in the region, with heterozygosity (He) and corrected allelic abundance (Ar) ranging from 0.404–0.563 and 2.56–3.73, respectively. Additionally, high overall genetic differentiation (F_{ST} = 0.131) was observed among local populations. The population structure analysis revealed two distinct and highly differentiated (F_{ST} = 0.184) gene pools, which are geographically separated by the valley of river Aoos. Further population subdivision is likely in the western gene pool. Gene flow analyses showed zero connectivity between the two gene pools and low migration rates within each one, indicating high population isolation. In total, only three populations appear to be important source populations, showing significant migration rates. In conclusion, the study area appears to be a hot-spot of intraspecific diversity of the Macedonian crested newt, hosting two gene pools that can be characterized as distinct Evolutionarily Significant Units (ESUs), thus requiring separate conservation practices.

Keywords: Macedonian crested newt, heterozygosity, gene pool, gene flow, Evolutionary Significant Units (ESUs), conservation.

Persistence and extinction risk of a Greek smooth newt population, exhibiting facultative paedomorphosis

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Amphibians are amongst the most threatened vertebrates and their populations have been declining worldwide. Newt populations, and especially those exhibiting facultative paedomorphosis, i.e. the retention of larval characteristics such as gills in sexually mature individuals leading to distinct phenotypes, depend on both aquatic and terrestrial habitat and are prone to alterations of the environmental conditions. Our study focuses on a paedomorphic Greek smooth newt (*Lissotriton graecus*) population in a permanent artificial pond. Utilizing data on fecundity, offspring viability and genetic diversity we aimed to predict the extinction risk of the studied population, and to investigate the sensitivity of the paedomorphic phenotype to pond desiccation and fish introductions, that are considered as the most environmental stressful factors for newt populations. According to the population viability analysis, both these environmental factors lead to the extinction of the paedomorphic phenotype within the next 25 years, while sex-specific differences in the persistence of the paedomorphic morphotype were evident. In stressful environmental conditions, male newts metamorphosed earlier than females probably due to differences in life history traits. In Epirus prefecture, NW Greece, several cases of facultative paedomorphosis have been recorded, however several lakes and ponds in the region have been used for watering or stocked with fish for recreational fishing, thus raising concerns for the negative impacts on the paedomorphic populations. Future work should focus on possible management actions for the preservation of paedomorphosis, an important alternative ontogenetic trajectory, as well as the development of viability models that have a central part in conservation planning.

Keywords: *Lissotriton graecus,* phenotypes, conservation, viability analysis

Genome-wide characterization analysis reveals potential selection signatures in local Greek sheep

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Local Greek sheep have been adapted to variable environmental conditions and artificially selected for production purposes, while reared in different farming conditions. However, these genetic processes are largely understudied for Greek livestock species. Runs of homozygosity (ROH) and heterozygosity (ROHet) represent inherited consecutive homozygous and heterozygous regions utilized to estimate inbreeding and characterize population demographic history and their adaptive evolution. In this study funded by SMARTER Horizon 2020 project, we genotyped 828 Greek sheep in total from Boutsko (n=298), Frizarta (n=363), Mytilini (n=107) and Pelagonia (n=60) breeds using the OvineSNP50 Bead Chip to estimate inbreeding levels, detect ROH/ROHet regions throughout their genome and identify ROH and ROHet hotspots potentially related with selection processes. In total, 13 ROH islands were identified (0.34–1.27 Mb), eight on chromosomes 2 and 10 with overlapping regions among Greek breeds. Moreover, 15 of the 20 detected ROHet islands (0.06-1.01 Mb) were distributed on chromosomes 3, 9, 10 and 17 with common heterozygous regions among two or more breeds. Functional annotation analysis revealed 117 QTLs and 181 candidate genes within or closely located to the identified ROH and ROHet islands, mostly associated with milk yield and composition (e.g., VPS13B, ZNF804A), growth (e.g., MBD5, EPC2), paratuberculosis susceptibility (e.g., GTSF1, COPZ1), parasites resistance (e.g., CLCN3, NEK1) and environmental adaptation traits such as fat deposition and tail morphology (e.g., HINT2, NPR2). Our findings contribute to our understanding of the selection impact on Greek sheep genome and to the development of efficient breeding schemes while balancing conservation of genetic resources.

