

14th PROCEEDINGS of the ICZEGAR



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Zoogeography and
Ecology of
Greece and
Adjacent
Regions



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Hellenic Zoological Society (<http://www.zoologiki.gr/en>)



School of Biology, Aristotle University of Thessaloniki, Greece

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Prologue

The 14th International Congress on the Zoogeography and Ecology of Greece and Adjacent Regions (ICZEGAR) is taking place in Thessaloniki, Greece, in 27-30 June 2019. The ICZEGAR is returning to Thessaloniki after 17 years, carrying a long and successful tradition of 42 years. This experience has demonstrated that ICZEGAR is an important crossroad for scientific contact, information exchange, exploration of new ideas, and cooperation building among scientists working on a wide range of subjects on the animal diversity of the eastern Mediterranean region and beyond. In this way, the 14th ICZEGAR aims to present the most recent work related to the systematics, phylogeny, biogeography, ecology, evolution, and conservation of animal species at a biodiversity hotspot.

In addition to the four abstracts submitted by the invited speakers, a total of 177 abstracts were submitted from which 82 were accepted as oral presentations and 95 as posters. Oral presentations were grouped in 14 sessions that are outlined in the programme along with the round tables and discussions on hot issues of biogeography and ecology of Greece and adjacent regions. Almost 500 authors from 33 countries across the globe submitted their work; all continents, except Antarctica, are represented. The majority of abstracts were submitted from Greece followed by Turkey, Algeria, Czech Republic and Republic of North Macedonia. Most animal taxa, from marine invertebrates to land vertebrates, are represented in these works, all contributing to the understanding of the patterns and processes that shaped the richly diverse fauna of the region.

The 14th ICZEGAR will be hosted at the conference centre of Aristotle University's Research Dissemination Center (KEDEA Building, Tritis Septemvriou Str., Aristotle University Campus, Thessaloniki, Greece), also known as the *Red Building*, which was granted by the Research Committee of Aristotle University of Thessaloniki.

On behalf of the Organizing Committee

Prof. Dionisios Youlatos
School of Biology
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The organizers would like to thank the Research Committee, Aristotle University of Thessaloniki for granting the *auditoria* and the *foyer* of the KEDEA Building.



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KEYNOTE

Understanding the dynamics of mammal biodiversity loss

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If habitats contract or get fragmented, these reduced habitats cannot continue to support the same biodiversity as they did before, so they must lose species. While some species will be lost immediately, others can persist for a long time before going extinct. Indeed, areas recently protected may continue to lose species long after habitat loss has stopped. So, just because we don't observe extinctions right away does not mean that everything is going to be OK. This phenomenon, often called "extinction debt", also has implications for how ecosystems respond to climate change and to ecological invasions. A major scientific challenge is to understand the dynamics of this effect: how long before the extinctions are complete and which parameters drive it? Answering these depends to a large extent not only on having good empirical results but also on having a sound theoretical model of the community. I will be reviewing our current state of knowledge in this area and what analyses of case studies in mammals have revealed. I will also discuss how such theoretical results can be used to improved design of protected areas.

INVITED

Risk analysis tools for assessing the potential risks posed by non-native species in the eastern Mediterranean region

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The risk-based identification and assessment of non-native species (NNS) for their potential invasiveness is an essential process for implementing NNS legislation and regulatory controls and thus avoid or mitigate the adverse impacts of invasive NNS. Derived from the hazard assessment protocols developed for the nuclear industry, NNS risk analysis schemes are of various forms, both qualitative and quantitative, but all rely upon, as a first step, the identification of NNS that are likely to become invasive. To facilitate this process for aquatic species, an electronic decision-support tool was developed, the Aquatic Species Invasiveness Screening Kit (AS-ISK), to be compliant with the 'minimum requirements' for use with the new EU Regulation on invasive alien species of EU concern and therefore includes questions to assess the potential risks and impacts under both current and predicted future climate conditions. This facilitates the ranking of species by their likelihood of being invasive in the risk assessment (RA) area concerned. To assess AS-ISK's applicability across broad taxonomic, geographic and climatic ranges, a global trial was undertaken by assessors from various countries around the world to risk screen a wide range of aquatic NNS for their potential invasiveness across a variety of RA areas that encompass marine, fresh and brackish waters. Many of the assessments involved RA areas in the Mediterranean Region, and the results from those risk screenings will be examined in this presentation within their broader, global context.

INVITED

Was the Balkan refugium a speciation trap for mammals?

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For many years biogeographers, taxonomists, and evolutionary biologists have taken it for granted that the glacial-interglacial cycles over the last 2 million years had a major impact on current European biodiversity. Due to a limitation of suitable habitats during the glacial maxima, temperate species must have endured such periods in geographically restricted refugial areas. When they were isolated in small habitat fragments, many taxa began to diverge but complete speciation had not yet occurred in the majority of them. Refugia for some species, however, were further subdivided within the same major refugium and some of these microrefugial populations remained entrapped for disproportionately protracted periods. As a result, species with extensive geographical ranges may have the oldest phylogenetic lineages by far, constrained to tiny marginal areas which acted as traps for speciation in the past. I will compare the phylogeographic pattern in mammals between the three traditional European refugia, the Iberian, the Italian, and the Balkan Peninsula as the largest and the least isolated among them. Molecular evidence is essential to retrieve phylogenetic lineages, estimate support for their monophyly, and assess the time of divergence. Phylogenetic information, however, usually must be translated into the language of taxonomy, which is more readily acknowledged by those who make use of biodiversity information. This involves a decision for each pair of sister lineages as to whether they are or are not conspecific. Opinions differ as to what is a species, hence species delimitation is a crucial step in making biodiversity information comparable and meaningful.

INVITED

The lizards' fight for lunch - progress and questions

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Ectotherms need less food than endotherms but all carnivores have two problems: Finding the prey and competing for it with other individuals and other species. This subject has many aspects, reflecting the multidimensional subdivision of zoology. The prey can be encountered by searching or by ambushing, yielding differently behaving prey. Prey resources would be divided between predators hunting by day or night. Prey resources can also be divided among individuals and among co-existing species by size differences among the predators, enabling the consumption of differently sized prey. We asked how insectivorous lizards cope with these challenges, heeding also the often low night temperatures. We investigated mainly Gekkonoidea, an ecologically very heterogeneous group, and Lacertidae, a relatively uniform group with often several species cohabiting. We used observing in the field, measuring in the museum, and data from the literature. Species, even within Lacertidae, are either active searchers or ambushers. These two types differ in assorted morphological and biological variables. In some lizards the sexes differ in foraging behavior. But many geckos are in all respects intermediate between the two types. Geckos are relatively flexible concerning their preferred body temperature. But those foraging at low night temperatures may secretly warm in daytime to efficient high temperature. In many lizards, including some geckos, the sexes differ in head size or relative head size. Cohabiting Lacertidae differ in body size. The major open question remains whether the foraging behavior is dichotomous or a gradient with all degrees of activity existing but the extremes emphasized.

Length-weight relationships of 31 fish and invertebrate species in the northern Aegean Sea (Greece)

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The purpose of this study was to determine length-weight relationships (LWR) in 31 fish and invertebrate species collected using gillnets and trammel nets. Length and weight measurements were collected during experimental trials carried out seasonally from April 2016 to February 2017 along the northern Aegean Sea coastline using a wide range of mesh sizes set at three different depth zones. A total of 4358 specimens from 31 species (28 fish species, 2 crustaceans and 1 cephalopod species) representing 21 families were collected. The slope b of the LWR ranged between 2.48 for brown comber (*Serranus hepatus*) and 3.75 for rough ray (*Raja radula*). With the exception of these two species, all other LWR slopes fall within the 2.5 to 3.5 range. The median value of b for the fishes was 3.11 and 50% its values ranged between 3.04 and 3.24. Somatic growth was isometric ($b = 3$) for 14 species, positive allometric ($b > 3$) for 12 species, while only 5 species exhibited negative allometric growth ($b < 3$). This is the first reference on LWR for sand sole (*Pegusa lascaris*) in the Eastern Mediterranean Sea and for snake blenny (*Ophidion barbatum*), common cuttlefish (*Sepia officinalis*) and deep-water rose shrimp (*Parapenaeus longirostris*) in the Greek waters.

Keywords: isometry, allometry, seasonality, gillnets, trammel nets, Aegean Sea

Freshwater phytoplankton in Hammam Boughrara dam (west of Algeria)

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Phytoplankton are vital components of both freshwater and marine aquatic ecosystems. They are the primary producers being at the base of aquatic food chain and are also important biological indicators assessing the water quality. They are chlorophyllian plants that develop in water or in wetlands and constitute an important part of the ecology of aquatic environments. Therefore diversity and ecological studies of phytoplankton population are quite popular. A study on freshwater phytoplankton was carried out at H.Bougrara dam located in west of Algeria. 3 stations were sampled from December 2015 to May 2016. During this study, we have recorded 5 classes: Chlorophyceae, Bacillariophyceae, Cyanophyceae, Cryptophyceae and Euglenophyceae. The class of Chlorophyceae is the most dominant with 40,03% followed by the Cryptophyceae with 23,1%, the other classes have low percentages. The species of this class proliferates in the eutrophic environment which is the case of H. bougrara dam.

Keywords: freshwater phytoplankton, Chlorophyceae, H.Bougrara Dam

Preliminary results on the distribution extension of five data-limited fish species in the eastern Mediterranean Sea

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The biodiversity of the Mediterranean Sea is rapidly changing due to anthropogenic activity and the recent increase of sea water temperature. Citizen science is escalating as an important contributor for the inventory of rare and non-native species. In this study we present five new records of rare native fish species from the eastern Mediterranean Sea: *Alectis alexandrina* (Geoffroy Saint-Hilaire, 1817), *Ranzania laevis* (Pennant, 1776), *Dalatias licha* (Bonnaterre, 1788), *Lophotus lacepede* (Giorna, 1809) and *Sudis hyalina* (Rafinesque, 1810). All records were collected by a participatory process involving fishermen and validated by associated taxonomic experts of the citizen science programme "Is it Alien to you? Share it!!!". In total, 21 new occurrences were recorded, along with morphometric and capture data. This study fills an important knowledge gap for the distribution of the reported species and signifies the important role of citizen participation as a contributor to extended knowledge on marine biodiversity.

Keywords: Alexandria pompano, Slender sunfish, Kitefin shark, Crested oarfish, *Sudis hyalina*, Rare Records

Occurrences and illegal trade of the critically endangered spiny butterfly ray in Greece

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The spiny butterfly ray, *Gymnura altavela* (Linnaeus, 1758), is a species of ray, native to the Atlantic Ocean (including the Mediterranean), exhibiting a patchy distribution in tropical and subtropical areas. The Mediterranean population has been listed as Critically endangered in the latest IUCN Assessment while in the Greek Red Book is not evaluated due to lack of data. Accordingly, to its poor conservation status, the species is included in the Annex II of the Barcelona Convention and is currently protected via the Recommendation GFCM/42/2018/2 (amending GFCM/36/2012/3). Hereby, we present records of the species in the Greek waters provided by the citizen science project M.E.C.O. (Mediterranean Elasmobranchs Citizen Observations). We complemented our data with observations of landed individuals observed in auction markets of North Greece. Through M.E.C.O., citizens report to iSea observations of sharks and rays from the Greek waters. All observations associated with pictures are inserted in the database and a taxonomic expert identifies the species to the lowest taxonomic level possible. Moreover, researchers from iSea visit in a monthly basis the ports of North Greece, namely Alexandroupoli, Kavala, Michaniona and Volos, collecting species-specific data on the elasmobranch landings. We collected 10 citizen science occurrences of the species from the Aegean Sea and 4 observations from the auction markets of North Greece. About 80% of the occurrences (n=8) were reported from divers and the rest from recreational fishers (n=2). Combined with the existing bibliography this data can outline potentially important areas for the species population in the Aegean Sea.

Keywords: elasmobranchs, citizen science, distribution, batoid

Species on the brink of extinction: an integrated approach

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Earth has entered the Anthropocene, a human-dominated era severely challenging global ecosystem health. Shifts in biotic composition and ecological linkage disruption have formed a historically novel adaptive matrix, which likely imposes an ongoing mass extinction phenomenon. Endemic species suffering from habitat loss and fragmented populations are most prone, since - by definition - they exhibit narrower geographical ranges and environmental niches. Most conservation studies focus only on the extent and quality of the species' habitat. However, multidisciplinary schemes that combine genetic data with species distribution modeling qualify as an extended prism through which current extinction risk assessments of threatened and highly endangered taxa can be enhanced. Herein, for the first time, we set out to combine ecological niche modeling and population genetic approaches on the Critically Endangered *Albinaria retusa* (Gastropoda: Clausiliidae) - a single-island endemic land snail occurring exclusively on the islet of Dia - northeast of Crete, in order to obtain an insight on the species genetic potential and its ability to cope with the anticipated stressful climatic changes. The current level of genetic diversity is compared to that of thriving *Albinaria* species distributed in Dia, with future projections in its geographical distribution showing that the study species will likely become extinct under any climate model and scenario in the forthcoming decades. The framework of this study serves as a guideline for all the Critically Endangered Greek endemic taxa and constitutes the first synthetic assessment of the most prone to extinction species in the EU and the globe.

Keywords: genetic diversity, IUCN assessment, Species Distribution Modelling

Within-island geological evolution shapes the genetic diversity of
Armadillo officinalis (Isopoda: Oniscidea) in Cyprus

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Islands are nature's evolutionary laboratories, shedding light on the factors shaping species' distribution and diversity. However, the patterns of island genetic diversity are still understudied in comparison with their mainland counterparts. For this purpose, *Armadillo officinalis* (Isopoda: Oniscidea) is used as a model organism to explore the effects of past geological events on the patterns of genetic diversity in Cyprus. Mitochondrial COI, 16S rRNA and CytB molecular markers are used to assess the phylogeography and population clustering of *Armadillo officinalis* in the island. Moreover, via a Species Distribution Modeling framework, the spatial structure and distribution of *Armadillo officinalis*' genetic clusters is investigated. Results indicate a remarkable population clustering in the island, while highlighting the influence of the geological evolution of Cyprus on the species' present genetic diversity. The case study of *Armadillo officinalis* in Cyprus emphasizes the effects of island paleogeography on the patterns of genetic diversity and demonstrates the past geological events ruling Cypriot biodiversity.

Keywords: island biodiversity, phylogeography, Species Distribution Modelling, *Armadillo officinalis*

Diversity of *Diaphanosoma* in 7 Greek lakes based on morphological and molecular assessments

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The genus *Diaphanosoma* (Cladocera) is a typical case of misconceptions about its world-wide diversity, with the characteristic example of the wrong use of the species's name "*D. brachyurum*" in identifying other species of the same genus; as in the case of Greek lakes where *D. brachyurum* has been historically recorded in almost every lake. The aim of the present study was the morphological and genetic identification of the *Diaphanosoma* species in seven Greek lakes, L. Doirani, L. Kastorias, L. Kerkini, L. Mikri Prespa, L. Paralimni, L. Vegoritis and L. Volvi. For the morphological analyses, 327 *Diaphanosoma* individuals were examined based on their main taxonomic features. As regards genetic analyses, the mtCOI gene was sequenced in 57 individuals and in total, 65 sequences (8 additional GenBank® sequences) were aligned and a phylogenetic tree was constructed. Combining the morphological and genetic results, we deduce that all sequences of L. Doirani, L. Kastorias, L. Vegoritis and L. Volvi correspond to *D. mongolianum*, all sequences of L. Mikri Prespa to *D. macedonicum*, all sequences of L. Kerkini to *D. orghidani* and sequences of L. Paralimni to *D. mongolianum* and *D. orghidani*. In two of the studied lakes an intermediate form of *D. macedonicum* and *D. mongolianum* was morphologically identified that needs to be further molecularly identified.

Keyword: zooplankton, morphology, mtDNA sequencing, mtCOI gene, phylogeny

Fish taxonomic and trait diversity patterns in perennial and intermittent rivers

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Unveiling the processes shaping biodiversity and community assembly along environmental gradients in intermittent rivers attracts growing attention in freshwater macroecology. So far, few studies have explored differences in fish community patterns between intermittent and perennial rivers. In the current study, we compared fish species richness, abundances and trait diversity in perennial and intermittent sites and explored the role of environmental filtering in shaping fish communities. A three year quantitative electrofishing survey (2012-2015) was undertaken to compare species richness (147 sampling sites) and species abundances (130 sampling sites) between perennial and intermittent sites. ANOVA was applied for species richness and abundances comparisons, Model selection and averaging for the identification of the environmental factors driving species richness patterns and PERMANOVA for determining associations between environmental variables and fish assemblages. To identify associations between species traits (Feeding type, Habitat type, Feeding Habitat and Reproductive habitat) and environmental variables, fourth-corner analysis was applied. Fish species richness and abundances were both significantly lower in intermittent sites. Species richness patterns in perennial sites were shaped by upstream catchment area, elevation, depth and temperature, while in intermittent rivers, by upstream catchment area and depth. Abundance and species composition in perennial sites were determined by upstream catchment area, depth, conductivity, elevation and temperature, while in intermittent sites by elevation and pH. Trait-environment relationship analysis provides evidence that environmental filtering shapes fish communities in perennial rivers, whereas, in intermittent rivers, fish communities appear to be shaped randomly.

Keywords: species richness, species abundances, functional diversity, river intermittency

Oithona davisae Ferrari & Orsi, 1984: A newly recorded species in the
North Aegean Sea

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Oithona davisae is a recently described cyclopoid copepod, firstly reported from the coastal waters of Japan as *O. brevicornis* f. *minor*. It was first described from Sacramento-Saint Joaquin estuary, California, suspected to have arrived there by ship ballast water from Asia. Progressively it has been introduced in many sites around the globe and it is known as an invasive species in the north-western and central Mediterranean, the Black Sea and the Sea of Marmara. Nevertheless, no records of *O. davisae* exist in the Aegean Sea and the aim of this study is to verify the presence of *O. davisae* in the North Aegean Sea. Zooplankton samples were collected from four stations along Thermaikos Gulf during the autumn of 2018. Adult *O. davisae* individuals were isolated and identified under a microscope based on morphological features of the rostrum, mandible, maxillule and urosome as well as the number of exopod spines in swimming legs. The presence of *O. davisae* was confirmed, based mainly on the presence of a long setae in the first inner lobe of the maxillule. Despite the fact that *O. davisae* has been successfully imported in a wide range of environments, due to its high tolerance in temperature and salinity variations, its distribution range can be underestimated, as it has frequently been confused with other *Oithona* species; most commonly with *O. brevicornis*. The results of this study indicate that *O. davisae* is present in the North Aegean as well as the importance of proper species identification concerning the genus *Oithona*.

Keywords: zooplankton, copepod, distribution, invasive species, Mediterranean, coastal area

Shape morph-specific life strategy in an intertidal marine shrimp

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Studies on shape/color polymorphisms in caridean shrimps show significant results on their evolutionary adaptations. *Hippolyte sapphica* is an endemic intertidal shrimp of the Central/Eastern Mediterranean, with an unusual dimorphism: morph-A bears a long dentate rostrum and morph-B a short, juvenile-like one. Recently, the two morphs confirmed to be conspecific, while offspring and morphological studies showed significant micro-evolutionary adaptations, which balance the disadvantage of the “rostral loss”. The present study aims at investigating possible mechanisms of morph-specific adaptation and their significance for population dynamics and reproduction of *H. sapphica* mixed (morph-A and B) and unmixed (only morph-A) populations. Specimens were sampled bimonthly by means of a net (frame: 30X35cm, mesh size: 200µm), got photographed, weighed and subjected to morphometric analysis using the image processing program ZEN 2012. Brood chambers were studied for fecundity evaluation. Pearson Chi-square, Mantel-Haenszel, Breslow-Day, Kruskal-Wallis tests, and ANCOVA were used, depending on the question nature. Our results indicate that a) the sex transition does not occur, as in other species of the genus, and the species is gonochoristic, b) there is a temporal advantage to morph-A individuals, by maturing and giving progenies earlier, c) both mixed and unmixed populations showed a significant dominance of males during the cold season and female dominance in the hot season, d) unmixed population demonstrated generally bigger carapace sizes, while the median size for maturity was found significantly smaller in the mixed population, e) slight but significant differences of some traits related to buoyancy were observed between the two forms in females.

Keywords: Hippolytidae, morphotypes, population dynamics, microevolution, life strategy, gonochoristic

The relative importance of biotic and abiotic factors as drivers of alien bird species richness patterns

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Biological invasions are a significant environmental concern with dire economic consequences. Understanding the ecological mechanisms behind biological invasions remains a focus of conservation biology. Several hypotheses highlight distinct environmental characteristics as the primary factors affecting the establishment and spread of alien species. Here, we approached these hypotheses by examining the spatio-temporal relationship between alien bird species richness and the biotic and abiotic characteristics of three US states (New York, Pennsylvania and Massachusetts), each state has been surveyed for two time periods (twenty years apart). We calculated native species richness and functional and phylogenetic diversity metrics. Using climate and land cover datasets, we extracted mean temperature, precipitation and land cover types, richness and diversity for each atlas cell for the different time periods. We used GLS models to account for spatial autocorrelation. We generated one model using the taxonomic, functional and phylogenetic metrics as predictors, one using the climatic metrics as predictors and one using land cover metrics as predictors for alien species richness. We found that the biotic characteristics were more strongly correlated with alien species richness, whereas climate and land cover characteristics exhibited a considerably weaker correlation with alien species richness. Our results show that alien species richness is consistently higher in areas with high native species diversity (taxonomic, functional and phylogenetic). Climate and land cover characteristics' weak correlations with alien species richness indicate that the abiotic characteristics play a less important role than previously assumed.

This research is co-financed by Greece and the European Union in the context of the project "Examination of multiple hypotheses on the ecological mechanisms behind alien species invasions" (MIS 5004812).

Keywords: alien species, birds, richness, invasions, climate

Population size and structure of the rock-dwelling land snail *Albinaria arcadica* (Boettger, 1878) (Pulmonata, Clausiliidae), along the altitudinal gradient of Mt. Chelmos

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Life history characteristics of many organisms are affected and often evolve in response to environmental conditions. Different conditions prevailing at different altitudes can affect a range of life history characteristics such as population size, birth rate, and life cycle. *Albinaria arcadica* is a rock-dwelling land snail endemic to Greece, occurring in Peloponnese and Central Greece. It is active from mid-October to late-April and aestivates during the rest of the year. In this study we attempted to estimate, i) the size and ii) population age structure of its populations along the altitudinal gradient on Mt. Chelmos (Peloponnese). We used sequential (November, January, March and May) mark-recapture data and shell-size measurements from 5 stations at different altitudes (38m, 137m, 668m, 907m, and 1478m). We examined whether population size and structure of *Albinaria arcadica* are associated with the differential environmental conditions along that altitudinal gradient.

Keywords: population size, age structure, altitude, mark-recapture

Recording of the herpetofauna of Attica

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Greece hosts the richest herpetofauna of Europe, in both absolute and relative numbers. In total, the Greek herpetofauna comprises 69 reptile species (12 of them endemic) and 26 amphibians (3 endemic). However, our knowledge on the distribution of Greek reptiles and amphibians remains rather scrappy. Though the insular range has been well studied, the mainland one is still underexplored. Attica represents one of these «black spots» in the mainland. In this study, we aimed to cover this gap and record the herpetofauna of Attica. In particular, we focused on the mountains, the Natura sites, the wetlands and the National parks. Visual Encounter Standard (VES) Technique, which is rated as the most appropriate for time-limited research, was used. VES is carried out by investigator(s) who traverses a focal area and records the identities of taxa as they are encountered. Initially, Attica was divided into a grid of 53 squares (10x10 km) in order to have at least two records in each sampling square. Field work starts at 10.00 am and lasts till 15.00 pm. So far, we have visited 21 sites where we recorded 19 species, which included 4 lizards, 2 turtles, 2 tortoises, 8 snakes, 2 frogs and 1 limbless lizard.

Keywords: reptiles, Greece, amphibians, Visual Encounter Standard Technique, Attica

Fish farming test in the Koudiet Lemdouar dam lake (Algeria)

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The Koudiet Lemdouar dam (Algeria) is located in the wilaya of Batna (Algeria) at an altitude of 979 m, a longitude of 06° 00'31" and a latitude of 35°24'31" N. It has been exploited in 2002 and has a total capacity of 69.10 million cubic metres. It is used for drinking water supply, irrigation of agricultural land and industry in the region, it is also used for tourism and for inland fishery. It is located in a semi-arid bioclimatic floor with a fresh winter. For physico-chemistry, samples were taken from the water's surface using a 1.5-litre bottle. Fish were caught in a passive way with 3 nets of different meshes. The morphometric and scalimetric methods have allowed us to follow the study of these fish. The physico-chemical water's quality in the dam Koudiet Lemdouar is good for fish farming. Silver carp (*Hypophthalmichthys molitrix*), bighead carp (*Hypophthalmichthys nobilis*), common carp (*Cyprinus carpio*), common bleak (*Alburnus alburnus*) and algerian barb (*Barbus callensis*) are caught daily by a professional fisherman. Only the Algerian barb fish is a native species, the other fish have been introduced since 2003 where 20 common carp broodstock were introduced. Fishing (all species combined) has amounted to 284613 kg over the last 10 years.