Keywords: Greek sheep genome, runs of homozygosity, runs of heterozygosity, adaptation, human-mediated selection, candidate genes

Genome-wide SNP profiling of Greek sheep with worldwide domestic breeds revealing population and admixture patterns

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Greece hosts one of the largest and highly diverse pools of animal genetic resources in the Mediterranean region, where numerous sheep breeds have been regionally selected for centuries. The present study focuses on the genome-wide characterization of population structure, diversity, and admixture patterns of local Greek domestic sheep collectively analyzed with 38 global breeds from the Sheep HapMap project. A total of 1,008 animals (Chios=173, Frizarta=367, Boutsko=300, Mytilini=108, Pelagonia=60) from 23 locations in mainland and island Greece were sampled and genotyped utilizing the OvineSNP50 Genotyping BeadChip featuring 52,152 SNP markers. Principal component analysis and model-based clustering depicted a central position for Greek sheep among worldwide sheep as an intermediate genetic link between Asia and Europe, indicating cross-continent and within Europe genetic clines. Genetic clusters of Asian fat-tailed and Balkan Zackel sheep were identified as major contributors in Greek breed formation. Additionally, genetic relatedness between Greek sheep revealed several admixture and crossbreeding events for human-mediated selection purposes, while the studied sheep were well differentiated at breed level. Average genetic diversity levels of Greek breeds, explained by heterozygosity indices (H_o = 0.358 and H_e = 0.363), were estimated similar to Mediterranean sheep. Long-term directional selection was characteristically depicted for Greek Chios sheep with higher genetic differentiation (F_{ST}=0.09-0.15). These results suggest a diverse and composite genetic makeup of Greek sheep indicating multiple migration routes during sheep domestication and expansion from Asia to Europe, while inferred admixture patterns are related to productivity and adaptation enhancement. This work was funded by SMARTER Horizon 2020 project.

Keywords: Greek domestic sheep, Sheep HapMap project, genome-wide structure, model-based ancestry, diversity, livestock genetic makeup

Twenty-year evolution of a barn swallow (*Hirundo rustica*) population in the historical center of Athens, Greece

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The Barn Swallow (*Hirundo rustica*) is a migrating bird, which belongs in the Passeriformes Order and Hirundinidae Family. It is the most widespread swallow species in the world, with its distribution ranging over 251 million square kilometers according to IUCN. Although its abundance is directly linked with the existence of livestock, there are recorded cases of nesting individuals in highly populated areas such as villages and cities. The present study contains 20 years of observations (2002-2022) regarding the evolution of a nesting population of Barn Swallows in the historical center of Athens (Greece), especially focusing on the old neighborhood of Plaka. The extent of the study area was 27 ha, roughly defined by the E-NE slopes of Acropolis Hill and the Areopagitou, Amalias, Filellinon and Mitropoleos streets. In 2002, 18 pairs of Barn Swallows were observed, nested in the central roads of Plaka. During their first birth 70 fledglings were born and 8 more during the second birth. From that year onwards the population showed an increasing trend, with a peak during 2015. In that year, 31 nesting pairs were recorded and 114 fledglings were born during the first birth and 53 additionally during the second birth. Then, the population declined significantly, with only 3 nesting pairs and 9 fledglings from a single birthing in 2022. The main reasons of this declining trend are the increase in building restorations for touristic accommodations, destroying many nests, as well as the unusual weather conditions during their migration period, hinting at climate change.

Keywords: Passeriformes, Hirundinidae, nests, Plaka, Acropolis, observations

Stomach Content Analysis of Diamondback puffer *Lagocephalus guentheri* from Iskenderun Bay, northeastern Mediterranean Sea

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Pufferfishes are invasive marine fish species in the Mediterranean Sea. Diamondback puffer, *Lagocephalus guentheri* was found from the Indo-West Pacific to the Red Sea and Southwest Atlantic. Stomach content analysis of fishes not only helps document their food spectrum but also provides an overview of the food network they are involved in. In this study, we aimed to investigate the feeding ecology of *L. guentheri* from the Iskenderun Bay, northeastern Mediterranean Sea. Specimens were caught from January 2022 to August 2022. A total of 200 *L. guentheri* specimens stomachs were examined during the study for stomach content analysis. Of the 215 stomachs analysed, 60 (27.9%) stomachs were empty and 155 (72.1%) stomachs contained food items. Analysis of the diet composition showed that fish is carnivorous and prey on crabs, prawns, fish and bivalves. Based on the index of relative importance, crustaceans were identified as the most important prey (48.3%), followed by fish (24.4%), bivalves (8.9%), and unidentified content (18.4%). The results show that *L. guentheri* has a high feeding tendency to crustaceans. Interestingly, the showing of fish prey found was invasive venomous lessepsian species (*Plotosus lineatus, Siganus rivulatus and Siganus luridus*), which was showing the ability of *L guentheri* to resistance to venom. This species will share with other demersal carnivore species food in the Mediterranean. This study increases the knowledge of the feeding preferences of *L. guentheri*. The present paper is also the first document on the diamondback puffer *Lagocephalus guentheri* feeding strategy.

Keywords: *Lagocephalus guentheri*, feeding strategy, stomach content, diet analysis, pufferfish, diamondback puffer

Dispersal movements of juvenile Bonelli's eagles (*Aquila fasciata*) from Greece. Preliminary results as revealed from satellite telemetry

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In the framework of a 5-year LIFE project (2018-2023) for the Bonelli's eagle (*Aquila fasciata*) in Greece, an extensive satellite telemetry programme was undertaken. One of the main objectives of the research was the study of the species' movement patterns during the natal dispersal phase, in order to identify important sites, which would enable focusing of conservation actions and facilitate proposals for management implications. We present spatial data describing the dispersal movements of 26 juvenile Bonelli's eagle individuals during the first year of their life. Spatial data analysis outlined important dispersal areas and identified some of the main movement corridors for the species. In addition, our study highlighted the differences of dispersal patterns between four different breeding areas in Greece, namely Peloponnese, Cyclades, Dodecanese and Crete. The preliminary results presented here, suggest that further research is needed in order to acquire a thorough knowledge on the subject and, as a result, additional important sites for the species are expected to be identified in the future.

Keywords: *Aquila fasciata,* dispersal, satellite telemetry, juveniles, Greece

First record of a relict *Cladocora caespitosa* reef in Kalloni Gulf, Lesvos Island (N Aegean Sea): Bioecological description and present status

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A coral bed of the scleractinian *Cladocora caespitosa* is documented for the first time in the Gulf of Kalloni, Lesvos Island, Greece. It is among the largest *Cladocora* reefs in the Mediterranean, and corals can be found up to 5.8 m depth. Overall, 1492 colonies were visually sampled *in situ* by scuba divers to assess colony size, coral surface area, necrosis level, type of necrosis and growth mode (i.e. fixed to the substrate or mobile). A mean coral density of 4.79±2.25 colonies/m^2 was estimated. The most typical size range in the study area was 10-20 cm, and aggregated colonies were frequently found, reaching up to 203 cm in diameter. Almost 80% of the colonies sampled were fixed. A mean necrosis percentage of 34.6±38.2% was recorded, whilst almost half of the corals had no necrotic tissue, placing the *C. caespitosa* population of Kalloni among the healthiest ones in the Mediterranean Sea. Necrosis was associated with epibionts in most cases. Correlation analyses showed a significant negative correlation between coral density and depth. A qualitative assessment of the reef's biodiversity was also conducted, identifying 10 macrophyte and 64 animal taxa, including biotic assemblages between dead and alive coral colonies and other animals. Since *C. caespitosa* has been included in the IUCN Red List as an Endangered species, its conservation should be a priority. Therefore, a restoration project based on direct transplantation is proposed to be carried out in the Gulf of Kalloni to recover damaged colonies and enhance their viability, ultimately increasing their abundance.