Keywords: Fish farming, dam, Algeria, fish stock.

Passive acoustic monitoring: development and assessment of automated detection algorithms

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Biomonitoring should inform protected area managers not only about changes in the state of species and their habitat over time, but also on the levels of threats they face. Only then can the drivers of change be determined, permitting the evaluation and adaptation – as required – of existing conservation strategies. Passive acoustic monitoring (PAM) is gaining global recognition as a tool that can reliably, affordably and transparently provide information on both the status of species and human activities that could impact wildlife. A prerequisite for using PAM across large spatiotemporal scales is that the monitored species/activities have sound signatures that can be efficiently detected using automated detection algorithms. As part of a pilot project pairing PAM with other novel biomonitoring methods in Greece's Rodopi Mountains, such automated detection algorithms are being developed (e.g. for wolf/jackal howling, gunshots, chainsaws). We present the algorithm development process, assess their performance, and discuss steps that could increase PAM's adoption in the broader eastern Mediterranean region.

Keywords: acoustic sensors, law enforcement monitoring, logging, hunting, howling

When a pest is not a pest: the story of Giant Pine Scale home and away

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The giant pine scale (GPS) *Marchalina hellenica* (Hemiptera, Margarodidae) is endemic in Greece and Turkey, where it is not considered a major pest of *Pinus* spp. but rather an important honey dew source for honey production, since it rarely causes tree mortality. Natural enemies may reduce the impact of *M. hellenica* within its native range, in particular the predatory fly *Neoleucopis kartliana* (Hymenoptera, Cynipidae). For the first time (in 2014), GPS was detected in Melbourne and Adelaide (Australia) on ornamental pines and is expected to cause significant damage mainly to *Pinus radiata* plantations since there are currently no effective control methods. The aim of this study was to investigate the natural enemy complex of GPS in Greece and identify the most promising biological control agent to be used Australia. Egg-masses of GPS were collected from different areas of Northern Greece and examined in the laboratory to identify potential natural enemies and assess to quantify the abundance of *N. kartliana*. The predatory fly *N. kartliana* has been recorded at every GPS population studied in Northern Greece, with a predation rate around 50%. In addition, several other arthropod families were also identified preying and parasitizing *M. hellenica* (Coleoptera, Lepidoptera, Neuroptera and Thysanoptera). Based on this preliminary survey, it is apparent that *N. kartliana* is the biological agent with the most potential to limit the negative impact of GPS in Australia.

Keywords: parasite, arthropod, fly, predation

Resolving the phylogeny of *Pygopleurus* species in the Aegean Sea: a first and exciting glimpse

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The genus *Pygopleurus* includes some of the most important primary pollinators of the “red anemone guild” flowers. Despite their abundance and the overall significance of this genus, its phylogeny has only rarely been studied in depth. The existing complexity of apparent morphological characters vis-à-vis the frequent synonymization of different species, render this endeavor even more challenging. The aim of this preliminary investigation is to shed light into the phylogeny of *Pygopleurus* species that occur in the islands of the Aegean Sea. We screened 167 individuals from 10 islands of the Aegean Sea that belong to five *Pygopleurus* species (*P. foina*, *P. karelli*, *P. laubaumei*, *P. medius*, and *P. vulpes*) using a locus of the mitochondrial Cytochrome Oxidase One gene. All five *Pygopleurus* species were successfully recovered and separated using this locus, resolving with accuracy the phylogenetic relationship among them. At intraspecific level, some very interesting patterns were also revealed; individuals of *P. laubaumei* from Lesbos are distinctly different from those from Chios, with the latter exhibiting an additional split among individuals from Chios alone. *P. foina* shows an even more intriguing pattern, with individuals from every island clustering together and separating clearly from one another. To verify these preliminary yet exciting results, additional *Pygopleurus* samples have been collected in 2019 and will soon be integrated into the dataset.

Keywords: synonymization, morphological characters, pollinator, Aegean Sea

Water usage patterns and social interactions by Eleonora's falcon (*Falco eleonora* Gén , 1839) during bathing and drinking: the first systematic study at a natural pond, on the island of Antikythira (Greece)

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Eleonora's falcons breed colonially on dry rocky islands scattered in the Mediterranean Sea and the Atlantic Ocean during the hot summer period. While at their breeding grounds Eleonora's falcons have been observed drinking and/or bathing at ponds, yet systematic studies are currently lacking. In spring (pre-breeding period) and autumn (breeding) 2018 we monitored the drinking and bathing activity of Eleonora's falcons at a natural pond located on Antikythira island (Greece), which hosts one of the largest colonies worldwide. The data analyzed in this study furnished useful information on the species' temporal pattern of water usage, revealing seasonal, sex- and morph-related variability, in accordance with the species pre-breeding and breeding biology, hunting activity and thermoregulatory needs. Temperature seems to play an important role on the species' attendance to the pond, either exerting an indirect effect through insect activity, which is the main food source of Eleonora's falcon during the pre-breeding period, or directly inducing heat stress on Eleonora's falcons during the breeding period. Social interactions, as well as disturbance by goats, also affect the observed attendance pattern of the species. Consequently, our study not only constitutes the first behavioral study on water usage by a colonial falcon, but also serves as a benchmark for future work on the Eleonora's falcon biology at its breeding grounds, highlighting less-studied drivers, pressures and threats.

Keywords: drinking, bathing, thermoregulation, social behavior, colonial falcon

Polychaetes from Thermaikos Gulf sediments under a routine monitoring programme

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Thermaikos Gulf (north Aegean Sea) has been thoroughly studied over the last few years under a routine monitoring program, funded by Thessaloniki Water Supply & Sewerage Company, covering three stations of interest (S1: Chalastra 25m depth, S2: White Tower 13-15m, S3: Angelochori, 25-30m) to assess its environmental quality. Sediment samples were seasonally collected with a standard VanVeen grab during the years 2017-2018 to analyze benthic fauna, sediment composition and organic content. Benthic polychaetes were sorted out, as being the most dominant taxon, and identified up to species level. Overall, 18 samples were analyzed, revealing the presence of 2,323 specimens of polychaeta (38% of benthic fauna) identified to 274 species (91 Errantia and 183 Sedentaria). Sedentarians, which inhabit various sediment types, dominated in both diversity and abundance over the time period of the study (2017: 57% and 2018: 71%); they were the most abundant group in all three studied stations. S1 showed the lowest diversity and abundance probably due to its proximity with the estuarine system of Axios River. Sediment composition and organic load were similar in S1 and S3 (mud), whereas organic content was increased in the sandy mud of the shallower S2, located in the inner part of the Gulf. Overall, the three most dominant species were *Magelona mirabilis*, *Sternaspis scutata* and *Heteromastus filiformis*, which are considered as tolerant to organic pollution. The same species have been also previously reported in similar researches for the area. The environmental quality of the area was, overall, assessed as good to moderate.

Keywords: north Aegean Sea, Annelida, benthos, soft substrata

Entomofauna biodiversity of a citrus orchard in Meftah (Algiers)

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Orchards and minimally processed with surrounding hedges form a significant source of biodiversity. These orchards are an entire ecosystem, home to a rich insect fauna associated with the presence of a large diversity of plant species. The values of the richness and diversity rise when the intensity of the chemical protection is reduced emphasizing the importance of such orchard in the conservation of biodiversity. To show the interest hedges fauna perspective, we conducted a study in an orange grove located Meftah surrounded by hedges and windbreaks consist of several plant species. With the sweep net there were the invertebrate fauna of the herbaceous and after a year of inventory was collected consists of a 2177 individuals distributed among 156 species grouped into five classes and 15 orders fauna. Hymenoptera and Diptera are in first place with 34 species (AR% = 19.3%), followed by Coleoptera with 27 species (AR% = 15.3%), Homoptera dominate in the workforce with 735 individuals (AR% = 34.1%). The Shannon-Weaver index calculated reflects a great diversity of population sampled equal to 5.2 bits. The equitability is 0.7, showing a strong trend of balance between the numbers of species present.

Keywords: biodiversity, a citrus orchard, reaps net, hedges, Meftah, Algiers.

Some biological aspects of *Belone svetovidovi* Collette and Parin, 1970
from the northern Aegean Sea, Turkey

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Belone svetovidovi was known since 1999 from the Aegean coasts of Turkey. The aim of this study is to provide the first knowledge about the age structure, longevity, growth and reproduction of this poorly known by-catch species from the northern Aegean Sea. 417 specimens were collected during year of 2005 at monthly basis by using commercial purse seine boats from the Candarli Bay. All specimens sexed, measured, weighed and some meristic characters were counted for species identification. Total length and weight of the specimens ranged from 15.80–47.30 cm and 4.21–127.49 g, respectively. 12 specimens couldn't be aged and 42 couldn't be sexed. Ages ranged between 0 and 4 years and age group III was dominant. The female:male ratio was 1:0.95. The highest growth rates found between age groups 0 and I. Length group 33 cm was dominant. The von Bertalanffy growth parameters and growth performance index (ϕ') were calculated ($L_{\infty}=54.641$, $k=0.281$, $t_0=1.737$ and $\phi'=2.923$). All individuals showed positive allometric growth, except unsexed specimens. Average condition factor values of females were higher than males. Females reached 50% sexual maturity at age 2.13 and at 33.72 cm total length. According to the gonadosomatic index values the reproduction occurs from February to April. Oocyte numbers varied from 882 to 10618. The relationship between total length (TL) and fecundity (F) is described by the power equation: $F=2E-06*TL^{5.8276}$. *B. svetovidovi* showed the highest growth rates within the first ages, but males were faster than those of females but, females have higher L_{∞} values.

Keywords: Svetovidov's garpike, age, growth, condition factor, reproduction, Candarli Bay.

Preliminary study on some biological aspects of *Lampanyctus crocodilus*
(Pisces: Myctophidae) from the southern Aegean Sea, Turkey

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Lampanyctus crocodilus is caught by-catch in commercial trawling targeting deep-water shrimps and there is no available scientific information on the biology of the species from the Aegean Sea. This preliminary study represents the first information on the age, growth and the condition factor of *L. crocodilus* for the Mediterranean deep-sea environment. 424 *L. crocodilus* were obtained from bottom-trawl surveys from off the Sığacık Bay) between February and November 2007. All specimens were sexed, measured, weighed and aged under stereozoom microscope with reflected light. The male to female sex ratio was 0.88:1. In the present study, age was ranged between 0-5 years, although maximum age was reported 8 years in Ionian Sea for the species. Standard length ranged from 4.7-16.6 cm. Parameters of the von Bertalanffy growth curves were $L_{\infty}=27.48$ cm, $k=0.128$ year⁻¹, $t_0=-1.976$ years, the growth performance index was $\phi'=1.99$. According to the von Bertalanffy growth curves, males (27.77 cm) have larger asymptotic length size than females (24.25 cm). The weight-length relationship of the all individuals, $W=0.0076SL^{3.098}$; $r^2=0.98$, described a positive allometric growth. Average K value was estimated $K=0.966$ (± 0.118). Although it's not commercially important, its ecological importance is evident by its presence in the diets of several predators (*Micromesistius potassou*, *Gadiculus argenteus*, *Galeus melastomus* and *Etmopterus spinax*). So, *L. crocodilus* is the one of the most important prey of the predator fishes which were share the same habitat and has an important role in to the trophic level of the deep-sea environment in the area.

Keywords: Jewel lanternfish, age and growth, condition factor, Sığacık Bay

Molecular systematics of the genus *Metafruticicola* von Ihering 1892
(Gastropoda, Hygromiidae)

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The land snails of the genus *Metafruticicola* von Ihering 1892 are distributed in NE Mediterranean from the Aegean islands to Israel. Currently, 24 species are recognized (two polytypic), half of them present in the Aegean region. It is one of the most common land snail genera in the Aegean Archipelago, distributed in the majority of islands and islets and in ecosystems, from seaside to the subalpine zone in the case of Crete. The taxonomy within the genus (subgenera, species, subspecies) is based on the microsculpture of the shell alone and in some cases the anatomy of the genitalia, while no phylogenetic relationships among the species have ever been studied. In this study, nucleotide sequences from two mitochondrial loci (16S rRNA & Cytochrome c Oxidase subunit 1, COI) were used to infer inter-phylogenetic relationships between the majority of the taxa within the genus through Bayesian Inference and Maximum Likelihood approaches using the sister genera *Cyrnotheba* and *Hiltrudia* as outgroups. The phylogenetic analyses showed that *Metafruticicola* is a monophyletic genus and that most of the existing species inside the genus that were examined are also monophyletic, some of them showing greater intraspecific genetic diversity than others. However, the relationships between the species were not resolved, stressing the need for both taxonomic reconsideration and use of more genetic loci to unravel the phylogeny inside the genus. This study was funded by the General Secretariat for Research and Technology (GSRT) & the Hellenic Foundation for Research and Innovation (HFRI).

Keywords: Phylogeny, land snails, Eastern Mediterranean

A camera trapping survey on seasonal habitat use and circadian activity
of brown bears (*Ursus arctos*) versus the human factor in NW Pindos,
Greece

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Camera trapping is widely used to evaluate presence, relative abundance, habitat choice and circadian activity of wildlife species. In the framework of the LIFE15NAT/GR/001108 project, we conducted an intensive survey on a brown bear (*Ursus arctos*) sub-population in NW Greece. The area stretches over 700km² and is characterized by relatively high density of small-sized human settlements, dense deciduous forests and an extensive transportation network. The survey design included (12) IR cameras placed over a 5X5km grid for 5 consecutive months (4 periods between July-December 2017). Site rotation within each cell was performed to maximize probability of detection. Within 1.491 trapping nights, 260 hunter, 268 bear and 3858 human-related events were recorded (total 7.566 events). Multi-model inference and kernel density estimation were used to analyze habitat preferences and diel activity patterns. The relative abundance index of bears was proportional to that of humans and to proximity to streams, while it decreased with hunters' presence. Bears were more nocturnal in cases of intense human presence and when close to settlements, trying to avoid disturbance. During summer, bears selected close proximity to villages due to anthropogenic food availability. Bears showed slight preference for habitat at forest edges (transitional woodland/shrub) and agricultural fields during fall. The human factor seems to play a key role in bears' ecology in Greece, shaping their ecological flexibility. This new information is viable for management decisions which support and reinforce conservation strategies in order to safeguard the future survival of brown bears in Greece.

Keywords: Brown bear, cameras, monitoring, ecology, activity, Greece

A first evaluation of the saproxylic Coleoptera fauna of Crete

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Saproxylic beetles are in the spotlight of wildlife conservation and the first non-taxonomical group assessed in an IUCN Red List. Most of the saproxylic beetles interact with dead or dying wood, acting as an important factor of ecological processes in forest habitats, being also a species-rich group and a significant pool for biodiversity, worldwide. Crete, being the far-most southern territory of Europe, has never been in the focus of any intensive saproxylic study yet and all known data are relying on individual and fragmentary efforts, mostly on the basis of entomologist's particular research interests. With this study, we are summarizing and propose a first version of the red catalogue for the Cretan saproxylic beetles. Scrutinizing the existing bibliography of the last 200 years and taking into consideration several European Red Lists of Saproxylic beetles, as well as identifying over 2.000 specimens deposited in NHMC and after a two years new research with fermented trapping in all major forest biotopes of the island, we've managed to record 296 saproxylic beetle species, divided in 29 families. The most diverse group (87 species) is the family Buprestidae, followed by Cerambycidae (59). In the proposed list, we are also analyzing: 1) trophic categories, 2) the amount of endemism and 3) their conservation status in Europe. Furthermore we present new data about several species of conservation interest and new information about new or alien species to the Cretan fauna, like the recent finding of the East Mediterranean/African *Steraspis squamosa*, in west Crete.

Keywords: conservation, alien species, endangered species, Buprestidae, Cerambycidae.

Distribution of Culicidae larvae (Diptera) according to environmental factors in Oued El Harrach, North-Central Algeria

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Aquatic ecosystems of running water are highly susceptible to anthropogenic discharges and disturbances. The watershed of the Oued El Harrach is characterised by a very important industrial activity, the wastewater from these units is loaded with multiple pollutants, 10 stations were selected from upstream to downstream located between 220 and 15 m of altitude. Faunal analysis consists of inventorate benthic aquatic invertebrates collected from their natural habitat. As these organisms reflect the environmental conditions, they allow to reveal some dysfunctions of the environment. Culicidae are the most dangerous mosquitoes by the number of deaths they cause in the world. Their ability to carry diseases and transmit them to human beings results in thousands of deaths every year. The Faunal inventory of Benthic Macroinvertebrates of Wadi El Harrach is mainly represented by insect larvae. Among these insects, the Culicidae (Diptera) are the most dominant in comparison with other groups. A positive correlation was recorded between the abundance of Culicidae and pollution. Other correlations were significant between Culicidae and mineral elements (Cl^- , SO_4^{2-}), nutrients (NO_3^- , NO_2^- , and PO_4^{3-}), and mineralization. Culicidae are abundant in the downstream part of the stream where the current is low and the organic matter is important. This part of the Oued is severely disturbed by industrial, agricultural and domestic activities. The presence of the Culicidae in this part of the Oued presents a real nuisance for the residents and the diseases transmitted by these mosquitoes can be a real danger to public health.

Keywords: Culicidae, distribution, pollution, Oued, public health.

Study of the quality bacteriological of the waters of the river network of the El Arab Wadi (Wilayates of Khenchela and Biskra) Algeria.

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This work examines the bacteriological quality of the waters of the hydrographic network of the wadi El Arab, it is located in the southern slope of the eastern part of the Saharan Atlas from Algeria, and its watershed covers an area of 1900 km². It pours into the Zribet Wadi before flowing to its outlet of the chott Melhrir after having made a course of 175 km. Across this hydrographic network seven (07) study stations were selected from upstream to downstream. The results obtained from bacteriological analyses in the hydrographic network of the wadi show that all stations that have undergone bacteriological analysis are contaminated. The germs most involved in this contamination of the waters are coliforms and fecal streptococci, with an increasing degree of contamination from upstream to downstream. The stations in the middle section of the Wadi are relatively polluted by fecal contamination agents, the number of faecal coliforms being similar to that of total coliforms. In the downstream we always notice the presence of fecal contamination with high levels of total coliforms. The presence of fecal streptococci is significant in all stations, particularly for the swallows with very high rates, indicating an early contamination of this part. For sulfite-Reductor anaerobes the number of streptococci is clearly low compared to other bacteria in all sampled stations. The analysis of pathogenic bacteria (vibrions and salmonella) is almost nil in all sampled stations. As far as salmonella is concerned, the situation is reassuring because the results have been negative. The results of vibrions are also negative in the upstream part, but in the downstream we have recorded unidentified vibrions.

Keywords: Wadi, water quality, bacteria.

Effects of plastic wastes on fish health

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Plastic wastes can reach oceans via the municipal solid or sewage waste units, rivers and winds. Plastic wastes can stay in the oceans for decades and the degraded smaller particles can act as sponges that absorb toxins. The participation of microplastics into the food-web was previously detected in marine organisms but it's long-term effects are unknown. The aim of this preliminary study is the determination of microplastic presence in the stomach content of horse-mackerel (*Trachurus mediterraneus*) and mullets (*Chelon auratus*) caught in Istanbul Strait (The Bosphorus) and their effects on fish health by using macroscopic, microscopic and histologic methods. Fish samples were examined externally and internally. Stomach content was precipitated in 10% formaldehyde and examined under light microscope. Tissue samples were embedded in paraffin blocks and stained with a modified haematoxylin&eosin method. No clinical symptoms of bacterial or parasitic diseases were observed on fish samples. A polystyrene particle was detected in the digestive tract of a fish sample. Shiny, solid possibly plastic particles were observed in the stomach content of almost all mullet samples where they were relatively less in horse-mackerel samples. Melanomacrophage centers, hyperemia, and necrotic-focci were observed in the spleen, liver and heart tissues of mullets. It is thought that these fish samples of wild populations were exposed to various stressors for a long time. In conclusion, the results of this preliminary study revealed that microplastic particles may affect fish health and as they can include toxins, the microplastic pollution in the oceans should be avoided.

Keywords: Microplastics, stomach content, fish histopathology, pollution

Antiproliferative effect of rosmarinic acid isolated from *Onosma bourgaei* Boiss

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Natural products are important source for drug discovery due to their large variety of biological effects. *Onosma* L. genus consists of 230 species and it is represented by almost 103 species in Turkey flora. *Onosma* species are traditional medicine used as laxative and anthelmintic, with bronchitis, itch, leucoderma, fever, wounds, burns, piles and urinary calculi. *Onosma arenaria* root extract includes naphthalazarin derivatives displayed the cytotoxic effect on human cervix adenocarcinoma cells and leukemia K562 cells. In this study, Aerial part of *Onosma bourgaei* was extracted with hexane and methanol successively. The methanol extract was subjected to column chromatography to isolate the rosmarinic acid. The structure was elucidated by spectroscopic techniques including 1D-, 2D NMR, LC-TOF/MS. Antiproliferative activity of rosmarinic and methanol extract was executed on A549 (Human lung carcinoma) cell lines, cisplatin was used as a standard. Rosmarinic acid revealed the excellent activity on this cell lines. However, metanol extract displayed the moderate activity. The viability was observed for cisplatin, methanol extract and rosmarinic acid as 92%, 94% and 85% respectively at 10 µg/ml concentration. The viability decreased with increased concentration. The viability was detected for cisplatin, methanol extract and rosmarinic acid as 74%, 83% and 26% respectively at 60 µg/ml. These values decreased to 35%, 64% and 7% for cisplatin, methanol extract and rosmarinic acid respectively at 200 µg/ml. As a consequence, *Onosma bourgaei* could be a source of rosmarinic acid, which could be a drug material for human lung carcinoma with extended clinical and in vivo studies.

Keywords: traditional medicine, cytotoxic effect, lung carcinoma

Using life-history traits to predict the invasiveness of non-native freshwater fishes in Europe and the Mediterranean region

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In 2007, Copp & Fox first presented a model, based on the relationship between mean age at maturity and the mean fish length at age 2 years (i.e. juvenile growth), for predicting the invasiveness of introduced populations of the freshwater fish, pumpkinseed (*Lepomis gibbosus*), in Europe. This rare example of biological traits being used in a statistical model to predict invasiveness was tested and further validated in subsequent studies of European pumpkinseed populations. Similar predictive models, based on the Copp & Fox template, were developed using age-at-maturity and juvenile growth data for crucian carp (*Carassius carassius*), a native of continental Europe introduced to England, and a second North American ictalurid catfish in Europe (black bullhead *Ameiurus melas*). This presentation will explore the validation of the Copp & Fox predictive model for pumpkinseed, including examples of its application within a climate-warming context for pumpkinseed. Also examined will be the models for black bullhead and crucian carp, with the potential application of this model considered for predicting the invasiveness potential of other non-native species from North America, such as channel catfish *Ictalurus punctatus*). Most of these species are present in parts of the eastern Mediterranean, so the relevance of these models for predicting non-native species invasiveness in that region will be discussed, as well as data needs for applying this life-history model to small-bodied non-native fishes.

Keywords: introduced, age at maturity, growth, freshwater fishes

Elytral uv, visible and infrared reflectivity and absorbance on mountaintop beetles: the case of *Dendarus* spp. (Coleoptera: Tenebrionidae) of lowland and high elevations of Crete

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Sunlight is often treated in biological studies, in three different ranges, according to their electromagnetic wavelength: ultraviolet, visible and infrared, affecting living organisms differently and causing various morphological, physiological and/or behavioural adaptations. Species often respond to each type of radiation by reflecting it back, absorbing or transmitting it, to different extents. Beetles, having a unique body plan with 70% or more of their surface covered by elytral sheaths, may manage this radiation through different elytral structures (thickness, surface punctuation, tubercles, etc.). Recent morphological & molecular/DNA studies showed that there is a substantial morphological differentiation between lowland and higher elevation populations of the Cretan endemic darkling beetles of the genus *Dendarus*, not accompanied by adequate DNA differentiation in most cases. High mountain populations are characteristically shiny, in contrast to the rough/mat body surfaces of lowland or islet taxa. As environmental (e.g. high altitude UV radiation) or biological (e.g. differential predation by mice in lowlands or birds on mountaintops) factors, could possibly explain these differences in morphology, we assessed elytra capacity to manage ultraviolet, visible and infrared radiation with spectrophotometric analysis, while SE Microscopy was used to further evaluate surface morphology. SEM analysis showed indeed extremely smoothed surfaces on all high altitude populations, advocating the observed morphological differentiations also on microstructural level. Spectrophotometry showed extreme UV elytral absorbance (90%) and medium IR reflectivity (50%) for both lowland & high-altitude populations, leaving more space for the observed adaptations in elytral morphology to biological explanations, like differential predation in the two different environments.

Keywords: morphology, adaptation, ultraviolet, spectrophotometry, SEM.

Relationship between Orthoptera richness and pastoralism in
Mediterranean mountains of southern Balkans

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This study examined the effects of pastoralism on biodiversity in calcareous grassland mountain habitats in northwestern Greece and southern Albania (above 1200 m asl). We used orthopteran populations as an indicator of biodiversity, during 3 years. The overall Orthoptera communities' richness is an indicator composed of a combination of species richness, percentage of species with narrow ecological amplitude, equitability index and relative abundance of vulnerable species. Biodiversity has decreased at sites with medium to high impacts of livestock grazing. Cattle grazing had significant negative effects on biodiversity. Recent decades have seen the gradual transformation of a traditional mountain agro-pastoral practice into a generalization of cattle herds on lands formerly more commonly used by sheep, and also a replacement of small native breeds of cattle by imported larger and more productive breeds. In some places, livestock pressure became too strong, too early and too long, unsuitable for these xeric meadows. In the impacted study sites, we observed the collapse of biodiversity with soil erosion and the destructuring of plant formation with dominance of few species. In close relationship with overall Orthoptera communities' richness, the use of the threatened endemic genus *Peripodisma* as an indicator of the environmental health of these biotopes seems an appropriate choice. We can raise awareness at political level with the help of international instances. Urgent short term actions to guide grazing management are needed and their requirements and funding criteria must change to move towards local breeds and products.

Keywords: species richness, narrow ecological amplitude, equitability index, relative abundance

Cataloguing sponge diversity from Atlantic marine caves and comparison with relevant data from the Mediterranean Sea

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Marine caves are among the most complex and understudied ecosystems worldwide. Among the sessile animals that dwell these ecosystems, Porifera is the dominant taxon in terms of substrate coverage and species number. This study aims to catalogue information concerning sponges reported from Atlantic marine caves, providing the basis for comparisons with previous initiatives from the Mediterranean Sea. The project is part of a wider effort to create a comprehensive online database under the World Register of Cave Species (WoRCS, <http://marinespecies.org/worcs/>), which is a thematic species database of the World Register of Marine Species (WoRMS). Published and grey literature sources, found in private and institutional collections, were used along with material accessed via online search machines. Examination of 130 sources yielded 326 species that have been recorded in Atlantic marine caves. The taxonomic composition of the Atlantic cave-dwelling sponge communities presented similarities with that of Mediterranean caves, in which 331 sponge species have been found so far. Specifically, the demosponge orders Poecilosclerida, Haplosclerida and Tetractinellida dominated in caves of both marine areas. It was estimated that marine caves harbour 41 and 51% of the total regional sponge diversity in the Tropical Northwestern Atlantic and Mediterranean Sea, respectively. Within these marine provinces, scientific effort has mostly focused on the Western Caribbean (118 species) and Western Mediterranean (292 species) ecoregions, respectively, while several other ecoregions remain unexplored. Last but not least, Atlantic and Mediterranean marine caves host many endemic and deep-water species, which makes them extremely important for further research and conservation actions.

Keywords: Porifera, cave fauna, biodiversity databases, biogeography.

Effects of tail autotomy and regeneration on male social hierarchy in a Mediterranean lacertid lizard

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Tail autotomy is a defensive mechanism implemented by many lizard species in order to escape attempted predation. Nonetheless, tail loss comes with serious costs stemming from its function as a vital balance and fat storage organ, but also its role in social interactions. Here, we aimed to explore the effect tail autotomy and regeneration have on male social hierarchy of the Aegean wall lizard, *Podarcis erhardii*. We hypothesised that loss of the tail would lead to loss of social status for dominant males, but its regeneration would restore the previous hierarchy. In the laboratory, we staged agonistic encounters between same-sized males in a neutral arena. By scoring behaviours asserting dominance positively and submissive ones negatively, aggression scores were assigned to each lizard. The lizard with the highest score was identified as the dominant of the pair, while the difference between the two scores served as a measure of social disparity. Subsequently, the tail of the dominant male of each pair was autotomised and the encounters were repeated every two weeks, all along the regeneration process, leading to new scores and social disparities being computed. According to our results, social disparity significantly decreased after the dominant lizards lost their tails and the initial status was not restored after tail regeneration. Our findings suggest that tail autotomy affects male interactions and social hierarchy in *P. erhardii*, by reducing dominance and aggression discrepancies. Nevertheless, tail regeneration does not seem to restore dominance, indicating that social costs of autotomy might be even greater than previously thought.

Keywords: social status, behavior, social disparity, aggression, dominance, social interactions

Distribution of benthic foraminifera in the allocated zone for aquaculture of Thermaikos Gulf (north Aegean Sea)

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Allocated zones for aquaculture (AZAs) are established under national maritime spatial planning, to ensure viability and safeguard, both, fisheries products and environmental quality. In Thermaikos Gulf, the main type of aquaculture is mussel-farming (*Mytilus galloprovincialis*). The relevant sector is expanding over the last years and an AZA to host and manage relevant units is currently under development. The present study aims to assess the structure of foraminiferan communities under the impact of mussel-farming, to explore their potential as indicators of environmental quality in biomonitoring. Sediment samples were collected with a Bowser corer in January 2019, by diving at depths ranging from 10 to 25m, from eight, randomly selected stations in Chalastra bay. Additional samples were collected for granulometric and organic content analyses. The standardized FOBIMO protocol was applied in both collection and processing of samples. The examination of the collected material revealed the presence of 74 species classified to 47 genera. The foraminiferan assemblages comprised a typical group of stress-tolerant taxa (*Bulimina aculeata*, *Bulimina elongata*, *Bolivina spathulata*, *Bolivina dilatata*, *Nonionoides turgidus*, *Rectuvigerina phlegeri*, *Ammonia tepida*, *Triloculina tricarinata*, *Quinqueloculina seminula*) and a remarkable presence of agglutinated taxa (*Eggerelloides scaber*, *Textularia earlandi*, *Lagenammina difflugiformis*, *Leptohyalis scotti*, *Nodulina dentaliniformis*, *Nouria polymorphinoides*) suggesting specific geochemical sediment conditions. The spatial distribution of foraminiferans was mainly determined by the combined effect of organic matter, topography and hydrodynamics.

Keywords: Foraminifera, soft substratum, mussel-farms, biomonitoring, Thermaikos Gulf

The historical collection of Greek Mutillidae at the ZMUA: status and current taxonomy

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The first records of mutilid wasps from Greece were recorded during the first scientific expedition in Greece in 1833. It was long after that, when the first physical specimens were collected, curated and deposited in an entomological (then natural history) collection; currently named the Zoological Museum of the University of Athens (ZMUA). The Entomological Collection of the ZMUA, is regarded as the oldest and most historical entomological collection in Greece and has recently been under a revamping period with curators and Biology students curating, populating, reorganizing and databasing the specimens. After many changes in the location of the collection, the curatorial procedures and long periods of infrequent and even non-existent care for specimens, wasps of the family Mutillidae were located in numerous entomological drawers and were pooled into a single unit tray containing 39 specimens. Label metadata were deciphered and databased. The oldest specimens were collected from the then curator of the collection, Dr. Krüper with label information as from 'Graecia' and collection date 1859-1861. Although this small collection contains specimens in rather bad condition and even at a stage where some of them are not identifiable beyond the genus level, it still remains a significant addition to the knowledge of the Greek fauna. At the same time, its historical importance remains evident as it contains some of the oldest specimens of any insect from Greece. Currently, the work of the authors involves building a contemporary collection for the Mutillidae of Greece; so far yielding more than 1500 specimens.

Keywords: mutilid, wasp, curation, museum, specimens, old

Mediterranean Monk Seal pupping habitat availability and suitability in the Peloponnese and adjacent regions

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The Aegean and Ionian Seas in Greece host currently the largest population of the endangered Mediterranean monk seal (*Monachus monachus*). The species is the only pinniped of the Mediterranean Sea that uses marine caves (monk seal shelters) with specific morphological characteristics for resting and pupping. The existence of such marine caves is of utmost importance for the conservation of the species. In 2016-2017 we carried out the first thorough examination of the entire coastline of the Peloponnese and the adjacent islands of Kythera, Antikythera, Spetses, Hydra and Poros, as well as all surrounding islets, in order to record the existence of monk seal-suitable habitat and to evaluate its usage by the species. A total of approximately 1300 km of coastline was circumnavigated; fifty-one suitable monk seal shelters were recorded, of which 11 were evaluated as suitable for pupping. In 20 caves usage by monk seals was confirmed through direct or indirect evidence. In addition, in 6 of the 11 pupping caves, pupping activity was confirmed. The most important pupping sites were identified at the island of Kythera and in Western Mani (Messiniaki). These two areas are of extreme importance for the survival of the Mediterranean monk seal in Greece as they seem to function as a “stepping stone” between the reproductive populations of the species in the Ionian and Aegean Seas. Taking into consideration the importance of these reproductive nuclei, special conservation measures are urgently required in order to secure their protection.

Keywords: conservation, habitat suitability, *Monachus monachus*

Parasites of European wildcats (*Felis silvestris silvestris*) in Greece

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The European wildcat (*Felis silvestris silvestris*), is a protected mammal across Europe. Habitat loss is forcing wildcats to move to environments closer to human activity, resulting to frequent hybridization with domestic cats (*Felis silvestris catus*), and to fostering bridging infections between these felids. The aim of the present study was to investigate the occurrence and prevalence of parasites in wildcats in Greece, and assess the potential threats that these pose to wildcats and domestic cats in the examined areas. For this purpose, 16 road killed animals and 32 wildcat faecal samples were examined by necropsy and parasitological methods, respectively. In case considered necessary, the identification of parasites was confirmed molecularly. At least 18 different species of feline parasites were found in 39 (81%) out of the 48 samples (either carcasses or faeces), while some parasitic elements were most likely present in the examined wildcats due to pseudoparasitism (parasites of common preys like rodents, hedgehogs, hares and birds). Some of the most important species in terms of implications to wildcat health status or/and possible transmission to domestic cats were *Eucoleus aerophilus* (42%), *Toxocara cati* (31%), *Ancylostoma tubaeforme* (23%), *Aelurostrongylus abstrusus* (21%), *Cylicospirura* spp. (15%), *Taenia taeniaeformis* (19%), *Troglostrongylus brevior* (19%), and *Angiostrongylus chabaudi* (19%). Other findings include *Cystoisospora* spp. (33%), *Physaloptera* spp. (12%), *Sarcocystis* spp. (6%), *Spirometra* spp. (10%), *Mesocestoides* spp. (6%), *Alaria alata* (4%), *Acanthocephala* (2%) and *Oslerus rostratus* (2%). Moreover, *Thelazia callipaeda* was found in 2 (12.5%) and tick infestation in 4 (25%) of the carcasses. In conclusion, mixed parasitism is common in wildcats, posing threats to the health status and fitness of this mammalian species and also bringing possible implications to the health of domestic cats living in the same areas.

Keywords: parasitism, pseudoparasitism, threats, health status, domestic cats

Spatial variability of benthic diversity and physicochemical characteristics in a marine cave of Crete (Eastern Mediterranean)

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Marine caves constitute unique biodiversity reservoirs of high conservation value. Nevertheless, marine caves of the Aegean Sea have been studied less intensively than those in other Mediterranean regions. In this study, benthic biodiversity and physicochemical parameters were investigated for the first time in the Elephant Cave of Crete (Greece), along three distinct ecological zones (entrance, semi-dark and dark zone). From each zone, we collected with SCUBA diving: 1) photoquadrats and sediment corers for the study of benthos on hard and soft substrates, respectively, 2) water samples for estimating the concentration of nutrients, and 3) sediment samples for estimating the content of chlorophyll- α , pheophytins and organic carbon. The results showed that different taxa dominated different cave zones and substrate types. Sponges were prevalent in terms of surface coverage on semi-dark walls, while polychaetes dominated in terms of abundance the sediments of the cave bottom. On both hard and soft substrate, there was a notable decrease in species diversity and abundance from the entrance towards the dark interior of the cave. On the other hand, in the dark zone, the concentration of silicate and nitrate ions in seawater was significantly higher compared to the entrance zone. The concentration of chlorophyll- α and pheophytins in the sediment showed a gradual decrease towards the cave interior while the highest concentration of organic carbon was recorded in the semi-dark zone. This work serves as a first baseline survey for the most iconic and visited marine cave of Crete, thus allowing the setup of future monitoring activities.

Keywords: benthos, community structure, hard substrate, soft substrate, seawater nutrients, monitoring

Ecosystem modelling simulations and fishing effort reduction scenarios in Pagasitikos Gulf (central Aegean Sea, Greece)

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Ecosystem models have been used as a fisheries management tool in a holistic approach that explores the impact of fishing activities on the commercial and also non-commercial ecosystem components. Pagasitikos Gulf is an enclosed shallow gulf in the western coast of the central Aegean Sea, characterized as a semi protected area due to a trawling ban since 1966, where various highly commercial fish species are targeted by purse seiners and small-scale coastal vessels. In this study an Ecopath model was constructed including 31 functional groups, while Ecosim simulations were run for 18 years (2008-2025), including the calibration period (2008-2017). Ecopath statistics indicate an immature ecosystem probably as a result of intense fishing pressure, but in better state compared to other similar studied ecosystems possibly reflecting the long-term trawling ban. In order to explore the ecosystem dynamics, three Ecosim scenarios were examined, all aiming towards fishing effort reduction applied to both fleets (purse seiners and small-scale), by 10, 30 and 50% compared to the initial scenario. All the examined scenarios led in higher total biomass compared to the basic Ecosim simulation (the higher the reduction in fishing effort, the higher the biomass increase), while catches were significantly lower in all cases. The most profound biomass increase with reduced fishing effort was observed in the functional groups of anglerfish, hake, sharks and rays, anchovy, mackerels and other larger pelagics. Overall, it was predicted that modifying the current fishing regime by reducing total fishing pressure, will result in rebuilding of commercially important stocks.

Keywords: Ecopath with Ecosim, Fisheries management, Fishing regulations, Trawling ban

Genetic divergence of *Dendropoma petraeum* (Gastropoda: Vermetidae)
along Cyprus coasts

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The vermetid gastropod *Dendropoma petraeum* is a sessile reef-building species endemic to the Mediterranean. Although no significant morphological and/or ecological diversification was documented, recently published data revealed the existence of four genetically distinct lineages. Therefore, the application of molecular analyses is necessary to clarify systematics of this cryptic species complex. The present work aims to a) a taxonomic assessment of individuals found along the Cypriot coasts, b) the exploration of possible genetic variation within Cyprus populations of the 'species', and c) an investigation of phylogenetic relationships among representatives from different parts of the species complex distribution. Sampling effort focused on localities at the southeastern coasts of Cyprus. Two mitochondrial, genes, namely cytochrome c oxidase subunit I (COI) and 16S rRNA, as well as the nuclear internal transcribed spacers (ITS1 and ITS2) and 5.8S rRNA genes, were targeted. Bayesian Inference and Maximum Likelihood analyses were applied for the construction of phylogenetic trees. Furthermore, haplotype networks investigating the extent of gene flow between populations will be presented.

Keywords: gastropod, taxonomy, genetic variation, phylogeny

Mercury accumulation in *Phocoena phocoena* bones (Bulgarian Black Sea region)

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During the last few decades worldwide much research for determination of heavy metal accumulation in tissues of Odontoceti representatives was made, but only few findings regard the Black Sea, and even less – mercury (Hg), one of the most toxic elements. During 2016-2017 bone samples were collected from Black Sea Harbor Porpoises (*Phocoena phocoena* ssp. *relicta*), stranded on the Bulgarian Black Sea coastline. Overall 18 specimens were subjected to analyses (6 newborns, 6 calves (1 year old), and 6 older individuals). The mercury content was established by using the EPA Method 7473:2007 and in all samples total mercury was extant. Total Hg levels ranged from 0,0044 to 1,3711 mg/kg dry weight. Additionally the corpse of one adult female was sampled trice in periods of 30 days and no significant variation of the mercury concentration was found, showing that the decaying process under natural conditions does not affect substantially the total concentration in bone samples. The results show that with increasing age, the elemental mercury concentration increases too, despite detoxification mechanisms, and the group of lactating age individuals is clearly identifiable by all other age groups. The averagely highest but most varying values for the accumulation of mercury in harbor porpoise bones were found in the group of the older than one year individuals. This was probably due to the combined effect between the detoxification mechanisms and the more varied area and territories in the Black Sea that individuals were abide. The results have also shown a tendency of differentiation between the levels of accumulation of elemental mercury in *Phocoena phocoena* bones in some age groups between the northern (being generally higher) and southern coastline of the Bulgarian Black Sea, which might indicate the effect of the Danube River outflow.

Keywords: Harbor Porpoise, detoxification, heavy metals

Gastropods as intermediate hosts of feline cardio-pulmonary parasites in Greece: preliminary results

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Metastrongyloid nematodes are the main causative agent of cardiopulmonary parasitism in domestic cats (*Felis silvestris catus*) and wildcats (*Felis silvestris silvestris*), having gastropods as intermediate hosts. The aim of the present, ongoing, study is to fill gaps in the knowledge regarding i) the species of gastropods that serve as intermediate hosts, ii) the development of the nematodes in these hosts and iii) possible factors that may affect gastropod parasitism. Slugs and snails are being collected from various geographic areas in Greece, from habitats where domestic or/and wildcats are present. Until now, 89 snails and 73 slugs have been collected and examined by artificial digestion to detect metastrongyloid larvae. Parasitic nematodes and gastropod intermediate hosts were identified by morphology, morphometry and DNA sequence data. Hitherto, 18 (20.2%) snails and 18 (24.7%) slugs were infected with at least one of three species of feline cardiopulmonary metastrongyloid parasites. More precisely, *Angiostrongylus chabaudi* was found in *Eobania vermiculata*, *Helix lucorum* and *Limax* sp., *Troglostrongylus brevior* in *Cornu aspersum*, *Tandonia cf. sowerbyi*, *Limax cf. conemenosi*, *Limax flavus* and *Limax* sp., and *Aelurostrongylus abstrusus* in *Eobania vermiculata*, *Helix lucorum*, *Lehmannia valentiana* and *Limax flavus*. Also, *T. brevior* and *A. abstrusus* have been found in mixed infection in 5 gastropods. This is the first detection and identification of naturally infected gastropods with *A. chabaudi* worldwide and the first time that natural intermediate hosts of *T. brevior* and *A. abstrusus* have been identified in Europe and Greece, respectively.

Keywords: domestic cat, wildcat, nematodes, gastropods, parasitism

Historical collection of Greek spiders (Arachnida: Araneae) in the National Museum in Prague (Czech Republic)

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The collection of historical Greek spiders contains material from three distinct periods. The oldest material originates from zoological expeditions organized by the National Museum before the World War II. Spiders were collected by a herpetologist Otakar Štěpánek (1903–1995), an entomologist Josef Mařan (1905–1978) and a volunteer and later a curator of the Invertebrates Karel Tábořský (1906–1988). They were collecting at western Greece – Ioannina, Katarraktis – and the island of Corfu (1927), in the Parnas Mts. and Peloponnesus (1935), Crete (1934–1936, 1938), northern Greece – Nausa cave (1937) and the island of Gavdos (1938). Further material, containing five specimens only, comes from the collection of a Czech arachnologist František Miller (1902–1983). His collection contains *Meta menardi* and *Histoipona luxurians* (the first record for Greece) from the Kastria cave (1966). The relatively youngest samples of wolf spiders (Lycosidae) were collected by other Czech arachnologist Jan Buchar (1932–2015) in Thessaly, Thrace, Peloponnesus, Rhodes etc. As he published the material gathered by him, we do not treat with it in this contribution. The spiders were identified (or revised) according to current arachnological knowledge and databased. Hence, we provide here yet unpublished faunistic records for Greece. The most important records are those from caves.

This study was fully supported by the Ministry of Culture of the Czech Republic: project NAKI II (DG16P02B038).

Keywords: arachnological collection, faunistics, expeditions, caves, Crete, Peloponnesus

Reservoirs zooplankton from different regions in Turkey

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This study focused on trophic states and the zooplankton fauna of seven reservoirs (Demirdöven, Devegeçidi, Menzelet, Sır, Ömerli, Porsuk, Tahtalı) from six different geographical regions (Marmara, Aegean, Mediterranean, Central Anatolia, Eastern Anatolia, Southeastern Anatolia) in Turkey. Samples were collected in summer months (2015) from the epilimnion layer. Epilimnion layer depth accepted as 2.5 times of the Secchi disk depth. Water temperature, dissolved oxygen concentration, pH, electrical conductivity were measured in situ. Transparency was determined using by Secchi disk. Chlorophylla concentration was determined as the primary production. Also, total nitrogen and total phosphorus concentrations were quantified. Trophic status of the reservoirs were determined according to Carlson's Trophic State Index. Species richness, diversity, evenness, saprobic, and also similarity indices for zooplankton were computed. To comparison of the biological and limnological variables several statistics were applied. Trophic conditions of the reservoirs varied between oligo- and eutrophic status. Chlorophyll a concentrations determined considerable high for each reservoir. 44 rotifers, nine cladocerans and nine copepods were identified along the study period. All of the reservoirs, except Demirdöven, were dominated by rotifera group. Common dominant taxa for all reservoirs was the rotifer *Polyarthra vulgaris* Carlin, 1943. Saprobic index was defined as β -mesosaprobic for the reservoirs. Rotifera variation, as the dominant group, was affected mainly by physical variables (pH, temperature, dissolved oxygen concentration, conductivity), and crustacean variations were related with total phosphorus. The comparative assessment between limnological variables and zooplankton community in this reservoirs was studied for the first time.

Keywords: Turkey, trophic state, limnological conditions, rotifera, biological indices

Antioxidant and antiproliferative properties of natural products isolated from some aromatic and medicinal plants

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Natural products have been used worldwide for treatment of various illnesses since ancient times. Aromatic and medicinal plants play a significant role in drug discovery process due to the including bioactive compounds. The extraction methods of the plants are important to isolate the bioactive compounds. In this work, the plant materials were extracted hexane, ethl acetate and methanol successively. The antioxidant activity was carried out on corresponding extracts and the chromatographic techniques were applied for the extract revealing the most antioxidant activity. Preperative HPLC, Sephadex LH-20, preperative TLC, silica gel column, C-18 reversed phase silica gel were used as chromatographic techiques to isolate the bioactive compounds. Spectroscopic methods basically 1D-, 2D-NMR, LC-TOF/MS were used to identify the isolated compounds. DPPH^{*} scavenging, ABTS^{**} scavenging, and reducing power (FRAP) assays were used for antioxidant activity. HeLa (Human Cervix Carcinoma), HT29 (Human Colorectal Adenocarcinoma), C6 (Rat Brain Tumor Cells), and Vero (African Green Monkey Kidney) cells were used for antiproliferative activity. Crismaritin, luteolin, rosmarinic acid methyl ester, 3,4-dihydroxyl benzaldehyde, caffeic acid, rosmarinic acid and luteolin-7-O- β -glucoside were isolated from *Salvia absconditiflora* and revealed the excellent antioxidant activity. Apigenin, ferulic acid, vitexin, caprolactam, rosmarinic acid, and globoidnan A were isolated from *Origanum rotundifolium*. Vitexin revealed the most antiproliferative activity against HeLa, HT29, C6 and Vero cells lines.

Keywords: bioactive compounds, drugs, *Salvia absconditiflora*, *Origanum rotundifolium*

Would it be really possible to protect the sandbar shark (*Carcharhinus plumbeus*) in Turkey?

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Regarding the current information related to various aspects of protection efforts (e.g. national policies, management strategies, available relevant databases, scientific manner), we have aimed to find out an accurate and satisfactory answer to whether Turkey is already providing a convenient protection for the sandbar shark. Whole information given here was compiled from official newspapers, national and international legislations and scientific literatures. Turkey has the necessary national legal groundwork for the species' protection. However, a management plan specific to the conservation of the species and its habitat have not been prepared yet. Until 2019, a single training project was carried out to set up a public awareness in local for the introduction and protection of the sandbar shark. 12 studies have been conducted in the region since 2006, the year in which the importance of Boncuk Cove (i.e., the issue taken into consideration by the government for the first time and foundation of the future monitoring activities) for Sandbar Shark was comprehended. Considering the current national legislation, in terms of species and habitat protection, Turkey has provided sufficient and strong legal structure on paper. Due to lack of management plan, however, the contribution of local people could not be provided and the whole protection strategies of both the species and habitat were merely built on prohibition. Also, due to the lack of management plan, the efforts and encouragements to provide scientific data on the species are low and weak.

Keywords: sharks, Marine Protected Areas, endangered, Elasmobranchii, Boncuk Bay

First data on Endogaeal fauna of olive orchards in Crete, Greece

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The endogaeal fauna provides important information for the soil activity and fertility. Soil samples, at 5 cm depth, from 14 olive orchards, located at Messara plain, south Crete, were monthly collected for a six-month period. Berlese–Tullgren funnels were used for invertebrate extraction and storage in propylene glycol. Specimens were identified at order level. The more abundant taxonomic groups were Collembola, Acari and insects' larvae. By comparing (at 95%) specimens per sample from organic and conventional olive orchards, we found: a) double numbers of invertebrates in the organic ones, not statistical significant difference (19.6 to 10.0, $p = 0.140$), b) acari were more abandoned in organic olive orchards (7.4 to 2.0, $p = 0.046$), c) the same applied to the insects' larvae (3.3 to 1.0, $p = 0.014$), d) we did not found statistical difference for collembola (6.9 to 5.3, $p = 0.499$). Specimens from an abandoned olive orchard were found to be similar to the organic olive orchards, regarding the total abundance (19.6 to 20.0), the abundance of acari (7.4 to 6.0), Collembola (6.9 to 7.0) and insects' larvae (3.3 to 5.0). The work was delivered in the framework of the LIFE project LIFE IGIC (LIFE16 NAT/GR/000575) co-financed by the EU.