Keywords: Scleractinia, Mediterranean, coral reef, health status, conservation status, biodiversity.

Biodiversity crashed into a highway along the borders of Dadia National Park NE Greece

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Highways are directly linked to the progress and well-being of societies, but they are at odds with biodiversity conservation. This conflict becomes particularly pronounced when highways crosses biodiversity hotspot areas. Wildlife-vehicle collisions (WVCs) are caused when no measures are taken for sensitive siting and design of highways or mitigation of their effects. We assess the WVCs mortality along a road of 42km (of which 38 are highway) that connects Dadia National Park (DNP), with the city of Didymoteicho (European route E85, A21). 50% of the road is within the DNP (6km) and along its eastern borders (15km). While driving we map the WVCs for 298 days (82% of the year, Jan 2021-Jan 2022). 64 individuals from 15 different species (12-mammals, 3-birds) were detected dead due to collision: 15 jackals, 11 wildcats, 8 foxes, 8 badgers, 8 ferrets, 1 otter, 1 wild boar, 1 hare and 11 from other species. Although the WVC density (1.5ind./km) is identical with the median value of 17 studies conducted in national parks worldwide, our results are alarming since, from the mammals involved in WVC, two are endangered in Greece (jackal, otter) while the status of other two is not evaluated (wildcat, badger).We found also that 40% of investigated road (6km in the DNP and 11km along the borders) is complete unfenced and without any indication of wildlife crossing, while at the rest 60% of the highway the fence is destroyed at multiple places. We recommend the immediate highway mitigation fencing and the construction of appropriate wildlife passages to reduce WVCs.

Keywords: Conflict, wildlife, vehicle collisions, conservation, mitigation, endangered.

Population genomics analyses of transitions to self-fertilization in flowering plants

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Flowering plants display remarkable reproductive diversity. Evolutionary transitions from obligate outcrossing to predominant self-fertilization are quite prominent in angiosperms. Population genetics theory provides a framework to study the consequences of a transition to self-fertilization on genomic diversity. Selfing is expected to present a distinct signal on the present-day SNP variation data, in contrast to outcrossing. Our team has previously described the theoretical consequences of such mating system shifts on polymorphism patterns and developed two statistical inference tools that jointly estimate temporal changes in selfing rates and population sizes. This work aims to explore to what extent genome-wide empirical data of selfing plants agree with the theoretical predictions of these models and determine whether they allow accurate and robust parameter estimation in natural populations. Our preliminary findings on the observed sequence diversity along the chromosomes of *Arabidopsis thaliana* illustrate the need to disentangle the possible confounding effect of other evolutionary forces on interpreting genome-wide variation patterns. Pericentromeric regions in particular demonstrate elevated levels of nucleotide diversity which could interfere with our inference methods. This indicates that a transition to selfing alone can not possibly account for the observed sequence diversity of those regions and highlights that they should be handled with caution as it is important to distinguish the particular molecular signature of a transition to selfing from other confounding factors. Overall, by studying the consequences of reproductive transitions on genome-wide patterns of variation, we aim to shed some light on the evolution of mating systems.

Keywords: Breeding systems, diversity, *Arabidopsis thaliana*

Under pressure: A case study of batoid species distribution across the North Aegean Sea