Keywords: Acari, Collembola, Larvae, Organic, Conventional

Why are island species so often endangered? An assessment of
susceptibility in a Mediterranean island reptile taxon based on
quantifiable ecological characteristics

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The ecology and life history of island species differs in many accounts from their closest mainland relatives. These differences, often subsumed under the name 'island syndrome' are thought to be responsible for the long-established sensitivity and elevated extinction rates of island species to environmental disruption. Nevertheless, no comprehensive analysis has been done to date that includes the different constituent aspects towards a calculation of the sensitivity of the different island reptile populations. We combined both published and unpublished information on the life history and the ecology of Aegean Wall lizard populations to predict their susceptibility to an invasive predator. Multiple factors such as reduced running speed, attenuated predator recognition, downregulated antipredator defenses as well as lower reproductive rate and smaller overall population size all contribute to the sensitivity of an island lizard population. Overall, population risk rises with decreasing island size and declining presence of natural predators on an island. This type of analysis provides for the first time an estimate of sensitivity or reptile populations to exotic predators.

Keywords: lizard, predator, population size, sensitivity, population risk

Enhancing the adaptation of the Eleonora's Falcon to climate change by improving its nesting habitat quality

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The LIFE Nature project "LIFE EIClimA" (LIFE13 NAT/GR/000909) aims at enhancing the adaptation of the Eleonora's Falcon (*Falco eleonora*) to climate change in the Aegean Sea, the core of the species' global breeding distribution, by tackling some of its main existing pressures and limiting factors at breeding sites, including predation by introduced rats and limited availability of nesting sites providing sufficient protection from heat, sun exposure and wind. For this purpose a series of field surveys for rat eradication and construction of artificial nests were carried out between 2015 and 2018 in some the species' key colonies within the southern extent of its distribution range in the Aegean Sea, an area that is expected to be the most vulnerable to climate change. Rats were successfully eradicated from two uninhabited island complexes in the Cyclades and of NE Crete, consisting of 7 islands with a total area of 705ha, which host approximately 6% of the Eleonora's Falcon national breeding population. Rodenticide baits were used in bait stations to minimize risks to non-target species. Additionally, more than 1000 artificial wooded and stone nests were constructed and established in these two island complexes, as well as in other colony sites in the southern and central Aegean Sea. The highest short-term response of the Eleonora's Falcons to the interventions was observed on small islets, which are more affected by the rat predation pressure and limited availability of suitable nesting sites.

Keywords: Rat eradication, Artificial nests, *Falco eleonora*

Length-weight relationships of some endemic fish species in the
collection of Istanbul University, Faculty of Aquatic Sciences

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Fish samples collected from freshwater and marine environments of Turkey are preserved in İ.U., Faculty Aquatic Sciences. This collection has a large number of fish species belonging to 34 family and 64 genus. The aim of the present study is to investigate the present status of endemic species in the collection and to determine the length-weight relationships of these fishes. Identifications of the fish samples were made and the conservation status of each fish species were checked from IUCN Red List. The length-weight relationships of the species were estimated using the equation $W=aSL^b$. The parameters a (regression intercept) and b (slope) were calculated. The null hypothesis of the isometric growth was tested. *Alburnus escherichii*, *A. nicaeensis*, *A. tarichi*, *Aphanius* sp., *Capoeta antalyensis*, *C. tinca*, *Chondrostoma beysehirensense*, *C. meandrense*, *C. holmwoodii*, *Clupeonella muhlisi*, *Garra kemali*, *Gobio hettitorum*, *G. insuyanus*, *G. intermedius*, *Pseudophoxinus handlirschi*, *P. anatolicus*, *Squalius anatolicus*, *S. fellowesii*, *S. pursakensis*, *S. recurvirostris* and *Oxynoemacheilus phoxinoides* are the Anatolian endemics in the collection. The b values in the length-weight relationships of 6 endemic species were estimated between 2,6043 (*A. tarichi*) and 3,3754 (*Aphanius* sp.). The rare fish species of endemic are available in the collection. The changes on the status of these species from the past to the present were investigated and the significant arguments for exchange and richness of Turkey inland fish fauna were obtained. This work was supported by Scientific Research Projects Coordination Unit of the İstanbul University (Project number: 40134).

Keywords: endemic, freshwater fish, lake, museum, stream

Thermal tolerance of the marine invader *Percnon gibbesi* from eastern Mediterranean Sea

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The knowledge of thermal tolerance of Non-Indigenous Species (NIS) is essential for the prediction of their establishment success along a geographical area. The invasive decapod crab *Percnon gibbesi* has already established in Mediterranean Sea and expanded northward, till the port of Genova (Italy). The aim of this study is to describe the thermal tolerance of this NIS in eastern Mediterranean Sea. In total, 30 animals were collected from Pantanassa's port (Heraklion, Crete). Firstly, the crabs acclimated at 20°C, in 60lt aquariums, for 30 days. Secondly, half of the crab's population were acclimated at 14°C and 27°C for 60 days, respectively. Furthermore, the temperature in each tank increased at a rate of 4°C per hour, until the temperature that crabs lost their right-flip ability, which is known as Critical Thermal Minimum (CTmin). The crabs acclimated at 14°C showed lower CTmin as opposed to the crabs acclimated at 27°C. The crabs acclimated at lower temperatures have already decreased their metabolism and can achieve lower CTmin. According to these results, animals established in sites with lower sea temperatures could be gradually expanded northward in Mediterranean Sea, confirming the "stepping stone" expansion of sub-tropical fauna under the IPCC climate change scenarios.

Keywords: Alien species, benthic fauna, biological invasions, thermal tolerance, invasive species, Mediterranean Sea

Shedding light on the unknown vulnerable benthic communities of the deep Eastern Mediterranean Sea

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Benthic invertebrate diversity in the deep waters of the Eastern Mediterranean Sea (>200 m) has attracted limited research effort compared with other Mediterranean basins. Over the last two decades, HCMR has coordinated and/or participated in numerous research projects and expeditions investigating deep-sea resources, seabed features and wrecks in the Eastern Mediterranean Sea, for both scientific and operational oceanographic purposes. Within the DEEPEASTMED project (funded by HCMR and IUCN) archive video material recorded by remotely operated vehicles, towed video systems and a manned submarine was assessed for the presence and abundance of benthic invertebrates with a special focus on protected and indicator taxa for Vulnerable Marine Ecosystems (VMEs). The examined video material (250 hours of dive time) covered 36 sites spanning from the Eastern Ionian to the Levantine Sea and covering a bathymetric range of 200-1560 m. A total of 46 vulnerable invertebrate taxa were identified, which belonged to 6 major groups (16 Porifera, 25 Cnidaria, 1 Annelida, 2 Echinodermata, 1 Brachiopoda, and 2 Ascidiacea) and included several rare and new records. A considerable number of “hotspot” areas were identified, such as sites with high species number and/or abundance (e.g. mixed sponge and coral gardens) and geological features harbouring unique communities (e.g. submerged calderas and chimneys). These findings provide a baseline for further surveys tailored specifically towards quantitative recording of species and habitats, and samplings for the molecular characterization of deep-water biological resources, in the light of future plans for offshore oil and gas exploration in the deep Eastern Mediterranean Sea.

Keywords: sponges, corals, Vulnerable Marine Ecosystems, video assessment.

The effect of Hydrogen Peroxide (H₂O₂), a HABs control agent,
on life-history traits of *Daphnia magna*

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Currently, Hydrogen Peroxide (H₂O₂) is being used for the degradation of cyanobacteria forming blooms and their cyanotoxins, but is crucial to apprehend its effects before actually using it. *Daphnia* sp. is a key species for the food web functioning and among the most sensitive species in aquatic toxicology. Thus, the aim of the present study was to highlight the likelihood of negative effects H₂O₂ has on *Daphnia magna* Straus, 1820. For that, we conducted a chronic toxicity test with a duration of 21 days, where we applied six geometrically increased concentrations of H₂O₂: 0 (control), 0.6, 0.9, 1.3, 2 and 3 mg/L. Each concentration had 10 replicates and each replicate was consisted of one *D. magna*, resulting to a total number of 60 individuals. Every day, *Daphnia* mortality, body length and number of neonates were recorded. The highest mortality rate (80%) was recorded in the highest concentration of H₂O₂, but nonetheless even in the smallest concentrations individuals were affected. Body length increase was in inverse proportion to H₂O₂: as the concentrations increased, body length increase was smaller. The recorded minimum length increase was 1.63 mm (2 mg/L) and the maximum was 2.66 mm (control). In the two highest concentrations a very low number of neonates were recorded, while small and intermediate concentrations (0.6, 0.9, 1.3 mg/L) did not have such an adverse effect. In conclusion, our results showed that H₂O₂ is adversely affecting *D. magna*, showcasing that this method should be avoided to be used in natural lakes.

Keywords: Chronic toxicity, Cladocera, survival, length, reproduction.

The effects of the Late Quaternary glacial–interglacial cycles on Balkan wall lizard

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The present study as a part of PhD thesis aimed to understand how Balkan Wall Lizard, *Podarcis tauricus* (Pallas, 1814), has responded to global climate changes in terms of range distribution throughout Late Quaternary glacial–interglacial cycles. The ecological niche modelling was used to evaluate interaction between bioclimatic data and species concurrence records with extensive sampling from Turkey. The bioclimatic variables have been obtained from online database the Worldclim and species observation records were gathered from field observations and articles. An ecological niche model was developed via using maximum entropy machine learning algorithm in MAXENT to predict the potential geographical distribution of the species under reconstructed past (the Last Interglacial, approximately 130 000–116 000 years ago, the Last Glacial Maximum, 21 000 years ago, Mid-Holocene (7000–5000 years ago) and the present (between 1950–2000). According to initial model results, *P. tauricus* has an east-west directional distribution and goes on expanding its range. In accordance with the former studies, niche model projections revealed that *P. tauricus* as a temperate (mid-latitude) species has responded to global climate changes through the Late Quaternary glacial–interglacial cycles as contracting its range during the glacial periods and expanding during the interglacial periods.

Keywords: Ecological niche modelling, global climate changes, Last Glacial Maximum, Last Interglacial, *Podarcis tauricus*

Socio-economic status of small-scale fishery in the northeastern Mediterranean coast of Turkey

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The aim of this study was to investigate socio-economic structure and problems of artisanal fisheries in Samandağ, Arsuz, İskenderun, Payas and Dörtyol districts of Hatay Province, in the northeastern Mediterranean coast of Turkey. Technical and physical features of fishing gears, socio-economic characteristics of fishermen, economic analysis of fishery activity and the problems faced by fishermen were examined. A total of 317 boats were found to be registered in the small-scale fishing activity in these regions. The data were obtained face to face from 209 fishermen who are mainly engaged in the fishing activities in the Samandağ, Arsuz, İskenderun, Payas and Dörtyol coastal areas. A total of 40 questions were asked to the fishermen. Small-scale fishery is a source of income for many people, particularly in small towns and fishing areas with low-capital investments. Small-scale fishery also contribute to the healthy nutrition of the people of the region. Aquaculture plays an important role in human protein requirements. There is a increasing need to supporting bodies or programs in order to get a sustainable small scale fishery in these coastal regions. there is also a serious risk for small-scale fishermen and their families whose life are related to fishery resources which are getting decreased in these coastal areas.

Keybords: Small-scale fishery, northeastern Mediterranean, socio-economic, Hatay

Fine-scale habitat use evaluation and threat assessment for a long-distance migratory raptor at its wintering grounds: the case of Eleonora's Falcon in Madagascar

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Eleonora's falcon predominantly overwinters in Madagascar, where the natural habitats are increasingly threatened by intensive forest degradation and other primarily human-induced habitat alterations. Through this study, we explored Eleonora's falcon fine scale habitat use, including daily and hourly spatiotemporal activity patterns, and the factors affecting the presence of the species across Madagascar. We used high resolution GPS telemetry technology to establish bird-habitat associations and investigate birds' movements. Moreover, through on-site field surveys in Madagascar, we verified habitat composition on a sample of the species' activity centers and assessed pressures and threats. Eleonora's falcon uses a diversity of habitats during the overwintering period (austral summer) in Madagascar, exhibiting high site fidelity, moving progressively from more open habitats towards areas with denser tree cover, possibly as a response to food availability. The species dedicates about 15 % of its time foraging, which is performed almost exclusively during daytime, while about 80 % of its time is spent resting or roosting. The field work undertaken in Madagascar showed that the existing maps tend to overlook smaller fragments of habitat types and fail to notice small scale land uses. On-site assessment also indicated that land use changes are the primary threats to the species. Our findings suggest that the advent of GPS logger technology can enhance our understanding of the species' ecology at finer and more ecologically relevant scales, while ground surveys are still very useful in habitat assessment to identify problems and to facilitate management and planning for conservation actions in remote areas.

Keywords: *Falco eleonorae*, telemetry, ground-truthing, fidelity, humid forest, conservation

Zooplankton diversity and water quality assessment of Ghrib lake
(Algeria), with special reference to planktonic indicators

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The study aimed to assess the zooplankton diversity in Ghrib Lake, located in the northwestern part of Algeria, it is at an altitude of 435 m and is between 36°12'-36°16'N and 2°55'-2°60'E. Zooplankton diversity in the lake was monitored for two years between June 2014 and May 2016. Only one sampling per month has been taken into account on six stations and for the temporal monitoring of water quality. Zooplankton is a secondary producer which acts as the intermediate link between phytoplankton and fish in aquatic environment. A total of 67 species of zooplankton were recorded, including 47 rotifers, 15 cladocerans, and 5 copepods. Percent composition of zooplankton communities revealed that rotifer was the most dominant group. The Shannon–Wiener diversity index (H') varied from 1.151 to 3.763 bits.ind⁻¹ indicating moderate-to-good level of zooplankton diversity. The results of the saprobity index -based on bioindicator species- show that the water quality was between Oligo to Beta Mesosaprobic (very slight pollution to moderate pollution). The Ghrib lake was affected by various factors such as anthropogenic activities in the watershed of lake and agricultural runoff.

Keywords: Water quality, Lake, Algeria, Zooplankton, Bioindicator

Impact of Aegean paleogeography on diversification of freshwater gammarids from the Aegean Islands

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The Aegean Sea houses around 7500 islands and islets and with that, the Aegean region is globally recognized to have the highest number of islands in a single sea basin. Its islands along with other Mediterranean Islands are considered to be one of most important biodiversity hotspots in the world. Still, the knowledge about the Aegean freshwater biota is scarce, with very few studies focusing on the molecular phylogeography of the insular freshwater fauna. We analysed the multi-marker dataset including 107 individuals collected at 20 sites from the Aegean Islands including Crete, Lesbos, Samothraki, Skyros, Evia, Andros, Tinos and Serifos. The reconstruction of time-calibrated phylogeny revealed that divergence within the insular gammarids started in Middle Miocene with the first fragmentation of the Aegeis landmass and formation of the Mid-Aegean Trench. Moreover, we provide a first evidence of the presence of freshwater populations of *Gammarus* on six Aegean islands and at least three endemic species, most probably new to science. Our results indicate a strong connectivity between the diversification of the insular freshwater gammarids and the geological history of the Aegean Sea. Interestingly, our results support a recent dispersal of the newly described *Gammarus plaitisi*, indicating its presence on three different islands and providing the insight in its evolutionary history. Our findings provide also yet another evidence for deep divergence of the Mediterranean freshwater insular gammarids, helping to reveal the complexity of origin and timeframe of the evolution of freshwater species from the Mediterranean islands.

Keywords: *Gammarus plaitisi*, molecular phylogeography, insular freshwater fauna

Origin and numbers of Greater Flamingos (*Phoenicopterus roseus*)
resighted in Evros Delta, Greece

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Evros Delta is an internationally important site for Greater Flamingos meeting the 1% criterion over the last 23 years. The wetland hosts $9.6 \pm 4.7\%$ (SD) of the species at country level. Greater Flamingos are observed during autumn migration and winter, with numbers usually ranging from 3,000-4,000, while recently there is an increasing trend, with the maximum historical record being 8,500 individuals in February 2018. Surveys were carried out by the staff of the Management Body of Evros Delta and Samothraki Protected areas in 2011-2019 aiming at disclosing the origin of the birds met in the area and evaluating its importance for wintering. The 162 ring resightings from 77 different birds were analyzed by country of origin and sub-population. 53.2% of the birds were ringed in Turkey. Of the rest, 16.9% were ringed in mainland Italy, 2.6% in Sardinia, 13% in France, 13% in Spain and 1.3% in Algeria. 53.2% of the birds belonged to the eastern Mediterranean population and 46.8% to the western Mediterranean population. All the listed birds were ringed in 9 different Mediterranean wetlands. Most birds came from the Gediz Delta. The percentage of ringed birds observed in the wetland more than once - in different winters - is 26%, while those seen over 2 times amount to 9.1%. The age structure of the birds was: ≤ 3 years 13.1%, 4-9 years 57% and ≥ 10 years 29.9%. Evros Delta it is a wintering site equally important for birds from both the Western and the Eastern Mediterranean sub-populations.

Keywords: ringing, range, population, wetland, Management Body

Contrasting biogeographic histories of two freshwater shrimp genera in Periadriatic region

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Due to a set of geological and climatic factors influencing the region, circum Mediterranean area, with emphasis on Periadriatic, became one of globally important hotspots for endemism and biodiversity. This territory was also the refugium for species during glaciation events. Thus it is considered as being a good model for biogeographical and evolutionary research. Freshwaters of Europe are inhabited by representatives of two genera of shrimps. Till now, in the Periadriatic region, there are known five species of *Atyaephyra* from the family Atyidae and *Palaemon antennarius*, the species belonging to Palaemonidae. The investigation was upon shrimps occurring in rivers and lakes of Apennine and Balkan Peninsulas. Collected individuals were identified basing on morphology and studied with genetic methods. Molecular analysis revealed high genetic diversity in the examined dataset. For Atyidae family we obtained five MOTUs (Molecular Operational Taxonomic Units), which is in accordance with the number of nominal species described so far. Investigated Palaemonidae, were grouped into six MOTUs and therefore into six potentially existing species, among which five were formed by individuals deriving from Balkans. Our study provides two contrasting biogeographic histories dedicated to studied shrimp genera. Our results indicate also the utility of DNA barcoding combined with morphological studies for discovery of cryptic and pseudo-cryptic diversity. It emphasizes as well the need for taxonomic survey concerning freshwater taxa diversity in the Mediterranean biodiversity hotspots, even in case of well-known groups such as decapods.

Keywords: DNA barcoding, cryptic diversity, Caridea, circum Mediterranean area, phylogeography

Meta-analysis of the Barn Owl prey diversity on Mediterranean islands

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The barn owl (*Tyto alba*) is an excellent model predatory organism for exploring patterns of dietary diversity due to its wide spread distribution, habitat generalism, feeding flexibility, and the ease of diet analysis from pellets. Despite the fact that its diet is well known, the knowledge of the barn owls' prey diversity on islands is inadequate and fragmentary. The Mediterranean Basin with more than 5000 islands and islets is a global biodiversity hotspot with high species richness and endemism. Mediterranean islands vary considerably in size, shape, spatial arrangement, distance from the mainland etc. that influence islands' biotas. The main aim was to test if prey diversity on Mediterranean islands follows the MacArthur-Wilson (1963, 1967) island equilibrium model of species richness, in which larger islands that are closer to the mainland support greater diversity of species compared to smaller and more distant ones. For the meta-analysis of the barn owl prey diversity on Mediterranean islands, we obtained data from 14 published studies of the owl's diet performed on 16 Mediterranean islands. Mammals and birds (84.7% and 11.7% of total number of taxa) were the most frequent prey and present in owls' diets at all investigated islands. Murines were the most numerous (60.8%). Diet diversity followed the island biogeography theory. Diet diversity was greater on larger and less isolated islands. Island size and isolation were also good predictors of the proportions of preyed taxa. On smaller islands, more birds and reptiles than small mammals were consumed.

Keywords: insular biogeography, MacArthur-Wilson equilibrium model, diet diversity

Qualitative and quantitative analysis of the Syllidae (Annelida: Polychaeta) assemblages associated with the algae *Cystoseira barbata* in two coastal areas of the northern Aegean Sea, Greece

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The polychaete family of Syllidae has been reported to be a promising environmental indicator when it comes to selecting a particularly indicative group in hard bottom environments. We evaluated the qualitative and quantitative composition of the Syllidae community associated with the algae *Cystoseira barbata* at the sublittoral zone of the hard substrate, at two coastal areas in the Northern Aegean Sea, Greece, impacted by different human pressure. Our objective was to record the existing syllid communities in these areas and to compare them at a preliminary level, both for abundance and species richness. To accomplish this, samples were collected from Almira (Kavala) and Kallithea (Chalkidiki) in Greece and syllids were identified down to the species level. In Almira, 1,294 syllids were found belonging to 15 different species, while in Kallithea 1,089 syllids were identified from 9 species. Multivariate analysis methods suggested a statistically significant difference between the two areas. According to our results and previous studies, we concluded that although Syllidae has been considered an important group for the evaluation of the ecological state of coastal ecosystems, the information available on how each stress factor affects each species is not yet sufficiently determined and, therefore, further studies are to be needed.

Keywords: polychaete, syllids, ecological state, hard bottom

Benthic communities in the underwater cavern of Panteronisi islet
(Cyclades, Aegean Sea)

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Marine caves represent a key coastal habitat of the Mediterranean Sea. Within the Aegean Sea, they are particularly common in the island-dominated Cyclades Archipelago, where they represent hotspots for diving tourism. Regardless their high ecological value, only a handful of marine caves have been investigated in the region to date. Herein, benthic communities thriving in the frequently visited semi-submerged cavern of Pantieronisi islet were assessed using a non-destructive, photo-sampling method. Moving at different depths along the exterior-interior cave axis, 3 image samples were taken at regular 5-meter intervals on each cave wall (right and left). Image samples were analyzed using 100 stratified random points via the photoQuad software. 51 benthic organisms were recorded, belonging to 6 taxonomic groups (9 Macroalgae, 1 Foraminifera, 31 Porifera, 5 Anthozoa, 2 Polychaeta, 3 Bryozoa). To investigate structural patterns, organisms were also aggregated into 8 morphological groups (Algae: encrusting, turf; Animal: boring, cup, encrusting, massive, tree, and tubes). Across the cave, Porifera (35.52%), Algae (25.27%), as well as encrusting forms (algae with 19.68% or animal with 25%) dominated in area cover. However, the relative contribution of each taxonomic or morphological group varied considerably depending on its spatial position within the cave. The PERMANOVA analysis indicated significant differences in community composition and structure along the exterior-interior axis, reflecting a typical cave zonation with increasing distance from the entrance. Our work provides important baseline data for the future monitoring and management of this fragile habitat at a local and regional level.

Keywords: marine caves, benthic ecology, biodiversity, photo-quadrat surveys, eastern Mediterranean

Endoparasites in wild populations of Cypriot mouflon (*Ovis orientalis ophion*): preliminary results

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The Cypriot mouflon (*Ovis orientalis ophion*) is a wild sheep subspecies, unique to Cyprus. As there are only about 3,000 animals left, it is strictly protected. The surveys investigating diseases that can be potential threats to its conservation or that could be transmitted to domestic ruminants, and vice versa, are to date scant. The aim of this ongoing study is to investigate for the first time the occurrence and prevalence of endoparasites in wild populations of Cypriot mouflon, in order to assess their possible role in the health status of these animals and to evaluate their impact to domestic ruminants that share the same biotopes. Until today, 29 samples of mouflon faeces were collected from different localities of Cyprus where these animals are present and examined by three parasitological methods, i.e. floatation, sedimentation, and Ziehl Neelsen. All (100%) the samples were positive to parasites. More precisely, *Eimeria* spp. oocysts were found in 27 (93.1%) samples, larvae of the lungworms *Muellerious capillaris* in 26 (89.6%), and *Cystocaulus ocreatus* in 19 (65.5%), eggs of the nematodes Strongylidae in 14 (48.3%), *Trichuris* spp. in 4 (13.8%), and *Nematodirus* spp. in 4 (13.8%) samples, and of the cestode *Moniezia* spp. in 1 (3.5%) sample. According to the results, these animals have high prevalence of parasitism and great variety of parasitic species. Nevertheless, the number of samples that were examined is small, so further research is warranted to form a clearer picture about the impact of parasites on the health status and population dynamics of these animals and to domestic ruminants of the same areas.