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Elasmobranch stocks are progressively declining over the past decades due to anthropogenic stressors, such as overfishing, habitat degradation, and pollution. The number of threatened elasmobranch species augments steadily, nonetheless more than half of the recorded landings in the Mediterranean Sea belong to threatened species. Despite the need of attention, our knowledge on this group is still limited in species level, since catches and landings are being recorded in aggregated categories in most Mediterranean countries. In this study, batoid geographical and bathymetric distribution on species level is examined, overcoming the challenge of scarce records and species rarity. We attempted modeling the occurrence and abundance of batoid records from the North Aegean Sea, Greece collected by the MEDITS samplings from 2018 to 2021. We used two modeling approaches: a) Random Forests (machine learning) for occurrence and Generalized Additive Models for abundance. In total, our sample included 873 specimens, which belonged to 11 species. Overall, abundance models produced wider distribution projections than occurrence, which sometimes failed to predict occurrence on actual sites of specimen capture. Nevertheless, the abundance was more prone to overfitting for species with scarce records. Most species inhabited coastal areas and depths up to 300 m, where fishing pressure is elevated. Our findings increase the knowledge on such understudied and vulnerable batoids of the North Aegean Sea and could contribute to the sustainable management planning of stocks in the area.

Keywords: Elasmobrancii, MEDITS, GSA22, skates, rays, species distribution models

Estimating bat colony size using infrared thermography

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The global decline of bats due to habitat loss and fragmentation, as well as accelerated climate change, demands more widespread monitoring of populations for conservation and management. Current censusing methods for bat colony size estimates are based on capture, passive acoustics, sight counts or optical-mechanical count methods. Infrared thermography (IRT), a fast-growing non-contact and non-invasive technique, offers considerable promise for censusing bats at colonies that range from a few hundred to millions of individuals. In this work, we estimated the size of a bat colony comprising four different species (*Rhinolophus euryale, Rhinolophus ferrumequinum, Rhinolophus blasii, Myotis capaccini*), which winter and breed in the tunnel area of the Pithari reservoir in western Lesvos, Greece, by using IRT. We developed thermal indices by extracting and analysing bats' thermal signatures using the ArcGIS image classification toolset, while statistically significant spatial clusters were assessed using local spatial autocorrelation statistics. We used the Getis-Ord Gi* statistic to identify bat hotspots and the Anselin Local Moran's I to estimate statistically significant spatial clusters. Our results show that IRT accurately counted almost 2000 overwintering bats inside the tunnel. Significant clusters with high (hotspots) and low (coldspots) temperatures, as calculated by the Getis-Ord Gi* tool, were observed. The cluster and outlier analysis revealed the areas where the bats were distributed inside the tunnel, ultimately producing a complete census of the colony. IRT provided promising results in detecting and counting bats and could be used as a monitoring tool for the assessment of their colonies.

Keywords: Chiroptera, thermal imaging, spatial statistics

Estimating Stress-Induced Hyperthermia in wild-caught mammals: a pilot study with domestic dogs using physiological and behavioural traits during a typical clinical examination

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The measurement of the maximum temperature of the eye area of a mammal (T_{eye}) can be used as a proxy to estimate Stress-Induced Hyperthermia (SIH) and can be detected via non-invasive methods, such as infrared thermography. The potential benefits from non-invasive monitoring of stress, through thermographic assessment of SIH, are significant, especially for use in the field or in captive wild mammals which are not amenable to handling. In this pilot study, we investigated the effect of a typical clinical examination on 35 domestic dogs (*Canis familiaris*) by using minimally invasive and non-invasive diagnostics as well as their personality traits. During a standardized veterinary examination, we recorded body temperature (BT) with an electronic rectal thermometer, T_{eye} with an infrared camera, heart rate (HR) with a conventional stethoscope, and respiration rate (RR) by counting chest wall movements. To assess personality traits of each test animal we focused on the five-factor personality taxonomy provided by a validated dog personality questionnaire. Our results show (a) a significantly high positive correlation between all the physiological traits related to stress, (b) a statistically significant increase in T_{eye} during the examination phase compared with both pre-examination and post-examination phases, and (c) personality traits are significant predictors of SIH. These findings may contribute to developing protocols for non-invasive monitoring of SIH in wild-caught mammals in the field as well as in captivity, enhancing other analytical techniques.

Keywords: Infrared thermography, rectal temperature, heart rate, respiration rate, eye temperature, personality traits

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