Keywords: *Ovis orientalis ophion*, Cyprus, endoparasites

Phylogeny of the Eastern Mediterranean lizards of the genus
Anatololacerta (Squamata: Lacertidae)

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Genetic diversity is not always congruent with phenotypic heterogeneity, resulting in cryptic species complexes, which cause a great struggle for scientists trying to define 'species' and describe relationships among taxa. *Anatololacerta* is a lizard genus distributed in southern and western Anatolia and some neighboring Aegean islands. Three morphospecies were recognized in *Anatololacerta* but a recent molecular study revealed the presence of cryptic diversity within the genus which led to the description of a fourth species. The phylogenetic relationships between the four species (*Anatololacerta anatolica*, *A. budaki*, *A. danfordi* and *A. pelasgiana*) were not fully resolved. The present study aims to resolve these relationships using a more comprehensive sampling concerning both the number of specimens and the genetic markers. We used 218 specimens and 6 genes (3 nuclear and 3 mitochondrial) to perform phylogenetic analysis including tree reconstruction, species delimitation and divergence times estimation. Surprisingly, the results revealed the occurrence of one more distinct lineage, in other words, the existence of five well differentiated species. Yet phylogenetic relationships between the five lineages were still not fully resolved which may indicate that the speciation within *Anatololacerta* is relatively recent.

Keywords: morphospecies, genetic marker, lineage, cryptic diversity

The Hellenic Bear Register: Understanding the remarkable comeback of brown bears in Greece

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Brown bears are considered to be endangered in Greece. In 2000 we established the Hellenic Bear Register in order to understand the patterns of brown bear recovery in Greece. We analyzed genetic data from 350 individuals, tracking data from 22 bear-years, 66,500 locations of field evidence and 8,800 compensation claims. More specifically: we carried out a capture-mark-recapture study and estimated the bear population in Greece at >450 individuals, indicating a 100% population increase; we studied the recovery genetics of bears in Greece: genetic diversity in western Greece was the lowest in southeastern Europe; we documented also genetic sub-structuring in the West; we used GAMMs to study seasonal and circadian activity and GLMMs to study factors influencing bear activity and habitat use. During their recovery bears in Greece were mainly nocturnal, while habitat selection analyses revealed a high importance of shrublands and rough terrain as refuge areas for all bears; using PPPMs we show that bear distribution in Greece increased almost 100% during the study; we reconstructed pedigrees to reveal dispersal patterns of the Greek brown bear population during recovery; using geographic profiling we developed a method for identifying hotspots of bear activity in the country; we carried out a thorough analysis of human - bear conflicts. This is the most thorough study of brown bears in Greece, indicating a significant improvement in their conservation status. Based on our results we recommend the updating of the National Action Plan for the brown bear in Greece.

Keywords: conservation, population monitoring, Species Action Plan, *Ursus arctos*

Hydrological factors and ultimately local habitat conditions shape benthic macroinvertebrate communities in perennial and intermittent river ecosystems

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The abiotic factors that regulate species richness and community structure in running waters have long been studied; but how these factors hierarchically and/or interactively influence benthic communities still remains a challenge. To tackle this issue, the principal environmental factors that hierarchically determine the taxonomic composition-functionality of stream macroinvertebrate communities were examined. A large dataset from Greek rivers was used, and multiple macroinvertebrate metrics and traits between perennial and intermittent watercourses in high (spring) and low (summer) flow periods were compared. The results showed that stream macroinvertebrates were primarily influenced by two ecological gradients; (i) aquatic vegetation-conductivity and (ii) water temperature-canopy cover. Macroinvertebrates in perennial rivers were mainly influenced by the first gradient, while in intermittent rivers both gradients were important. Intra-annually, taxonomic richness and diversity were stably higher in perennial, in contrast to intermittent rivers, where they peaked during early summer, before the onset of drought. The two aforementioned gradients determined the taxonomic richness and diversity in both spring and summer; however, a clear influence of hydraulic factors (wetted width, water depth, flow velocity and discharge) was observed only in the intermittent samples. It is concluded that macroinvertebrate taxonomic richness and diversity in highly variable environments is primarily determined by hydrological variation and ultimately fine-tuned by local habitat factors. As climate-change scenarios predict severe modification of these factors, this study concludes that in river management, hydrological restoration should be prioritised over other local habitat factors by maintaining natural hydrological variability, to ensure aquatic community richness and diversity.

Keywords: species richness, diversity, species traits, spatial, temporal factors

Stream macroinvertebrate multi-metric index for altered hydrological regimes in Greek running waters

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Flow is a major determinant of aquatic biota community structure. The status of an unpolluted river may not reach ecologically acceptable conditions due to hydrological alteration. The degree of hydrological alteration cannot be ecologically quantified and the indices currently used in ecological monitoring do not distinguish between stressors of degradation. In this study, we developed a macroinvertebrate based multi-metric index to assess and classify hydrological alteration in Greek running waters. Prior to the index development, we defined optimal flow ranges for 96 macroinvertebrate taxa and categorized them in classes of flow tolerance, ranging from highly generalists to highly specialists. For the index development, seven metrics were combined: (i) the relative-abundance distribution of the highly generalist, generalist, meso-generalist and intermediate taxa, (ii) the relative-richness distribution of the aforementioned classes, (iii) the degree of deviation of the mean community discharge-per-unit-width (q) preference from the optimal q, (iv) the relative abundance of rheobiont (RB), rheophilous (RP) and rheolimnophilous (RLP) taxa, (v) the relative abundance of limnobiont (LB), limnophilous (LP) and limnorheophilous (LRP) taxa, (vi) the relative richness of RB-RP-RLP and (vii) the relative richness of LB-LP-LRP. The index performance was calculated using a test dataset of 1189 samples with different degrees of hydrological alteration. We tested the performance of 607 combinations of the seven metrics, from a single-metric to a seven-metric index, with various metric combination alternatives (average, minimum, median, majority-vote). The selected index has an accuracy ranging from 67% to 94% and can accurately (67%) distinguish between polluted and hydrologically altered sites.

Keywords: flow, discharge, hydrology, freshwater, monitoring

Arctodiaptomus steindachneri (Richard, 1897) no longer endemic to the western Balkans

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Arctodiaptomus steindachneri is a calanoid copepod species, known as an endemic to the Western Balkans, with distribution that is limited by the Pindos mountain range and inhabits large deep lakes. Even so, there have been records of its presence outside its known distribution; while its presence in neither large nor deep lakes has been recorded ever since its first description from Lake Pamvotis. Thus, the aim of our study was to reassess the distribution and suitable habitats for *A. steindachneri*. To that end, formalin-preserved adult individuals from Greek lakes, both on the east and the west of Pindos mountain range were isolated and morphologically identified under a microscope using taxonomic keys. Particularly, the isolated individuals were from Lakes Smokovou, Karla, Megali Prespa, Mikri Prespa and Pamvotis. The presence of *A. steindachneri* was confirmed in all the above-mentioned lakes, mainly based on the morphology of the right antennule and the fifth pair of legs (P5) on males as well as the shape of the last pediger on females. Its presence in Lakes Smokovou and Karla, located to the east of Pindos mountain range, points to its distribution expansion; which is possible for zooplankton species through several means of passive transportation. Furthermore, its presence in Lakes Karla and Mikri Prespa, which like Lake Pamvotis are shallow lakes, proves that *A. steindachneri* should no longer be categorized as a species that inhabits large, deep lakes. Thus, the species distribution and ecology of *A. steindachneri* should be updated.

Keywords: Copepoda, distribution, habitat, passive transportation, Mediterranean

Movement ecology of Eleonora's falcon at its breeding grounds:
revealing foraging patterns and identifying threats with the use of GPS
telemetry

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Eleonora's falcon (*Falco eleonora* Gén , 1839) is a transequatorial, long-distance migratory raptor, well-known for its delayed breeding period. Own to its great dispersal ability, especially so during the prebreeding period, detailed information on its distribution pattern is currently lacking. In this study we aimed at revealing the daily activity pattern of falcons originating from the core of its breeding population, namely the Aegean Sea, and ultimately identifying current pressures and potential threats. Based on GPS data of high spatiotemporal resolution from 2015 to 2018 we identified foraging areas visited during the prebreeding period and assessed the species' habitat preferences in these areas. We also investigated spatiotemporal patterns in the species' foraging activity during the breeding period. Our results indicated that until the onset of the breeding period the species visits insect-rich areas in the mainland lying several (even hundreds of) kilometers away of breeding colonies, whereas later on the species' movements are restricted in the vicinity of the breeding colonies. While important pressures were not identified within its prebreeding foraging areas, the predicted increased intensity and severity of wildfires as a result of climate change could challenge the quality of the species' foraging habitats. Additionally, offshore wind farms are considered an important threat given that the species' breeding colonies and its foraging range during the breeding period overlap with areas of high wind potential in the Aegean Sea. Consequently, future conservation schemes for Eleonora's falcon are encouraged to incorporate measured designed to tackle the anticipated threats.

Keywords: *Falco eleonora*, foraging grounds, wildfires, wind farms, climate change, Aegean Sea

Litthabitella, a truncatelloidean genus uncommon in Greece

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Litthabitella Boeters, 1970, is a genus of minute freshwater hydrobioid gastropods characterized by ovoid-conical shell, cylindrical, elongate bifid penis with irregular lobes, bursa copulatrix and two seminal receptacles. It includes two species, the type species *L. chilodia* (Westerlund, 1886) and *L. elliptica* (Paladilhe, 1874). At present, *Litthabitella* is distributed in Spain, France, southern Italy, western Balkan Peninsula and western insular Greece. The Greek populations have been recorded on two Ionian Islands, Kerkyra and Lefkada. Recently, *Litthabitella* specimens were found on another Ionian Island as well as in western Greek mainland. The aim of the present study is to elucidate the taxonomic status of these specimens and their affinities with the already known *Litthabitella* taxa. An integrative approach was designed by combining shell morphology, anatomical characters and mitochondrial DNA COI sequences. The results of this approach indicate that the specimens examined probably belong to a third yet undescribed species.

Keywords: Freshwater fauna, Mollusca, Caenogastropoda, Littorinimorpha

Avian community structure in a lowland, semi-natural woodland in northern Greece

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There are many factors that affect the composition and the diversity of the avian community in a forest, such as vegetation structure, season etc. Our aim was to study the avian community seasonal and spatial changes in a semi-natural, lowland woodland. The study area (29.1 ha) has a big variety of both local and exotic planted tree and shrub species, herb layer and grassland. Birds were captured in mist nets and traps that were permanently operated in three plots with different vegetation cover and heterogeneity: a) dense woodland (trees and shrubs cover up 76%), b) woodland with openings (trees and shrubs cover up 56% and c) sparse woodland (trees and shrubs cover less than 34%). Bird catching and ringing operation was carried out 1-4 times per month from 2007 to 2019. At least 5073 birds belonging to 71 species were ringed (recaptures are not included). The most abundant species was Great tit *Parus major* (18.5%) followed by Willow warbler *Phylloscopus trochilus* (13.3%). Fifty six bird species (47.5% of total birds) were captured during autumn migration period while 39 species (11.0%) were captured during spring migration. The bird species were not distributed evenly in the woodland and differences in bird diversity were recorded among the three vegetation types. The woodland with openings have had higher bird diversity (37 species) while the sparse woodland the lower (29). The dense woodland presented a medium situation (33 species). The findings indicate that the woodland with openings that present greater heterogeneity, support higher bird diversity.

Keywords: Bird ringing, bird diversity, stand heterogeneity

Importance of embryonic parasitoids in regulating populations of
processionary *Thaumetopoea pityocampa* (Denis & Schiffermuller, 1775)
in some Algerian cedar forests

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The purpose of this study is to propose alternative solutions based on the use of antagonists biologic, in order to fight against the pin processionary, *Thaumetopoea pityocampa* a defoliator damaging the silvicultural in the Algerian forests or wooded areas open to the public. To meet this objective, we have we conducted outings for harvesting the eggs mass of pine processionary in a random manner in pure cedar forests of three cedar forests: Chrea, Theniet El Had and Chelia. The prepared biological material is monitored daily in the laboratory to monitor the emergence of antagonists over time. A diversity of four parasitoids in control populations of the pine processionary moth was identified: *Baryscapus servadeii*, *Ooencyrtus pityocampae* and *Trichogramma embryophagum*. The fourth species is typical of *Anastatus bifasciatus* puntids cedar forest Theniet El had. From all the Eggs mass analyzed, the frequency rate of occurrence of the species *Baryscapus servadeii* stood at 29.31% for the station Chrea, 4.54% and 25% for Chelia and Theniet El Had respectively. For *Ooencyrtus pityocampae*, it is about 10.34% for the punters harvested site Chrea, 2.27% for laying harvested Chelia and 6.25% for biological material Theniet El-had. The attendance rate of *Trichogramma embryophagum* remains very low, with only 3.44% in Chrea and 6.25% in Chelia. This species remains absent in the site Theniet El had. The different rates of parasitism of a site to another depending on the species and in relation to the form of egg mass, cylindrical or plat. The *Baryscapus servadeii* remains more active than the rest of the parasitoids identified.

Keywords: parasitism, egg mass, antagonism, defoliation

Mass rearing and release of *Trichogramma embryophagum* for biological control of insect pests of forest cedar

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The purpose of this study is to propose biologic solutions based on the use of *Trichogramma embryophagum*, in order to fight against *Thaumetopoea pityocampa* that is considered as an important pest of forest cedar. To meet this objective, we went to search for a new substitution host of the species polyphagous, *T. embryophagum*, harvested only in the cedar forest. The rearing was be in tow batch. In the three study sites, three egg parasitoids were noted; *Baryscapus Servadeii* and *Ooencyrtus pityocampa* encountered in different habitat and *Trichogramma embryophagum* seen only in cedar. The presence of *B. servadeii* was noted over 80% of Egg mass studied. The eggs examined show a parasitism rate of 18% for the two natural ecotypes of the cedar forest of Chrea and the pine forest of Senalba Chergui. The longevity of parasitoids remains variable between species listed. The breeding of the polyphagous species, *T. embryophagum* on the egg mass of the pine processionary from the pine forests of semi-arid areas has yielded significant results. The multiplication tests are more conclusive on lots of the second test with 73% of parasitized Egg mass and an increase of 7% on the total number of eggs. Development of 5 ± 3 parasitoids through egg is noted. Comparable longevity of 7 to 15 days is noted on more than 80% of individuals in both tests. This result opens up a perspective for use the eggs of the currant clearwing moth as a host of substitution of the species *T. embryophagum* harvested in cedar forest.

Keywords: parasites, egg mass, biological control

Small mammals of Greece: A combination of *Tyto alba* (Scopoli, 1769) pellet analysis and Species Distribution Modeling

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The small mammals of Greece are comprised of 43 species which belong in the orders of Insectivores and Rodents, and they are a vital component of terrestrial ecosystems, but due to the cryptic ecology these species are poorly studied. Our aim is the study of distribution of the small mammals of Greece as well as the correlation of distribution of small mammal communities with environmental data. Barn owl, *Tyto alba* (Scopoli, 1769), pellet collection and analysis, and identification of the small mammal bone components. Distribution modeled through the MaxEnt algorithm. The collection of analyzed and recorded specimens of the Natural History Museum of Crete from *Tyto alba* pellets is comprised of 10233 skulls and 20056 mandibles which belong in 7 species of Insectivores and 21 species of Rodents from 147 locations. *Tyto alba* pellet analysis in combination with species distribution modeling may provide useful insight on the distribution and ecology of small mammals.

The H.F.R.I scholarship for PhD students is acknowledged.

Keywords: insectivores, rodents

Summer occurrence of cetaceans in the National Marine Park of
Alonissos, Northern Sporades, Greece

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The National Marine Park of Alonissos, Northern Sporades (NMPANS) is the largest Marine Protected Area in Greece (2220 km²). In the summers (June – September) of 2013–2015 and 2017–2018, we conducted boat-based surveys to study the poorly-known cetaceans of the NMPANS. Across 79 survey days and 2565 km of navigation, we encountered four species: common dolphin *Delphinus delphis*, striped dolphin *Stenella coeruleoalba*, common bottlenose dolphin *Tursiops truncatus* and Cuvier's beaked whale *Ziphius cavirostris*. Cell-based encounter rates were 0.95, 1.06, 0.64 and 0.18 groups/100km, respectively. Mean group sizes for the four species were 5.8, 16.1, 3.1 and 2.0, respectively. Common dolphins, encountered at mean depths of 68m (range 3–200) and bottlenose dolphins, at mean depths of 112m (range 3–370), were frequently seen in mixed-species groups, occasionally foraging at the surface. Striped dolphins were encountered at mean depths of 1141m (range 144–1580), Cuvier's beaked whales at mean depths of 1547m (range 1495–1580). Mean encounter rates of common dolphins increased significantly between 2013–2015 and 2017–2018: from 0.29 to 2.25 groups/100km. Group size did not show significant variation. Encounter rates and group sizes of bottlenose dolphin and Cuvier's beaked whale did not vary significantly. Encounter rates of striped dolphin increased in 2017, possibly an effect of smaller mean group sizes in that year. This study sets the stage for more detailed model-based investigations of cetacean distribution and habitat use.

Keywords: dolphin, encounter rates, Aegean Sea, Mediterranean Sea, marine mammal

Owl pellet analysis: the importance of post-cranial elements

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The study of owl pellets is the simplest method for zoologists who want to study the feeding preferences and preying habits of these predators. However, questions arise, concerning the methodology applied in such studies, since researchers worldwide seem to focus solely on cranial and teeth morphology for the identification and quantification of the material. In this study, a) we investigate the differences that appear in the number of prey individuals when the postcranial elements (skeletal or exoskeletal, in the case of insects) are included or excluded, respectively, in the identification and quantification processes and b) we explore the different results in biomass and biodiversity deriving from them. For this purpose, 62 pellets from two owl species, derived from NW Peloponnese, Greece, were examined, i.e. 35 pellets from *Athene noctua* and 27 from *Tyto alba*. When the postcranial material is taken into consideration, the results for both species, show an almost complete reversal in the values of the identifiable and non-identifiable specimens in favor of the former, while the number of determined taxa present in the pellets almost doubles. Differences are also observed in the biomass percentages per pellet or per taxon for the prey assemblages of each owl species, since their minimum number of individuals (MNI index) increases if the postcranial elements are included in the estimation.

Keywords: feeding preferences, prey habits, *Athene noctua*, *Tyto alba*, Peloponnese

Karyological study of three rodent taxa from Cyprus

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This constitutes a karyological study of three small rodents of Cyprus, i.e. *Acomys nesiotus*, *Mus musculus domesticus* and *Mus cypriacus*. The first two are characterised by Robertsonian (Rb) fusions in the karyotype, i.e. the merging of acrocentric chromosomes at the centromeric region to form bi-armed chromosomes. In *M. m. domesticus* this can lead to the reduction from $2n=40/FN=40$ down to $2n=22/FN=40$. Even though this phenomenon concerns only populations of the Euro-Mediterranean region, such Rb fusions have not been described in Cyprus house mice. Regarding *A. nesiotus*, it is characterized by $2n=38/FN=68$, with $2n=36$ being the lowest in the genus. The only karyologically studied population from Cyprus came from its NE tip, however several more populations throughout Cyprus remain unstudied. Finally, *M. cypriacus* is a Cyprus endemic, possessing so far only the typical acrocentric karyotype with $2n=FN=40$. Considering that these taxa need to be further studied karyologically in Cyprus, 32 specimens from various localities were examined, using the G- and C-banding staining techniques. The results showed that the two *Mus* taxa carried almost identical karyotypes with $2n=FN=40$. However, one *M. m. domesticus* specimen was characterised by the heterozygous appearance of a Homogeneously Staining Region (HSR), which is reported for the first time in Cyprus and another was heteromorphic for chromosome pair 1. All *A. nesiotus* samples possessed the same $2n=38/FN=68$ karyotype, described before, but the newly examined localities lie ca. 90 km SW of the previously studied, implying that this chromosomal race could be rather widespread on Cyprus if not the only one.

Keywords: Robertsonian fusion, HSR band, *Acomys nesiotus*, *Mus cypriacus*, *Mus musculus domesticus*

Cuvier's Beaked Whales strandings in Greece: causes of deaths and pathological findings

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Cuvier's beaked whale (family Ziphiidae) is the only beaked whale species frequently sighted in the Mediterranean Sea, whereas strandings of the species have been documented in the scientific literature in this region, since 1803. We aim to present a comprehensive distribution of stranded beaked whales in Greece (between 1962-2018) the possible causes of death and common pathological findings. A total of 157 stranded Cuvier's beaked whales have been recorded at our database. 46 animals were involved in 5 sonar induced atypical mass strandings (1996, 1997, 2000, 2011, 2014). Also, in 11 mass strandings (1962-2000) involving 29 animals no data of sonar used was available; the remaining animals stranded as single events at different times. Tissue samples gathered sporadically from fresh beaked whales' carcasses due to delays of alert notices and local difficulties. Full necropsy and tissue sampling was conducted *in situ* in only 8 animals, since they were sufficiently fresh to provide gross and histopathology findings. The results did not show any evidence of ship collision, blunt contact trauma, or fisheries related injuries. On the contrary, six animals had lesions compatible with "*gas and fat embolic syndrome*" that has been described for decompression-like sickness, most likely related to naval exercises, that took place at that time with the use of mid-frequency active sonar. In the remaining 2 animals infectious and environmental factors were involved. Stranding networks and systemic research on specimens with standardized necropsy protocols and sample collection for the investigation of death causes, are essential along the Mediterranean coastal countries in order to assess the threats and adopt protection measures for the species.

Key words: beaked whales, stranding, fat emboli, gas emboli, mid-frequency active sonar, death causes

Meeting the challenges of rehabilitating orphan Mediterranean Monk Seal pups in Greece

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With fewer than 700 individuals remaining (approx. 350 in Greece), the Mediterranean monk seal is classified as “Endangered” by the IUCN and rescue and rehabilitation of orphan pups has been identified as a conservation priority. The purpose of the present study is to present the rehabilitation program for Mediterranean monk seal pups in Greece and its challenges. Since 1990, twenty-nine pups (14 females and 15 males) have been admitted to the program, their age ranging from 1 week - 2.5 months, and their weight from 9kg - 18kg. On presentation, severe dehydration, malnutrition, mild to severe skin injuries, conjunctivitis, and mucosal pallor were noticed. After oral rehydration, fecal and blood samples were collected from all monk seal pups. Severe to moderate hypoglycemia and anemia, accompanied by parasitism by *Uncinaria* spp. were some of the major challenges during the first days of rehabilitation. As a response to these challenges an individually-tailored medical treatment was established. Furthermore, given that over the course of the rehabilitation program we often dealt with various gastrointestinal problems, we developed a specially-designed feeding schedule. In order to prepare the pups for their life in nature, contact with humans was kept to a minimum and animals were trained to catch live fish. Fifteen animals died during the rehabilitation process due to severe anemia, hypoglycemia, malnutrition, respiratory and gastrointestinal problems, as well as infections. After reaching a certain age and weight, fourteen seals were safely released back to the wild. Despite considerable challenges, rehabilitation of stranded monk seal pups is an important conservation tool for the species.

Keywords: monk seal, rehabilitation, anemia, hypoglycemia, parasitism, challenge

Life-cycle assessment as a method to identify environmental impacts in the Mediterranean aquaculture industry

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Aquaculture represents a core solution to satisfy human protein requirements, given that most fishery stocks are overexploited and global population is expected to reach 9 billion in 2050. On the other hand, the expansion and intensification of the aquaculture industry has raised concerns about environmental sustainability issues regarding for example resource use, production of by-products and effluents/emissions. Contemporary tools such as Life cycle assessment (LCA), has been recently applied as a method to assess environmental impact/performance of aquaculture activities. Overall, 27 species farmed in eight systems (in 28 countries) have been assessed by LCA, globally. However, the available published data on the LCA application in the Mediterranean Sea are very limited concerning species, systems and scope. In fact, only seven published papers related to sea bass and sea bream culture involved the application of LCA, revealing that fish feed is the most important contributor to most of the impacts studied. This is related to the production of fish meal and fish oil as feed ingredients and the amounts of nitrogen and phosphorus released into the environment. Other LCA works, compared either different rearing systems (RAS, cages, raceways) or farming types (traditional and cascade raceway). The current presentation aims to: a) review previous works related to the application of LCA in the Mediterranean aquaculture; b) explain data input requirements of the tool; and c) identify the need for more-tailor-made LCA applications for the sector.

Keywords: Life-cycle assessment, aquaculture, environmental impacts, Mediterranean Sea

An ecological and biogeographical approach to the geobiontic
orthopteran fauna of Crete

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The Orthopteran fauna of Crete consists of 72 species, 17 of which are endemic to Crete with an additional of 4 endemics to Crete and Cyclades. The rest are mostly wide-distributed species, some of which are on the northern/western limits of their distribution. The first extensive study of Orthoptera in Crete started at 1927 by Ramme, and continued by Willemse & Kruseman (1976), summarized by Willemse et al. in 2018. The aim of the present study is the analysis of the biodiversity of the communities of Cretan Orthoptera, using presence-absence data, relative abundances and yearly activity's data of all specimens deposited in the Natural History Museum of Crete. More than 80.000 specimens from the 30-year old collection, originating from all dominant habitats of the island (lowland and high altitude phrygana, oak, cypress and pine forests, wetlands and sand dunes), were identified to the species level. As more than 90% of the specimens were collected by pitfall trapping, they are predominated by ground dwelling species (geobionta and fissurobionta), which are usually neglected by classical Orthopterological research. Consequently, our first results showed not only a considerable number of species not previously recorded in Crete, including *Pteronemobius heydenii* and *Paramogoplistes novaki*, but many new locations (mostly on high altitude phrygana) of genera previously considered as troglobionts or troglophilic, like *Ovaliptila* and *Troglophilus* spp. In addition, we have identified several females of the Idi's endemic species *Eupholidoptera gemellata* (Willemse & Kruseman, 1976), which was previously known (and described) only by a single male specimen.

Keywords: fissurobionta, *Pteronemobius*, *Paramogoplistes*, *Eupholidoptera gemellata*, endemism.

The geographic structure of *Pelophylax* species in mainland Greece

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The water frogs of the genus *Pelophylax* are of the most diverse and widespread amphibians in mainland and island Greece, consisting of six species often with overlapping distributions. While the genus ecology has been extensively studied, we still know surprisingly little regarding species' genetic structure, especially in regions of contact zones, where cases of hybridization have been reported. Here, we used 12 nuclear markers to examine the genetic diversity and differentiation between *Pelophylax* populations and investigate the existence of hybrids. We focused on ten mainland populations of *P. epeiroticus*, *P. kurtmuelleri*, *P. ridibundus* and *P. bedriagae* distributed throughout Greece. We performed a Bayesian clustering analysis with STRUCTURE and multivariate statistics (PCA, DAPC) to identify the genetic structure of the *Pelophylax* populations. We then used HYBRIDLAB to simulate genotypes corresponding to individuals of explicit ancestry categories: pure parental populations, first-generation (F1) crosses, second-generation (F2) crosses, and backcrosses. With these new genotypes added into our dataset, we assign ancestry using discriminant analysis of principal components (DAPC). Our findings revealed clear genetic differentiation between populations and species with high levels of genetic diversity. On top of that, we were able to identify samples of admixed ancestry implying the existence of viable hybrids between *Pelophylax* species.

Keywords: hybrids, admixture, genetic structure

The value of hedgerows to overwintering bird communities in Mediterranean agricultural landscapes

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Hedgerows are one of the most important features of agricultural landscapes for wildlife. However, the response of overwintering bird communities to hedgerow structure has received little attention through Europe. In this study, we aimed to investigate how wintering bird communities respond to hedgerow characteristics. A total of 289 hedgerows with a length of 27.691 km were surveyed during December 2016-February 2017, in the plain zone of Trikala Prefecture, in Thessaly. Birds were recorded using line transects located 5 m in parallel from the hedge. For each hedgerow we recorded the length, width, height, number of trees, number of tree species, presence of berry shrubs, bordering crop category, presence of bordering ditch, forest and water body. A total of 1057 individuals of 41 bird species were recorded. The Chaffinch (*Fringilla coelebs*) was the commonest species, followed by the Tree Sparrow (*Passer montanus*) and the Blackbird (*Turdus merula*). GLMM analysis showed that bird species richness associated positively with the length ($P < 0.001$) and the height ($P = 0.007$) of the hedge, the number of tree species ($P = 0.045$) and the presence of berry shrubs ($P = 0.037$) in the hedge and the presence of water bodies ($P = 0.015$) adjacent to the hedge. Moreover, hedges bordering abandoned fields showed higher species richness than those bordering plowed ($P = 0.029$) and wheat fields ($P = 0.023$). In conclusion long, high and structurally diverse hedgerows support richest bird communities, thus providing foraging and shelter substrates during the severe winters in Mediterranean.

Keywords: hedges, winter, *Rubus* spp, avifauna, hedgerow structure.

Assessment of the physiological response of the bath sponge *Spongia officinalis* to elevated temperature conditions through differential gene expression

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The Mediterranean bath sponge *Spongia officinalis* is currently threatened by recurrent mortality incidents in its native habitats. Although elevated temperature has been indicated as the underlying factor triggering these events, the molecular mechanisms involved in the organism's response to thermal stress are not yet described. We experimentally tested the effect of exposure to temperatures of varying intensity and span on the species' gene expression profile, replicating thermal gradients encountered in coastal habitats of the Eastern Mediterranean. *De novo* transcriptome assembly was performed on data produced by an Illumina HiSeq next-generation sequencing (NGS) platform and gene expression analysis was conducted among the different experimental conditions. Our analysis revealed major shifts in the organism's transcriptomic profile induced by temperatures corresponding to the standard seasonal maximum (27°C), triggering processes related to signal transduction and response to stimulus. Further elevation of temperature corresponding to local extremes (30°C) activated additional processes, including immune response and apoptosis. However, following prolonged exposure to the extreme temperature, signs of resilience were observed through overexpression of regular cellular functions. Our results highlight the generally recognized sensitivity of *S. officinalis* to environmental shifts, providing an insight into the molecular mechanisms involved in the process. Furthermore, they suggest an innate capacity for thermal tolerance at the current extremes, implying a combination of factors and not solely temperature as the lethal agent. This sheds light on the mechanisms of pressure induced by ocean warming to its most sensitive receptors, coastal sessile invertebrates.

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Keywords: ecology, marine, climate change, transcriptomics, Porifera

Impacts of exurban sprawl on Mediterranean wildlife: Why we should worry about touristic development

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Islands harbor unique and sensitive wildlife. Little is currently known, however, on how touristic development affects island species. We analyzed how tourism-associated infrastructure impacts wildlife and wildlife habitat availability across a representative Mediterranean island landscape (Naxos, Aegean Sea, Greece). First, we aimed to evaluate how human-built structures (buildings and roads) affect island bird and reptile populations. Additionally, we investigated whether various factors associated with this development, such as cats, water, and food shape these impacts. Second, we mapped and quantified how touristic development over 33 years has changed landscape habitat availability for wildlife. We used wildlife field surveys to elucidate the spatial responses of wildlife to development and combined this with a compilation of image-derived spatial data of the recent touristic infrastructure expansion. Native birds declined strongly close to buildings and roads, and were replaced there by non-native invasive species. Reptiles also largely disappeared close to human development; much of this effect appeared to be driven by predation by house cats. Over the mapped period 1982-2015, human-built structures nearly doubled (buildings +94%; road length +107%). Combining the increase in infrastructure numbers with each structure's estimated ecological footprint revealed that only 20.5% of the potential wildlife habitat remains unaffected by development in the study region. This study demonstrates the landscape-level effects of diffuse touristic development on island wildlife and suggests the existence of interactive effects between touristic expansion and exotic species. Given the pervasive presence of tourism in island habitats, it raises concerns about its effects on resident biodiversity.

Keywords: tourism, wildlife habitat, landscape, birds, reptiles, Aegean Sea

Data over fauna of invertebrates on Sharr Mountain (Republic of North Macedonia)

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Fauna diversity in North Macedonia is represented by 13.447 species (Hristovski et al. 2015). 602 of these species are endemics, representing 4.47% of the overall fauna. Based on investigation of literature data over fauna of invertebrates on Sharr Mountain we have made lists of present taxa. The lists are supplemented with data from our own fauna research aided with the Project "Cooperative trans-boundary learning for ecosystem management and sustainable development in the Sharr Mountain region", which was financially been supported by IPA Project /2015/375-980. Our analyses show that from the fauna point of view Sharr Mountain Region is characterized with enormous diversity. Beautiful, rich and diverse ambient, presence of countless vegetation communities and diversity of biotopes have conditioned the appearance and attendance of abundant and diverse animal world. A lot of endemic species of organisms can be found within Sharr Mountain region, especially in the world of insects. Total numbers of registered taxa Invertebrates on Sharr Mountain are 2454, which represented 18.25% from Macedonian fauna, 90 taxa of them are endemic, which is 14.95% of Macedonian endemic Invertebrates fauna, Macedonian endemic are 14 species; Balkan endemic 72; 4 sub-endemic (Balkan and Apennine Peninsula); 2 species are on Habitat Directive Annex V and 2 are on Cites list. Butterflies (Lepidoptera: Rhopalocera) which are on IUCN Red List (Vu 5 species; Nt 27 species). On Habitat directive are 8 species and 3 species are Target.

Keywords: Fauna diversity, Sharr Mountain, North Macedonia, endemic

Identification of shark species using elliptic Fourier analysis

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Most of shark species are vulnerable and threatened to overfishing and mostly considered to be protected or endangered by the International Union for Conservation of Nature (IUCN) which categorized 43 shark species as endangered from 519 bony fishes found in the Mediterranean. There is a lack of information about the shark species identification and dangerous status in public. The goal of this study is to make a machine learning model for identification shark species using Elliptic Fourier analysis method. The number of harmonics can be estimated from a series of inverse Fourier reconstructions, or from the power spectrum. In this study, machine learning model such as Naive Bayes algorithm, K-nearest neighborhood (KNN) and decision tree algorithms were implemented to design an identifier for the shark species. Collected digital shark species images were used for identification of 14 shark species (*A. Vulpinus*, *C. Altimus*, *C. Limbatus*, *C. Plumbeus*, *C. Granulosus*, *D. Licha*, *G. Melastomus*, *H. Perlo*, *L. Nasus*, *M. Asterias*, *M. Mustelus*, *O. Centrina*, *S.S Canicula*, *S. Acanthias*). K-fold cross validation techniques are used for evaluation performance that is a statistical method to estimate the skill of machine learning models. The best result was achieved with the accuracy about 82% by the KNN model in which the other performance measure of average sensitivity and selectivity were 82% and 83% for 14 shark species, respectively.

Keywords: Machine learning, Elliptic Fourier analysis, shark species identification.

Modeling the distribution of refugia for marine biodiversity under climate change

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Climate refugia are areas where climate's physical and biological changes are slower than areas surrounding them. The ability to identify and include these areas into conservation planning could offer a promising approach towards improving conservation in a rapid change planet. Here, we developed and applied a methodology that was build the climate velocity context, to detect climatic stable areas along the Mediterranean basin. By using historical and projected data on sea surface temperatures (i.e. 1950-2100), we searched for climate-analogs (i.e. cells in space with an approximately similar climate to those of the cells under consideration) at five temporal bins of 30 years. Next, we investigated the extent to which the climatic stable area is enclosed within the current network of marine protected areas (MPAs). Our results demonstrated that climatic refugia along the Mediterranean Sea are gradually shrinking over time, while regions with high climate change velocity are expanding. The identified refugia are heterogeneously distributed across the region, with no clear evidence of a spatial clustering. We found that current MPAs enclose limited climatic refugia within their boundaries. This study constitutes the first effort of implementation the analog-based climate change velocity at the marine realm, while it provides the first comprehensive picture of the location and the extent of marine climatic refugia and their coverage from the Mediterranean MPAs.

Keywords: Velocity, MPAs, Mediterranean Sea, Climate-analogs

The enigma of *Barbus euboicus* resolved

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During the last two decades the knowledge on the diversity of the freshwater fishes in Europe increased considerably. The highest diversity and a degree of endemism is observed in the Mediterranean region. However, many endemic freshwater fishes are highly endangered. This is also the case of *Barbus euboicus* (Cyprinidae; Cypriniformes), barbel from the Greek island Euboia. There has been much confusion concerning the distribution of this species, and no knowledge about its biology and ecology. It was described in 1950, and mentioned to inhabit the streams on Euboia Island. Later publications assumed that the species is present only in the southern and central parts of the island, and it was expected that another species inhabits the north. Eventually, *B. euboicus* was considered to be endemic just to a single river basin, the Manikiotiko River, although this assumption was not corroborated by a research. We sampled river basins throughout Euboia, and *Barbus* was discovered in four of them. The populations were analysed genetically, based on mitochondrial (cytochrome b) and nuclear DNA (S7 and beta-actin). All markers unambiguously confirmed that all populations from Euboia belong to the same species, *Barbus euboicus*. Thus, the species is not endemic to the single or few rivers in the south-central part of the island, as suggested in the past, but it is present also in the northern part of the island. The conservation status of *B. euboicus* should be re-evaluated and appropriate management strategies developed to support the species, which is under considerable anthropogenic pressure.

Keywords: freshwater fishes, barbell, distribution, conservation

Quantitative analysis of the acoustic repertoire of free-ranging bottlenose dolphins (*Tursiops truncatus*) in N Aegean, Greece, recorded in the vicinity of aquaculture net pens

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The common bottlenose dolphin (*Tursiops truncatus*) is a vocal marine mammal that regularly occurs in the Aegean Sea, however studies documenting its acoustic repertoire are lacking in this region. This study provides a detailed analysis of the sounds produced by bottlenose dolphins in N Aegean Sea, and reports on the systematic presence of the species in southeastern Lesvos, Greece. Calibrated underwater recordings were obtained over 63 days using a fixed hydrophone deployed during October to December 2017 near an aquaculture installation located 200 m offshore southeastern Lesvos. 1510 hours of uninterrupted acoustic records were visually inspected for delphinid sounds, while the species was identified *in situ* by visual observations. In total, 13171 sounds were detected, 5019 of which were broadband pulsed signals (clicks and buzzes) and 8152 were tonal frequency-modulated sounds (whistles). All acoustic detections were used as presence indicators of the species, while whistles were categorized into 7 types according to their visual characteristics. Standard acoustic descriptors were subsequently extracted per whistle type. The results document the systematic presence of bottlenose dolphins around the aquaculture during afternoon to early morning hours (18:00 to 06:00) and their sparse occurrence during the rest of the day. Whistles produced by bottlenose dolphins in the study area have a center frequency of 9.5 kHz and mean duration of 0.6 s. Analysing cetacean sounds to the species level in a region-specific manner is important for conservation purposes, as long-term passive acoustic monitoring can help identify important areas for the target species.

Keywords: passive acoustic monitoring, cetaceans, acoustic communication, whistles, Lesvos, eastern Mediterranean

Biogeography of *Astacus leptodactylus* based on genetic data

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Astacus leptodactylus is a well-established Ponto-Caspian freshwater crayfish, which has extended its distribution to almost all Europe; its expansion is considered to be the result of natural phenomena and/or translocations. The aim of the present study is to identify the geographic pattern of *A. leptodactylus* populations by utilizing mitochondrial data (partial 16S and COI genes). The sampling effort included 987 visits in 364 potential sampling stations (2008 – 2013). The species was observed in two water bodies (Evros and Aliakmonas river systems). For each marker six new sequences were produced and combined with those derived from the GenBank. Two approaches were used: 1) concatenation of the partial 16S and COI genes, which comprised a total of 21 COI and 15 16S partial sequences, and 2) COI analysis of 107 partial sequences (7 countries from Europe and Asia). Divergence time between phylogroups was estimated in order to evaluate the phylogenetic history of the species. Both datasets indicated the existence of, at least, three phylogroups. It was estimated that the divergence of *A. leptodactylus* occurred between Miocene and Pleistocene, which could be explained by geological events. Nevertheless, in the case of Greece, the available information seems to be contradictory, “challenging” the considered native status of the species. It is proposed that the status of the species is introduced for Aliakmonas and unknown (cryptogenic species) for Evros river.

Keywords: narrow-clawed crayfish, species status, mtDNA markers, southern Balkans.

The freshwater mollusc diversity in Greece

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Molluscs have successfully colonized most of the world's freshwater ecosystems, and the freshwater molluscan fauna comprises about 6,000 of an estimated 81,000 described molluscan species. They are found in all continents except Antarctica occupying a wide range of aquatic habitats. In Greece, a country that is considered to be a biodiversity hotspot and exhibits high levels of endemism, there are 140 described species of freshwater molluscs with more than half of them being endemic. Although they are incredibly diverse, freshwater molluscs are also considered to be one of the most threatened mollusc groups because of their low survival and high extinction rates resulting from habitat loss, habitat degradation and species introductions. The most sensitive species are habitat specialists with restricted geographic ranges, elongated sexual maturation periods, low fecundity and are comparatively long lived. In Greece, roughly 40% of the freshwater gastropods and 23% of the freshwater bivalves fall into one of the threatened categories in the IUCN Red List, while 22% and 8% are listed in the Data Deficient category, respectively. The aim of the present review is to present the existing knowledge on the Greek freshwater molluscan fauna, identify the major threats and highlight the need for urgent conservation actions.

Keywords: diversity, freshwater molluscs, Greece, IUCN, threats

The diversity of the cetaceans frequent the Algerian littoral

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Cetaceans (whales and dolphins) remained for a long time the only zoological group for which a minimum of information was published and brought to the general public. Algerian waters are one of the regions of the Mediterranean where the presence of cetaceans is most frequent, from the point of view of the frequency of individuals than that of species diversity. This investigation work completed the gaps concerning the knowledge of marine mammals frequent the Algerian littoral. The contributions of this study address the strandings and necropsies of the bodies of these species found stranded, as well as, observations in seas carried out along the continental and island areas. To date eleven cetacean species have been recorded, eight dolphins and three species of whales of these have been reported washed up or stranded. One species, Humpback Whale (*Megaptera Novaeangliae*), was considered an occasional or visitor species. The results obtained confirm the presence of very diverse marine mammals in Algerian waters. However, these fragile, sensitive and beautiful marine creatures are subject daily to heavy anthropogenic pressure in their natural habitat.

Keywords: cetaceans, strandings, necropsy, observations, frequency, Algerian littoral.

The Greek Fauna Documentation Center of the Hellenic Zoological
Society

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The Greek Fauna Documentation Center of the Hellenic Zoological Society was established in 1979, one year after the establishment of the Society. The aim of the center is to collect, record and process the data related to the Greek fauna. Especially it contains the bibliography that is related to the fauna of Greece, the collection of elements of the characteristic ecosystems of Greece, the collection of means for identifying the Greek species, the statistic analysis and publication of the results, and the cooperation with other centers or individuals that are related to the fauna of Greece. The center collaborates with Greek and foreign scientists or scientific institutions, museums, collections for data exchange and mutual information. Individuals or institutions directly interested in the census can be accepted as official correspondents of the center. The center coordinates the action of those public or private bodies or individuals engaged in the inventory of certain groups of animals or ecosystems and offers every possible help. The center includes at the moment a list of approximately 17000 publications on the Greek fauna, 1200 publications on fossils, 1300 publications on the fauna of Cyprus, 500 publications on archaeozoology, 25 publications on ancient authors, 60 publications by travelers, 300 publications on invasive species and 5 on Byzantium. It also includes 473 publications that concern the fauna of the threatened species of Greece. At the moment 320 of the texts of these publications are available at icgf.myspecies.info

Keywords: fossils, archaeozoology, invasive species, threatened species

Nocturnal roost-site selection of overwintering corvids (Corvidae) in Thessaloniki, North Greece

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The high concentration of corvids in cities during winter can cause aesthetic or public health problems due to the high amounts of their excreta. The aim of this study was to investigate the characteristics of corvid roost sites in order to propose management measures for controlling urban wintering corvids. The study conducted in the Municipality of Thessaloniki from December 2017 to February 2018. Roost-site trees were searched out during extensive surveys on foot in parks and treelines between 6:30-10:00 p.m. Roosting flocks were mixed and consisted of Rooks (*Corvus frugilegus*), Jackdaws (*Corvus monedula*) and Hooded Crows (*Corvus cornix*). Roost-sites ($n = 39$) had higher mean height (16.3 m, $P = 0.000219$), larger mean canopy height (11.1 m, $P = 0.0079$), higher canopy height above ground (4.59 m, $P = 0.00878$), larger canopy radius (11.46 m, $P = 0.00088$) and larger dbh (0.55 m, $P = 0.0103$) than non-roost sites ($n = 39$). Crows avoided trees with sparse canopy density ($P = 0.025$), whereas corvids preferred larger trees for nocturnal roosting, in order to minimize the disturbance by human activities. Furthermore, the larger and more dense canopies the better the conditions provided and more space for communal roosting, thus allowing better thermoregulation for wintering birds. We recommend removal of roosting trees and replacement of short trees (<11.5 m) in urban environments in order to avoid creation of new roost sites. Other management actions, such as pruning of the existing trees should be adopted in order to become less attractive to corvids.

Keywords: crows, winter, urban, communal roosting.

Temporal and spatial distribution of the mesozooplankton community in the Kavala harbor (northern Greece)

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Harbors are sensitive ecosystems due to various activities carried out in them, resulting in pollution and degradation, which are known to affect the plankton community. This is the first study on mesozooplankton communities in a harbor of Greece and its aim was to determine the structure of the mesozooplankton community in the Kavala harbor. Monthly samplings took place between February 2017 and January 2018 at three stations, using a net with 250 μm mesh opening. Multivariate analysis showed higher similarity between the mesozooplankton communities from the two stations closer to the coastal front in comparison with the community from the station closer to the open sea. Mesozooplankton communities in Kavala harbor follow the pattern exhibited in other Greek coastal areas and are characterized by the presence of small pelagic Copepoda, such as Calanoida *Paracalanus parvus* (365 ind/ m^3) and *Acartia clausi* (186 ind/ m^3), and Cladocera *Penilia avirostris* (287 ind/ m^3). The high participation of meroplanktonic organisms (501 ind/ m^3) was evidence of a strong benthoplanktonic link; while gelatinous zooplankton (256 ind/ m^3) known as a dead end in the food web had a high participation as well. The maximum abundances recorded in this survey corresponded to the peak of the warm period and were greater in September because of a *Penilia avirostris* bloom, whose development is well known to be favored by increased temperature. On the other hand, no spring peak was recorded, as in other coastal ecosystems, probably due to the high abundance of the competitive protozoan *Noctiluca scintillans* in March (1,984 ind/ m^3).

Keywords: Copepoda, Cladocera, Meroplankton, Gelatinous zooplankton, *Noctiluca*, Mediterranean

A unique case of natural hybrids of the house mouse *Mus musculus domesticus* (Rodentia:Muridae) between Robertsonian chromosomal races with monobrachial homology

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The study of the karyotype of the western house mouse, *Mus musculus domesticus*, is very interesting, because of the formation of the chromosomal rearrangements, called Robertsonian (Rb) fusions: Non-homologous acrocentric chromosomes fuse at the centromeric region, thus forming biarmed-Rb chromosomes and leading to the reduction of the diploid chromosome number ($2n=22-40$). In nature, several Rb races of the house mouse (i.e. Rb populations with all their Rb fusions in homozygosity) have been recorded. Rb races sharing common descent form Rb systems, three of which are located in Greece. This work continues the study of the Rb system of Peloponnese and focuses on the contact zone between the Rb races GRKA with $2n=28$ and GROL with $2n=24$. The two Rb races are characterized by monobrachial homology, since the former carries the Rb(3.6) in homozygosity and the latter the Rb(1.3) and Rb(4.6). The karyological study was conducted on house mice, derived from within the contact area of the above two Rb races. The most remarkable result was the discovery of natural hybrids which carried exactly the intermediate karyotype of the two Rb races ($2n=26$), characterized by one pentavalent in meiosis (1|1.3|3.6|6.4|4). Such natural hybrids are extremely rare for the house mouse. Other interesting hybrid variants have also been found in the area between the two Rb races. Thus, we strongly believe that the contact zone between the Rb races at the NW part of the Rb system of Peloponnese, is an extremely interesting area for the study of hybridization events in nature.

Keywords: Robertsonian fusion, contact zone, gene flow, hybridization, meiosis

Study of the diversity of nematodes communities associated with olive
growing in Algeria

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The present study contributes to the exhaustive point on the species of nematodes associated on olive tree in Algeria. It aims at a better knowledge of the composition and the structure of the nematode communities infesting to olive orchards. The analysis of the data revealed a great diversity and a taxonomic richness of the nematodes associated on olive tree with the presence of 28 genera and 7 species of nematodes belonging to 17 families representing the different trophic groups: the fungivorous, the bacteriores, predators, omnivores and phytophagous nematodes. The latter, represent the dominant component followed by fungivores with respectively 46.42% and 32.14%, the other groups are weakly represented.

Keywords: olive orchards, fungivorous, predators, omnivores

Bioactive compounds from Mediterranean ascidians (Tunicata,
Asciacea): a review

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Marine invertebrates are an important source of biologically active compounds, as over 20,000 natural metabolites have been isolated so far. Ascidians are among the major taxa producing bioactive substances, and, therefore, the present study aims to revise the available published information regarding the isolation of bioactive compounds from Mediterranean ascidians. For this purpose, all publications, from 1975 to 2017, were collected, organized in a database and analyzed according to their content. The 184 publications studied (36% carried out in the Tyrrhenian Sea) reported the isolation of 364 compounds from 32 ascidian species, which represented 14% of the ascidian diversity in the Mediterranean Sea. Out of those compounds, 207 (63%) have been successfully tested for bioactivity, having shown mainly anti-infectious (antimicrobial, antibacterial, antifungal and anthelmintic compounds), cytotoxic, and/or anticancer activity. Ecteinascidin 743 (Yondelis®) and dehydrodidemnin B (Aplidine®), isolated from the species *Ecteinascidia turbinata* and *Aplidium albicans*, respectively, are currently in the pharmaceutical market as anticancer drugs. An interestingly large number of anti-inflammatory compounds are also reported in the literature, mostly isolated from the blood components of the ascidians (Morula cells). The species *Microcosmus exasperatus*, *Cystodytes dellechiaiei* and *Ciona intestinalis* have been found to contain the largest number of compounds. In particular, 35% of the ascidians inhabiting Greek waters contain one or more compounds. Mediterranean ascidians seem to be, therefore, a promising source of bioactive compounds that merits further investigation.

Keywords: tunicates, marine drugs, cytotoxic, antimicrobial, anti-inflammatory

Bending the rules: sexual size dimorphism and geographic variation patterns in the Hermann's tortoise (*Testudo hermanni boettgeri*)

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Large scale patterns of body size variation have long been the focus of many evolutionary studies. Among proposed hypotheses explaining body size variation are Rensch's and Bergmann's rule, according to which male body size varies more than that of females and that organisms tend to be larger at higher latitudes, respectively. This study aimed at evaluating patterns in sexual size dimorphism (SSD) and geographic variation of the eastern Hermann's tortoise (*Testudo hermanni boettgeri*). Both published and original data (carapace length and latitude) were aggregated and analyzed in order to determine whether the species follows Rensch's and Bergmann's rule. SSD was investigated by plotting log female carapace length versus log male carapace length using standard major axis regression, and the 95% confidence intervals (95% CI) were calculated. Next, we used linear regression to investigate the relationship between carapace length and latitude. Our results showed a significant negative allometry of female body size on male body size (RR: $b = 0.901$, 95% CI: 0.825–0.989, for $H_0: b = 1$, $P = 0.028$) indicating that SSD in Hermann's tortoise was not consistent with Rensch's rule. Conversely, carapace length was positively correlated with latitude ($r^2 = 0.64$ for females and $r^2 = 0.59$ for males), indicating that the species follows Bergmann's rule. Our results are consistent with the general patterns of SSD and geographic variation characterizing the *Testudinidae* family, according to which the smaller body size of males may be driven by sexual selection forces and thermoregulation processes.

Keywords: Rensch's rule, Bergmann's rule, Testudinidae, reptiles

Birdstrike risk assesement at “Makedonia” airport of Thessaloniki,
Greece

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Aircraft collisions with birds pose a major economic and safety issue for aviation industries worldwide. Identifying bird species that are more hazardous to airport safety allows the implementation of appropriate management strategies. This study aimed at creating a risk assessment matrix for evaluating bird strike hazards at “Makedonia” airport of Thessaloniki. Bird species were recorded from March of 2012 to February of 2013, from a vantage point overlooking the airport. Species data (relative abundance, body mass, flocking and flight behavior) were then used to evaluate bird strike risk by creating a probability-severity matrix. A total of 46 different bird species were recorded and were included in the analyses. Gulls (*Larus michahellis* and *Chroicocephalus ridibundus*) and ducks (*Anas platyrhynchos* and *Tadorna tadorna*) were identified as the most hazardous species for the airport’s safety. The aforementioned species showed seasonal variation in their habitat preferences. Gulls occupied water canals and water puddles in spring and air lanes in summer and fall months ($G^2 = 3759.701$, $P < 0.001$), whereas ducks mostly occupied vegetated areas during spring and water canals and water puddles during winter months ($G^2 = 591.633$, $P < 0.001$). Our results could provide a valuable tool for airport officials to rank species and then focus on mitigating bird strike events for those species presenting the greatest risk.

Keywords: probability, severity, aircraft collision, birds, relative abundance

Evidence for poecilogony and potential “sequential” poecilogony in members of the Genus *Raphitoma* (Mollusca: Gastropoda: Conoidea: Raphitomidae)

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Raphitoma species are uncommon to rare inhabitants of biogenic substrates of rather deep waters. Morphometry has been the only way for their systematics under the assumption that the dichotomy “paucispiral protoconch/lecithotrophic development vs. multispiral protoconch/ planktotrophic development” can identify members of “sibling” pairs of Mediterranean and NE Atlantic species. The implied idea that “loss of planktotrophy” leads *a priori* to “speciation” was not justified by experimental results while the acquisition of live specimens for DNA markers analysis is a laborious and long-term effort. So far, revision of the genus has produced 11 pairs of “sibling” species, an impressively frequent phenomenon of kinship in need of explanation. For this purpose, we investigated possible modes of reproduction that could lead to the phenomenon and proposed the theory that it could be attributed to a cell cycle regulating gene in the gonads that functions in conjunction with other genes and environmental factors to exhibit a discontinuous multifactorial inheritance leading to poecilogony by producing sister cells with a diameter smaller than that of the maternal cells by the factor 0.7937. For support, we used published morphometric data of the maximum diameter of protoconch I of 20 *Raphitoma* species belonging to 10 pairs of “sibling” species grouped in 11 sets and subjected them to the Deming “Orthogonal Regression Analysis” for congruence with the poecilogony hypothesis. Results exclude the possibility that the observed data are random and further support this hypothesis, while the pair *R. spadiana* - *R. contigua* exhibits a kind of “sequential” poecilogony pattern.

Keywords: paucispiral protoconch lecithotrophic development, multispiral protoconch planktotrophic development

Rivers as ecological corridors in the Balkan region and the impacts of flow disruption upon ecological connectivity

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Habitat corridors could offer safe passes for species, enhancing the exchange of individuals among isolated patches, and thus supporting long term population viability. Still, the ongoing habitat loss and fragmentation alter the structure and configuration of the landscape mosaic, generating a number of barriers to biological flows. In freshwater ecosystems and particularly in river networks, the development of dams largely disrupts the downstream river system's flow, affecting movement and dispersal of aquatic organisms. Here we assess the impact of dam-related infrastructure on the ecological connectivity of ten major, transnational rivers of the Balkan Peninsula. We combine and analyze spatial information on the rivers and the locations of existing and future-planned dams in the Balkan region. Using graph theory we transformed rivers into networks by considering dams as non-passable barriers. We calculated a series of graph theory metrics to quantify potential changes in structure, coherence and connectivity of the river networks under different scenarios on the extent and planning of human made constructions. Our results revealed that current connectivity patterns have already been affected by human infrastructures, a situation that will be intensified in the future. We further demonstrated that the sites that are more often selected for the establishment of an infrastructure project, are critical for enhancing connectivity of the river networks. This study clearly demonstrates that ecological connectivity is largely ignored when it comes to infrastructure planning in the region, suggesting for the need to adopt and apply a systematic, integrated, spatial, cross border conservation planning framework.

Keywords: Graph theory, Stream networks, Riverscape graph, Longitudinal connectivity, Freshwater ecosystems, River fragmentation

Systematic Conservation Planning accounting for connectivity across marine, freshwater and terrestrial realms in the Aegean Sea Basin

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Connectivity between and within different biotic realms is critical in conservation planning, especially given the growing understanding of the way in which anthropogenic landscape disturbances can significantly degrade both freshwater and marine environments. In this planning exercise, we aimed to identify high conservation areas for the protection of multi-realm species (i.e. species whose life or daily cycle includes habitats in more than one environment) and species whose activities are confined to one realm but face threats originating from multiple realms, taking into account the propagation of threats from land to freshwater and marine environments. We applied Marxan prioritization software incorporating various connectivity aspects to describe the processes between and within the different environments: (a) connectivity within the marine realm due to oceanographic currents; (b) connectivity between marine and freshwater realms through the estuaries; and (c) connectivity across freshwater realms through the river networks. We tested an innovative methodology that integrates processes and movements of organisms across and between environments into conservation planning, and show how accounting for connectivity across marine, freshwater and marine realms can benefit marine conservation. This article is based upon work from the COST Action 15121 “Advancing marine conservation in the European and contiguous seas (MarCons)” supported by the European Cooperation in Science and Technology.

Keywords: integrated coastal zone management, threat propagation, multi-realm species, Marxan, spatial prioritization, ecosystem based management

Climate change adaptive management for the protection of the loggerhead sea turtle in the Mediterranean Sea

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Ensuring effective conservation of marine biodiversity implies that all life cycle stages and related habitats should be protected. Climate change is likely to become the main cause of biodiversity decrease within the next years, with significant impacts on the marine ecosystems' structure and function, and the vulnerability of coastal areas. Particularly for long-range migratory species that depend on a variety of habitats such as sea turtles, climate change is expected to alter the species' ranges and phenology, posing a risk for the effectiveness of applied policies and management measures. The aim is to propose management actions for the long-term protection of the loggerhead sea turtle *Caretta caretta* population in the Mediterranean, suggesting important areas for the species' life cycle in both terrestrial and marine realms, accounting for the dynamics of ecological and climate change risks. Different scenarios were developed using MARXAN spatial prioritization software, and compared based on the present conditions and future impacts from climate change on the life cycle and preferences of sea turtles. The planning exercise attempts to make a substantial contribution towards the development of an integrative methodological framework for the protection of marine biodiversity, highlighting the risks of management actions when neglecting climate change effects. This research is carried out in the context of the project "Systematic conservation planning for biodiversity: developing integrated strategies in a changing planet" (MIS 5005001) under the call for proposals "Supporting researchers with emphasis on new researchers" (EDULLL 34). The project is co-financed by Greece and the European Union (European Social Fund- ESF) by the Operational Programme Human Resources Development, Education and Lifelong Learning 2014-2020.

Keywords: *Caretta caretta*, Systematic Conservation Planning, Marxan, management plan, vulnerability

Species-Area relationship of the Aegean: a multimodel and multitaxa approach

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The positive and monotonically increasing relationship between the number of species and area is one of the most discussed patterns in ecology and biogeography. The study of islands has played a crucial role in the understanding of this relationship, while the Aegean, an archipelago with more than 7000 islands and islets and complicated geological history, is a highly suitable region for these kind of studies. Over 20 SAR models have been described in the literature, however, despite this wide range of models, the majority of SAR studies are still based exclusively on the power model. Although the power model has been found to provide a reasonable fit to a wide range of datasets, it is not universally the best model, and a number of studies have reported other models to provide better fits to empirical data. Data concerning several different taxa (birds, plants, reptiles, land snails, chilopods, isopods-oniscidea, coleopters-tenebrionidae), for 38 to 184 islands and islets, were acquired from bibliographic references and from the collection of the Natural History Museum of Crete. The 20 different models were calculated and compared using the “sars” R package, for the total number of islands per taxon, as well as for subsets of common islands between taxa. From the analyses that were performed it is demonstrated that Crete plays an important role in the evaluation of the models. Also, there is no single best model that describes the SARs in the Aegean islands for all the different taxa.

Keywords: birds, plants, reptiles, land snails, chilopods, isopods, coleopters

Contribution of the LIFE program in brown bear conservation in Greece:
32 years of conservation efforts (1987-2019)

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Until the early-80s hardly any interest was attached to the fate of brown bears (*Ursus arctos*) in Greece. In the mid-80s isolated individuals and NGO initiatives managed to trigger the attention of state authorities to the precarious conservation status of the species. Between 1987 and 1989, the first national-scale conservation project, aiming at the establishment of urgent measures addressing mainly bear-human conflict, was implemented under EU/ACNAT. From 1994 to 2019, 9 consecutive LIFE-Nature projects marked one of the most productive period in brown bear conservation at national scale. Milestones from these efforts can be summarized as follows: a. Elaboration of a National Action Plan, b. proclamation of two National Parks in core bear habitat totalling 3,500km², c. radical amendments of the national compensation system for bear damage on agriculture, d. incorporation of subsidisation for electric fences in the Common Agricultural Policy and creation of an extensive Livestock Guarding Dogs network, e. rerouting of the largest highway in Greece and subsequent incorporation of specific environmental terms, monitoring programs and mitigation measures in all Environmental Impacts Assessments regarding highways construction, f. issue of specific law to control vehicle traffic on forest roads to minimize disturbance, g. institutionalization of a national Bear Emergency Team. Nowadays, brown bear range in Greece comprises of two distinct population nuclei located in Pindos and Rhodopi mountains covering a total range of 34,000km², including recolonization areas. With a total bear population of 475-500 ind. min, Greece constitutes the southernmost edge and stronghold of the species range in Europe.

Keywords: brown bear, conservation, LIFE program, Greece

The importance of a *Microtus vole* for Barn Owl in an Aegean island ecosystem

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Feeding ecology of Barn owl (*Tyto alba*) is extensively studied in agricultural areas of the Mediterranean region. However, there are few studies from islands, especially in the eastern Mediterranean. Lesvos, in the northeastern Aegean, is an island with a large total area of traditional mosaic of cultivated and grazing land. It is also the only island in the Aegean with a *Microtus vole*, *M. guentheri*. This study aims to investigate Barn owl feeding ecology in such traditional landscape of Lesvos. Prey remains, mainly skulls and lower jaws were collected and identified at genus and species level. The total number of prey items as well as the biomass per species and the total biomass for all species were also estimated. The results showed that in this area Barn owl feeds mainly on rodents and shrews, and opportunistically on passerine birds. Specifically, a total of 435 mammal individuals, corresponding to nine different species, were found. The most frequent species was *M. guentheri* with 39% of the total prey items and constituting and estimated 50% of the total biomass. A large proportion of prey were *Mus sp.* and *Apodemus mystacinus* with 11% and 10% respectively (8.1% and 7.6% of estimated biomass respectively). This study shows the importance of *M. guentheri* for Barn Owl when it is present on an island and demonstrates the important and functional role of *T. alba* in the possible control of species such as *M. guentheri* which can reach population densities that may be harmful to crops.

Keywords: food habits, agricultural area, northern Aegean, Barn Owl, Guenther's vole

Deep-sea biodiversity in the Eastern Mediterranean Sea: preliminary results from ROV observations from Kasos Strait and off South Crete

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The deep sea (>200 m depth) represents the largest mega-ecosystem in the world, containing as much as 95% of the global biosphere. Despite our limited knowledge on the deep sea, there is an evident increase in exploitation of living and non-living resources into deeper areas, leading to serious threats to deep-water communities and habitats. Therefore, there is a growing demand for the shifting of our attention to the studying of the deep-sea biodiversity, especially in the data-poor Eastern Mediterranean. The visual material examined in this study was recorded with the Remotely Operated Vehicle “Max Rover” and the submersible “Thetis” of HCMR, during the 2008-2009 expeditions of the DANAOS project, and was analysed in the framework of the DEEPEASTMED project (funded by HCMR and IUCN). Overall, 15 hours of video recordings, which covered a depth of 595-732 m in the Kasos Strait and off South Crete, were analysed. As a result, a total of 51 taxa were identified, belonging to 8 groups (3 Porifera, 14 Cnidaria, 1 Annelida, 3 Mollusca, 5 Crustacea, 6 Echinodermata, 1 Brachiopoda, and 18 Pisces), of which 8 have been listed in the threatened categories of the IUCN Red List. In addition, a considerable amount of litter from 6 different material types, mostly plastic, was found on the seabed. In most cases, lost amphorae on the seabed functioned as “artificial reefs” providing hard substrate to sessile invertebrates (e.g. Scleractinia). These results indicate that further research is required in the area for the adoption of appropriate management measures.

Keywords: benthos, hard substrate, soft substrate, fish, threatened species.

Estimating the stock status of fish and invertebrate species in the Aegean Sea

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It is widely accepted that the principal purpose of fisheries management is to ensure sustainable production from fish stocks over time. Fisheries stock assessments are an integral part of sustainable fisheries management. Due to the shortage of data in many countries of the Mediterranean Sea, such as Greece, there is an urgent need for stock assessment methods with limited data requirements. One such method is CMSY, which uses catch and resilience, to estimate reference points of fishing pressure (F) and biomass (B), relative to the ones that can produce the maximum sustainable yield (MSY). In the present work we estimated the status and exploitation level of 39 stocks in the Aegean Sea using the CMSY method based on catch and catch per unit of effort data. Of the 39 stocks, 22 (56%) were subject to ongoing overfishing ($F > F_{msy}$) and 19 stocks (49%) were outside of safe biological limits ($B < 0.5 B_{msy}$). In two stocks (5%), catches exceeded the maximum sustainable yield ($C/MSY > 1$). One stock could be considered healthy, defined by not being subject to overfishing and having a biomass above the one that corresponds to MSY. The stock status in the Aegean Sea agrees with previous studies regarding the western and central Mediterranean stocks that are also generally in poor state and heavily exploited. Stock recovery would require reduction of the total fishing pressure by modifying spatial and temporal fishing restrictions, as well as more efficient surveillance of fishing practices.

Keywords: reference points, fisheries, management, stock assessment, overfishing

Predicting habitat suitability for the European wildcat *Felis silvestris silvestris* in Greece

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The European wildcat (*Felis silvestris silvestris*) is the only felid with confirmed presence in Greece. Due to its elusive nature, the species has received little scientific attention and data concerning its distribution and population status is scarce and outdated. This is why the wildcat is listed as Data Deficient in the Red Data Book of Threatened Animals of Greece, whereas in the rest of Europe it has a decreasing population trend. This study examines the primary environmental factors affecting habitat suitability for the wildcat, using recent data from areas across Greece - from the Evros Delta in the north, to Helmos-Vouraikos National Park at the southern end of the species' historical range in the country. Using data from 114 camera trap sites (6 locations; range 6 to 54 traps), we run occupancy models evaluating a total of 21 environmental and human impact parameters. Wildcats were detected in 43 sites, and agricultural areas were shown to be more suitable for the species than previously thought, considering that the species was deemed to be primarily a forest resident. Water presence seems to be a crucial factor for preserving sustainable animal densities, featuring wetlands as critical habitat for the species to thrive.

Keywords: Occupancy model, camera trapping, felid

Climate and landuse effect on alien breeding bird species richness

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Climate change, land use change and biological invasions are considered significant threats to biodiversity and ecosystem services and they can have combined impacts on species, populations and ecosystems. In this context, we investigated how climate and land use have affected the diversity of alien breeding bird species, using two breeding bird atlases for two states (New York and Pennsylvania) (presence – absence atlases, cell size: 5x5 km²), each state was surveyed in two different periods 20 years apart. We also compiled climatic, land use, population density datasets from the different time periods, thus reflecting the climate changes and land use changes that occurred in this period of time. We found that in the earlier atlases, climatic variables played a more important role in shaping the distribution of alien bird species richness pattern than land uses, whereas in most recent atlases the reverse was observed. Additionally, when we selected the most informative variable to build an integrated model (including, climate, land use and human population) climate (temperature and potential evapotranspiration) was most often retained. For the earlier atlases, the most important role of land use effect was played by the variables that refer to anthropogenic interference, while in the most recent, landscape heterogeneity as well as anthropogenic intervention played a decisive role. Finally, we noticed that the best prediction was given by the integrated model which could predict alien species richness. Also importantly, when applying the integrated model constructed using the datasets of the first period on the datasets of the second period, its performance was far better than random with R squared for New York 50,4% and for Pennsylvania only 6,5%.

Keywords: bird atlases, generalized least squares models, spatio-temporal changes, prediction

Butterflies in the Aristotle University Campus

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In an attempt to register the butterfly populations in the university campus, line transect samplings were conducted on a monthly basis for a whole year in five sites differing mainly in the degree of disturbance. At each site, four replicate transect lines of about 100 m were walked for 10min, and all detected specimens within a distance of 2 m left and right of the line were recorded. Samplings were conducted at 10.00-12.00 and 16.00-18.00 during 4 days each month, in a way that none of the sites was sampled twice in the same morning or afternoon. Data were analyzed with PerMANOVA. Fourteen species were identified, belonging to the families Pieridae, Lycaenidae, Nymphalidae, Hesperidae and Papilionidae. The most abundant species was the “small white” *Pieris rapae* (27%), followed by the “common blue” *Polyommatus icarus* (26%) and the “large white” *Pieris brassicae* (16%), all three common throughout Europe. The “southern comma” *Polygonia egea*, with a southern European distribution contributed 10% to the total community. The total abundance of butterflies was significantly lower in the sites that were mostly disturbed by road traffic. The same holds for the number of species. The populations of most species peaked either in July or in October, leading to a statistically significant increase of total abundance during these months. Most butterfly specimens were recorded in the morning rather than in the afternoon samplings, especially during the summer months.

Keywords: abundance, disturbance, distribution, *Pieris rapae*, *Polyommatus icarus*

The biogeography of the South – East Aegean islets based on their terrestrial malacofauna

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We studied the Biodiversity and Biogeography of the most remote islets in the southeast Aegean, based on the rich material of land gastropods collected during several surveys since 1989 and stored in the Natural History Museum of Crete. More than 30 species have been found in 17 islets, with a total area of 13 Km². The analysis of the malacofauna supports: a) The high number of single island endemics and local endemics; b) The predominance of the Aegean character; c) The restricted influence of man; d) The rapid change of the composition of the malacofauna, based on the fossils and subfossils found. All findings suggest that the studied islets are remnants of an isolated submerged plateau that existed in Pliocene and early Pleistocene.

Keywords: Diversity, Remote Islets, Endemics, Zoogeography, Land Gastropods

Habitat and microhabitat of the foraging sites of the Red-backed Shrike
in the Prespa National Park (NW Greece)

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Land use change is one of the most important aspects of global change affecting many bird species worldwide. The Red-backed Shrike (*Lanius collurio*), is a species that often breeds in habitats that are connected to human activities, mainly agricultural and grazing land. The Prespa region is an area, rich in biodiversity, characterized by rural activities such as livestock and agricultural practices. The aim of this study was to investigate the habitat and the microhabitat characteristics used by Red-backed Shrike for foraging during the breeding season in this area of NW Greece. The study area comprised the full extent of the Prespa National Park protected area. Shrikes were systematically recorded by surveying all cells of a 1x1 km grid covering the area. Line transects were performed in a randomized way. For foraging individuals, we recorded characteristics of the microhabitat: the coverage of bushes, trees, roads, presence of hedgerows and other variables were compared between areas of absence and presence of the species. Additionally, habitat types of the study area were analyzed to identify the most used habitats by Red-backed Shrikes. Our results show that foraging sites of the species are located mostly in cultivated zones and grasslands grazed by livestock and with respect to microhabitat characteristics, our findings confirm the importance of habitat features such as shrubs, hedgerows, low vegetation and (dirt-) roads for the species. Therefore, the connection of the Red-backed Shrike to agricultural practices and their sensitivity to land use changes in such habitats is confirmed.

Keywords: microhabitat, land use changes, farmland birds, *Lanius collurio*, agriculture

α - and β - diversity patterns of two freshwater taxa in Balkan lentic ecosystems

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Investigating which are the factors that establish diversity patterns remains one of the fundamental goals in ecology and biogeography. Yet, few studies have simultaneously compared diversity patterns of different taxonomic groups in the freshwater realm. In the current study, we investigated the potential effect of geographical distance and environmental factors in shaping α - and β -diversity patterns of two highly diverse freshwater taxa: aquatic macrophytes and fish, in sixteen natural lakes of the Balkan Peninsula. Generalized linear models were applied to identify whether macrophytes and fish show similar patterns of species richness (α -diversity) along environmental factors. To examine whether geographical proximity or environmental factors explain the variation in the three β -diversity components [total β -diversity (β_{sor}), β -turnover (β_{sim}), β -nestedness (β_{nes})] or the community composition of the two biological datasets is determined by geographic distance of the ecosystems studied, generalized dissimilarity modelling was applied. Our results pinpointed lake area and altitude as strong predictors of α -diversity for both taxa; for fish, shoreline development was found the most significant predictor of species richness while macrophyte richness was also influenced by pH. Concerning the dissimilarity components, Sørensen dissimilarity (i.e. total beta diversity) of macrophyte communities was relatively low (mean β_{sor} = 60.1%) compared to fish (β_{sor} = 88.07%). In both taxa, compositional dissimilarity was attributed mainly to species turnover component (β_{sim}) rather than differences in species richness (β_{nes}). For aquatic macrophytes, the GDM model highlighted geographic distance to be the most influential parameter; conversely, for fish, altitude was found the most significant predictor of compositional dissimilarity.

Keywords: aquatic macrophytes, compositional dissimilarity, fish, lakes, species richness

Biology and conservation of *Pelophylax cerigensis*, the most endangered frog in Europe

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Pelophylax cerigensis, the Karpathos Marsh frog, is endemic to Karpathos Island (south Aegean Sea). It is considered the most endangered European amphibian because of its restricted range that comprises only two small rivers at the north part of the island. Since the first description of the species, there has been no information on its biology till very recently. For the past five years, we visited twice per year the island to evaluate populations' densities and did research on the basic biology of the species. Here we assess the demographic trends of the two *P. cerigensis* populations and the status of its biotope on north Karpathos. We also define the threats and risks that menace the species and present specific measures for its effective protection, that have been, at least partially, realized (e.g. building of small artificial ponds).

This study was sponsored by Stiftung Artenschutz (Amphibian Conservation Fund) and the Mohamed bin Zayed Species Conservation Fund.

Keywords: Marsh frog, endemic, Karpathos Island, demography

Nematode communities as indicators of the ecological functional state of microhabitats in heathlands of Island

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Soil organisms are pivotal in maintaining soil functionality, supporting significant ecosystem services like carbon and nutrient storage, water retention and pest resistance. Monitoring soil biodiversity components is especially important in areas where degradation processes, such as erosion or exotic plant invasions occur. In our study we aimed to assess the ecological functional state of soils across microhabitats with different types of degradation. At heathlands in Reykjavík (Iceland), we sampled soil from mosses, erosion spots and patches of *Lupinus* sp. (invasive alien). From the soil samples we extracted nematodes (Nematoda) and analyzed their community in terms of abundance, trophic and taxonomic diversity. We chose to study nematodes as they are efficient bio-indicators of soil condition. Several aspects of their community structure inform on the functional state of soils and reflect the type and intensity of land use. Our results show that nematode abundances vary significantly by microhabitat. Highest abundances were observed in the *Lupinus* microhabitat and lowest in the erosion spots. *Lupinus* was characterized by high contribution of bacterivorous nematodes, indicating an increased mineralization rate of nutrients, which may though be not entirely absorbed by plants and leak out to the environment. The nematode community structure in the eroded soil, as expected, indicated a suppressed environment with a low functional state. The moss microhabitat on the other hand had a taxonomically richer nematode community indicating an increased functional state. Our results show that the functional state differs highly between the different microhabitats and that carbon is differently metabolized across the heathlands.

Keywords: moss, *Lupinus*, erosion, ecosystem services

Riverine habitats of endangered fishes of the Balkan peninsula: extent of protection and their role in connectivity of protected areas

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Riparian systems are of a high scientific interest as they support a variety of ecological processes and provide numerous ecosystem services. Riparian systems could expand over broad geographic regions, acting as potential ecological corridors among distant sites. The Balkan Peninsula constitutes a European biodiversity hotspot that is shared by many countries. Hosting a number of drainage networks and riparian areas, the Balkans are characterized by a high endemism for freshwater fish distributed in rivers flowing across many landscapes. In this study, we examined whether the key rivers inhabited by 31 of the most endangered fish species could enhance connectivity of the protected areas on the Balkan region. We further investigated the extent to which protected areas cover the segments of rivers that host endangered fish. Towards this direction, we conducted a series of spatial analyses allowing to quantitatively address connectivity properties and protection patterns. Our analyses demonstrated that riverine corridors could enhance structural connectivity of protected areas, with a high proportion of the stream length currently lying within protected areas. We showed that 28 out of 31 fishes are currently found in river segments within protected areas from which 14 are found in segments that enhance connectivity but are not under protection. Acknowledging that connectivity is an essential for the efficiency of protected area networks, we suggest that in the Balkan region riverine corridors could become a key conservation tool.

Keywords: Protected area networks, ecological corridors, riparian zones, river ecosystems, Balkan region, freshwater

White-headed duck (*Oxyura leucocephala*) in Greece (1982-2017)

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The White-headed Duck (WhD) (*Oxyura leucocephala*) is a diving duck wintering in Greece, included in the list of the Endangered species (IUCN) and is a protected species in Greece (EU Bird Directive). Globally there are four populations. The migratory Eastern population breeds mainly in northern Kazakhstan and southern Russia and winters in western Asia, the Middle East and in eastern Europe as far west as Greece. The aim of this study is to present the wintering population of WhD in Greece based mainly on Mid-winter waterfowl counts. The species was first recorded in Greece in the winter 1857/1858. Since 1960 it has been recorded almost every year. The mean number of wintering birds during the period 1982-2017 was 378±496. The wintering population fluctuates from a few tenths to more than 1000 birds, numbers differ from year-to-year. The highest number (2.313 birds) was recorded in January 1997. The second highest number (1.472 birds) was recorded three years later, and the third highest, (1.200 birds) in 2015. Observations in recent years showed that birds are mostly female. Lake Vistonis and the coastal wetlands of the East Macedonia and Thrace National Park is the most important area for the WhD wintering in Greece (98%). Among the six more wetlands where the species had been recorded in Greece, Kerkini Lake is the most important and, recently, Volvi Lake. WhDs are present in Greece from October to March. In order to understand the presence of WhDs in Greece it is crucial to study the migration flyway.

The research was based on the voluntary participation of the staff of the Management authorities of Protected Areas and of the Hellenic Ornithological Society.

Keywords: Vistonis lake, wintering, birds, East Macedonia and Thrace National Park

Molecular phylogeny of *Phlebotomus* species (Diptera: Psychodidae)
from the Aegean islands

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Phlebotomine sand flies are able to sustain and transmit the parasite *Leishmania* spp., the causative agent of leishmaniasis in both humans and animals. In Greece there are 13 species of sand flies, 10 belonging to the medically important genus of *Phlebotomus*. Knowledge on the sand flies in the Aegean islands is minimal, since studies have been carried out only in Rhodes and Samos. The present study aims in the molecular study of the sand fly fauna in 11 Aegean islands through phylogenetic and statistical approaches. The samplings were carried out in the Aegean islands, Crete, Cyprus and Turkey using the CDC light traps. Phylogenetic trees were constructed based on mitochondrial and nuclear genes. Overall, about 3000 specimens belonging to 9 sand fly species were collected on the 11 Aegean islands. The most abundant and the most common species was *Phlebotomus neglectus*, which is the main vector of *Leishmania infantum*. Phylogenetic analyzes separated the species into separate branches and also showed that specimens of *P. neglectus* from Nisyros and Leros appear to be related to those from Turkey. Preliminary results from this study support that the Greek islands near Turkey may act as stepping stones of dispersal from Turkey to Greek mainland.

Keywords: Aegean islands, phylogeny, *Phlebotomus* sp.

Bio-ecological assessment of macro-zoobenthos of Shushica River
(Vlore), in the period 2017-2018

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In this study we are presenting data on systematic and bio-ecological macro-zoobenthos composition of Shushica River (Vlora, Albania) during 2017 and 2018. The aim of this study was to evaluate the ecological status (trend of changing) of Shushica River waters, under the direct impact of national road rehabilitation process during 2018. Changes in infrastructure and road developments are evaluated to have an important and direct effect on the water quality of the natural ecosystems. Biological evaluation of benthic macro-invertebrate composition was carried out to detect the possible trend of change on this river. During 2018 in the 3 study stations (Vranisht-Bridge; Gjormi-Bridge; Peshkepi- Bridge), a total number of 855 benthic macro-invertebrate organisms (22 families) were collected, compared with a total of 841 organisms (22 families) collected in 2017. The collected organisms belonging to 2 classes: Oligochaeta and Insecta. Between organisms of Insect class dominant are the families: Chironomidae, Simuliidae, Elmidae, Hydropsychidae, and Baetidae. The presence of the Leptophlebiidae (Ephemeroptera) family in the third station (Peshkepi-Bridge) as well as Sericostomatidae (Trichoptera) at the second station (Gjormi-Bridge) is confirmed. Based on the biotic SWRC - BI index the water quality in the three stations of Shushica River still remains good within the "Good" classification standard class (St. 1 – 3.97; St. 2 - 4.35; St.3-4.28).

Keywords: Shushica River, macro-invertebrates, SWRC - index, Insect

Hazard management and monitoring of a Golden jackal (*Canis aureus*) subpopulation living in the airport area of Samos Island, Greece

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The Golden Jackals (*Canis aureus*) in Samos island constitute the only insular population of this canid species in Greece. It is genetically distinct from the other populations in the Balkan Peninsula. A *C. aureus* subpopulation has been inhabiting Samos International Airport area, representing a potential risk for the air traffic and the welfare of the animals. Their gradual exclusion through non-invasive practices has become a priority. The subpopulation was monitored between May 2017 and October 2018 via camera traps and acoustic devices, deployed in locations with evidence of jackals presence, such as tracks around openings in the airport fencing used to access the airport area. The exclusion process began in March 2018 during which the entrance points into the airport fence were assessed and closed, except for one gate that remained open until October 2018. During that period, an attempt to herd the jackals out of the airport occurred. Afterwards, population monitoring continued alongside with vegetation removal. To study the post-exclusion behaviour and population dispersal, the camera trap and audio system monitoring continued. The results show an estimated number of 6-8 individuals in the airport using an instantaneous sampling estimator with peak activities between 23:00 and 4:00. Video footage provided information on the reproductive success, with recorded juveniles during breeding season and multiple identified dens within the airport area. Data analysis and telemetry study is ongoing to better understand the population dynamics and thus, elaborate improved plans on the management and monitoring of the Golden jackals in Samos Airport.

Keywords: *Canis aureus*, monitoring, population, airport, Samos island

Population size, fitness estimates and potential for connectivity of a local wolf (*Canis lupus*) population under risk of fragmentation from a multi-barrier infrastructure system (central Greece) using genetic markers and camera trapping

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Wolf population size, fitness and connectivity potential was estimated with genetic markers and camera trapping in a critical connection zone of the wolf distribution in central Greece (612 km²) during the construction phase (2010-2012) of a 4-lane highway (E65) and a high speed railway (NHSR). Wolves are strictly protected in that region under the 92/43 EU habitats directive. We used a canine nineplex with autosomal STRs (Short Tandem Repeat) to analyse wolf DNA samples (n=91) derived from scats collected at n=628 sampling spots. Camera trapping was performed in 42 locations to estimate wolf *Relative Abundance Index* (RAI) for each of the four sub-sectors defined according to spatial orientation and combination of infrastructures in close proximities. Ne was 12 and Nc was 20 individuals, or 2 wolves/100 km². Mean expected heterozygosity (He= 0.6508) was similar to other populations in Europe but slightly lower compared to other areas in Greece. Spatial distribution of the 15 wolf genotypes revealed that only one wolf crossed this double construction zone - a result consistent with camera trap data - as RAI index was significantly much lower in the sub-sector separated from both infrastructures. However, pedigree analysis and camera trapping indicated that migration of wolves in the study area has not completely ceased and was achieved through movement of wolves above a large tunnel and over undisturbed habitat. Our study reveal the importance of tunnels and large overpasses that may constitute a necessary technical condition when large infrastructure are combined and create overall large-width barriers

Keywords: Grey wolf, large infrastructure, disturbance, genetic markers, camera trapping

Is *Gambusia holbrooki* effective on the consumption of Diptera larvae in its non-native distribution range (Evros River Basin, Turkey)?

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Non-native *Gambusia holbrooki* Girard 1859, which is used as a biological agent for mosquito control, has entered to Turkey with cross-border river system (Tunca and Evros River systems) and expanded its range to all Thrace. The study aims to find the answer of the following question; is *G. holbrooki* effective on the consumption of Diptera larvae in its non-native range despite its invasion characteristic? In order to determine the feeding habit of the species, a total of 186 fish samples, which are collected from 13 different localities in Evros River Basin during summer months (July and August 2017) and stored among IUSHM (Istanbul University Science Faculty Hydrobiology Museum) materials, were investigated. The diet spectrum of the species consisted of five major groups: Insecta (Diptera, Ephemeroptera, Plecoptera, Odonata, Trichoptera, Coleoptera, Hemiptera), Arachnida, Crustacea, filamentous algae and detritus. According to the indices of relative importance (MI% and IRI%) of each uncountable (major groups such as plant, detritus, etc.) and countable (insect groups) preys, insect (MI%=94.4%) and Diptera (IRI%=95.8%) were the most prevalent preys. While females has fed with all the food types, small bodied males has mainly fed on Diptera (F% (the percentage of frequency of occurrence) = 97.7%). Levins' niche breadth indices ($B = 3.156$ and $B_A = 0.216$) and the diagram of the modified Costello graphical method also proved that the species had showed a narrow niche breadth and maximum specialization on Diptera.

Keywords: Diet, mosquito fish, invasion, Thrace

Tail regeneration alters the proteins digestive efficiency in lizards

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Lizards tails show a remarkably diversity in function. Importantly, tails are associated with predator escape through autotomy. The shed tail distracts predator's attention allowing lizard to escape. However, tail loss comes with many and severe costs. Therefore, it is imperative for lizards to regenerate their tail and restore overall fitness rapidly. To provide the required energy lizards need to undergo a number of physiological adjustments, including digestion. Digestive efficiency determines the amount of energy that animals gain from food. Here, we examined the relation between tail growth/regeneration and protein digestive efficiency in three mainland *Podarcis* species (*P. muralis*, *P. tauricus* and *P. peloponnesiacus*) and three island species (*P. erhardii*, *P. milensis*, *P. gaigeae*) that are subjected to different predation pressure. We presumed that tail regeneration would induce shifts in the process of proteins digestion as amino acids are used as building blocks. Furthermore, we hypothesized that lizards from habitats with high predation would regenerate their tail faster. To address our hypotheses, we simulated predation pressure in the laboratory and induced tail autotomy in lizards. Furthermore, we examined the digestive efficiency of proteins in two time points: before and after autotomy. In all cases tail regeneration increased protein digestion. Also, predation regime affected the rate of amino acid absorbance.

Keywords: predation, amino-acid absorbance, energy cost, autotomy

Deep-sea vulnerable sessile benthos in the Eastern Mediterranean:
identifying current knowledge and gaps

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Although deep-sea (>200 m) habitats cover more than 65% of the earth's surface, information on their associated biodiversity remains scarce and fragmented worldwide. Deep-sea benthic habitats are known to host long-lived emergent fauna of low turnover rates or fragile biogenic structures, thus being particularly vulnerable to numerous human activities (deep-sea fisheries, seabed extraction and mining, underwater cables/pipelines, etc.). In the frame of the DEEPEASTMED project, aiming to identify and map Vulnerable Marine Ecosystems (VMEs) in the Eastern Mediterranean, we reviewed the published and grey literature for available records of deep-sea sessile taxa and relevant metadata (date and method of observation, abundance, seabed type, pressures). In all, 441 records of a total of 51 taxa were compiled and mapped in the Eastern Ionian, North Aegean (excl. Sea of Marmara), the South Aegean, the Libyan, and the Levantine Seas, with the bamboo coral *Isidella elongata*, the crinoid *Leptometra phalangium*, the scleractinians *Caryophyllia smithii* and *Desmophyllum dianthus*, the sea-pen *Funiculina quadrangularis*, the demosponge *Rhizaxinella shikmonae*, and the brachiopod *Gryphus vitreus* being the most commonly reported species. Albeit much of the available records are outdated (~45% dating before 2000) and mostly obtained through soft-bottom biased and destructive methodological approaches (~70% acquired through trawling), our hereby compiled dataset clearly reveals the widespread presence of vulnerable deep-sea benthos across the study area and calls for more systematic studies that would consistently allow the design and implementation of robust and effective conservation actions in the Eastern Mediterranean Sea.

Keywords: sponges, corals, Vulnerable Marine Ecosystems, literature review, spatial distribution

Bat activity in relation to landscape cover associated with lakes in Greece

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All bat species are protected in Europe, in part because of the important ecological service role as insect predators in terrestrial and aquatic systems. Bats use aquatic ecosystems on the landscape for drinking and feeding on aquatic insects. However, water quality and other landscape characteristics can play a crucial role in bat activity. Understanding the relationships between landscape characteristics and bat activity is important for setting conservation priorities for ecosystems that are significant for bat species. Our aim was to investigate how landscape characteristics, including anthropogenic development, explain bat activity in Greece. We recorded the activity of bats with stationary acoustic detectors for 3 consecutive nights, from sunset to sunrise, in spring 2019. Our recording sites were near and away from the edge of 6 lakes. Spatial analyses were performed using Geographic Information System (GIS) with Corine Land Cover across the survey area. Percentage of land cover for landscape elements (e.g. urban cover, proximity to water and artificial light) was calculated using a buffer zone of 5km radius around each site. General linear models including land cover and meteorological effects were used to identify the role of each effect in explaining the variance in bat activity. In general, bat activity was higher at sites close to water, but specific trends with other single landscape cover characteristics were less clear. This study is within the framework of the research project “Bats and their relationship to water availability and quality in the Mediterranean sub-basin” and the results will contribute to conservation recommendations.

Keywords: Chiroptera, lakes, water, land cover

Diversity of *Phoxinus* in Greece: Insights from the genetic data

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Knowledge of the diversity of freshwater fishes in Europe has increased considerably during the last two decades. The taxonomy of the Eurasian minnows in the genus *Phoxinus* (Cypriniformes, Leuciscidae) have undergone drastic changes. A decade ago, only seven species were recognised, while currently 18 taxa have been documented; seven are undescribed. Such considerable change is mainly due to genetic analyses, as *Phoxinus* species are morphologically very similar. *Phoxinus* is present in Greece only in the rivers of northern and eastern Aegean Sea slope, usually these populations are isolated in cool-water sections of streams or spring-fed waters. Apart from *Phoxinus strymonicus* in the Strymon basin, the remaining populations were of unknown taxonomic status until this investigation. We sampled *Phoxinus* populations in Greece from five river basins. Mitochondrial (cytochrome b and COI) and nuclear (RAG1) markers were used. The results revealed the presence of three different lineages in Greece. The Strymon basin and the nearby Marmaras river basin are inhabited by *Phoxinus strymonicus*. The more easterly located population from the Filiouris basin is closely related to *Phoxinus strandjae*, though with a considerable genetic divergence from the population of this species from its type locality (Bulgarian Black Sea rivers). Finally, the westernmost basins of Loudias and Aliakmon are, surprisingly, inhabited by populations related to *Phoxinus lumaireul*, the species otherwise known from the western Balkans. Since the total distribution range of these populations is extremely range-restricted, taxonomic research is of high conservation relevance. Our data suggest the necessity to re-evaluate the conservation status and management strategy for the genus *Phoxinus* in Greece.

Keywords: freshwater fishes, taxonomy, isolation, populations

Morphological adaptation of geckos to clinging to trees or rocks

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Lizards adapt to their microhabitat by altering several features such as claw and toe morphology. On mainland Greece, Kotschy's geckos (*Mediodactylus kotschyi*) are found almost exclusively on trees. On the contrary, on small, tree-less islets geckos are saxicolous. On larger, tree-harboring islands geckos use both microhabitats. We tested whether gecko, collected from rocks or trees, toe and claw morphology differed, and whether it was related to their clinging ability to each substrate. We predicted that geckos will be better able to cling to the substrate on which they were caught, and that individuals caught on trees will have shorter toes and shorter and more curved claws than individuals collected from rocks. To test our hypothesis, we measured the weight, body and toe lengths, claw length, height and curvature in relation to clinging ability to both surfaces, of 15 geckos collected from trees and 51 geckos collected from rocks. Larger geckos, which had shorter and higher claws, could cling better to both substrates. There was no relationship between the geckos' clinging ability, toe and claw morphology, and the substrate from which they were collected. Our results suggest that the same morphological requirements, short and high claws, and large body size, are most important for better clinging to both trees and rocks, and that geckos can cling to both substrates equally well, regardless of their origin.

Keywords: claw and toe morphology, clinging, *Mediodactylus kotschyi*

The 'Megalonisos' island race: comparing biodiversity of Crete and Cyprus

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Cyprus and Crete are the 3rd and 5th largest islands of the Mediterranean, respectively, and are both called 'Megalonisos' ('large island') by locals. The two islands are definitely isolated from mainland for a comparable amount of time, that is, after the end of the Messinian Salinity Crisis (MSC), ca. 5 Mya. Even though Cyprus might have never been connected to mainland (i.e., is an oceanic island), its distance from neighbouring mainland during MSC was surely very short and rich in stepping stones, so that true biotic isolation has probably been most effective for the subsequent time period. Crete is a continental fragment, a bit more distant from the closest mainland than Cyprus is, with several stepping stones in-between, which Cyprus lacks. Crete consists of limestone with a complex topography and high elevation, whereas Cyprus is mostly volcanic (except for the low Pentadaktylos mountain range), with a much smoother topography. We use published and authors' own data for several taxa, including angiosperms, invertebrates and vertebrates, whose per taxon completeness and/or recording intensity is similar between the two islands. We compare total species richness, local endemics' richness, as well as generic richness for each taxon, using also information on interesting patterns regarding species composition for selected cases, to evaluate results in view of island biogeography theory and the evolution of the two islands' biota.

Keywords: island biogeography, endemism, species richness, biotic diversity, isolation

Biodiversity composition of Odonata order for Albania

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Dragonflies play an important ecological role in freshwater habitats and terrestrial habitats as they are the linkage of the food chains in these environments. They are considered as an indicator group, as well as model organisms to assess the effects of global climate change. This study is analyzing data on Albanian Odonata. 120 field trips were organized during 2013-2017. In this paper we are presenting for the first time for Albania an update list of 70 Odonata species belonging to 2 suborders Anisoptera and Zygoptera, 9 families and 27 genera. From the analyzed data we are reporting 1 new genus and 4 new species of Odonata order for Albania. The new genus is *Trithemis* and the new species are: *Calopteryx xanthostoma*; *Coenagrion mercuriale*; *Sympetrum sinaiticum*; *Trithemis annulata*. Two of these species *C. xanthostoma* and *S. sinaiticum* are collected only in one station during this study period, while the others, *C. mercuriale* and *T. annulata* are collected on a bigger number of stations. *C. xanthostoma* and *S. sinaiticum* are collected in the Soda Forest and Morava, areas that do not have the status of Protected Area. The results presented in this paper, are evidence of new sites and new locations for most species of this order and in particular for *S. nigra*, *S. vulgatum*, *S. fonscolombii*, *S. flaveolum*, *O. cancellatum*, *O. coerulea* and *O. albistylum*.

Keywords: dragonflies, freshwater habitats, updated list, diversity, new species

Three months of ranging data of an immature male marsh harrier (*Circus aeruginosus*) tracked by Satellite Telemetry in the Evros Delta, NE Greece

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An immature male marsh harrier (*Circus aeruginosus*) was trapped in late January, 2019 in the vicinity of the Evros Delta and fitted with GPS/GSM transmitter. Its home range encompassed an area of 146.2 km² (95% MCP), and 50% 5.6 km². MCP estimates showed a high monthly contraction of the home range (for 95% February=153.1 km², March=44.7km², April=27.3 km²), either due to higher food availability, or an active breeding attempt. The harrier hunted in farmland around the marshes and returned to a few places (7) to roost in reed beds within extensive marshes or abandoned fields. The overwhelming majority of roosting (>85%), within 98 nights of tracking, occurred in two reed beds on abandoned fields in the Greek part with a few within the marshes of Gala Golu in Turkey. The harrier remains in the area as of early May. Qualitative descriptions of its winter foraging areas indicate a high usage of abandoned and fallow fields, that probably relate to higher prey availability. Flight heights were mostly at <35 m within range of collision with infrastructures such as power lines and small wind turbines. The two large communal harrier roosts on the Greek side revealed by the telemetry, hosted high numbers of marsh harriers (>50) and small groups of hen harriers (*Circus cyaneus*). The information gathered in this instance highlights the importance of telemetry data for a better understanding of the crucial ecological parameters for this and other species that are utilizing the peripheral areas of National Parks.

Keywords: Home Range, GPS telemetry, Critical habitats, Raptors, Birds of Prey

Assessment of non-invasive passive acoustic detection of wolf (*Canis lupus*) and golden jackal (*Canis aureus*) presence

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Elicited howling (or call-response) surveys of wolf (*Canis lupus*) and golden jackal (*Canis aureus*) are widely used across the species' range. The method involves stimulating a response howl, confirming a species' presence, through either human-simulated or played back actual howls. Though effective, there are concerns that the method may be invasive to residential packs as they can be deemed as incursions of intruders in their territory. Moreover, wolves and jackals do not always respond to the howling stimulus. Since both species howl spontaneously, their presence could be also detected using passive acoustic monitoring (PAM). While PAM has been used to survey several wildlife taxa, its potential for monitoring wild canids is only now attracting attention. Recognizing the non-invasive nature of PAM (as no acoustic stimuli are used) and its potential to be used affordably across large areas, we assessed whether wolf and jackal presence can be detected in a typical Mediterranean landscape (Komotini, Thrace) using autonomous acoustic sensors. Two Cornell SWIFT acoustic sensors recorded continuously (8-KHz sampling rate) for 23 days (October 2017) in an area where wolf/jackal presence had been previously confirmed via a camera trap survey. Data were hand-browsed and putative jackal and wolf calls reviewed by an expert. In total, calls of both species were detected at both sites (wolf: 5 calls over 3 days; jackal: 19 calls over 13 days). We discuss the pros and cons of elicited howling vs. PAM wolf/jackal surveys, and suggest ways of making the later more efficient and affordable.

Keywords: passive acoustic monitoring, autonomous recording units, elicited and spontaneous howling, wild canids, call-response surveys

To be or not to be *Padogobius*

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Gobies (Gobiidae, Gobiiformes) are a remarkable group of fishes, not only due to their great diversity, but also due to their extraordinary ability to colonize different types of environments. The majority of species inhabit marine coastal waters and are benthic and small-sized. Within the *Gobius*-lineage, one of the three evolutionary groups of gobies distributed in the Mediterranean and East-northern and East-central Atlantic, at least two events of switch to freshwater lifestyle occurred. One of the documented switches happened in the ancestor of the speciose Ponto-Caspian clade benthophilines, and the other in the ancestor of the genus *Padogobius*. This genus comprises two species, inhabiting freshwaters of northern and central Italy and northern Croatia, and having allopatric distribution. As some previous studies pointed to the possibility that this genus might not be monophyletic, we analysed two mitochondrial and three nuclear markers in order to clarify the evolutionary relationships between the two species considered to belong to the genus *Padogobius*, and their relationship with the other genera of the *Gobius*-lineage. All results unambiguously showed that *Padogobius nigricans* is actually a species of Ponto-Caspian genus *Neogobius*, the genus *Padogobius* is monotypic, comprising only *Padogobius bonelii*, and the neighbouring distribution of the *N. nigricans* and *P. bonelii* is not a result of their common evolutionary history. But how did *N. nigricans* get so far away from his congeners?

Keywords: gobies, fishes, freshwater, Mediterranean, Ponto-Caspian

First record of *Rhyacophila pubescens* (Trichoptera: Rhyacophilidae) in
Republic of North Macedonia with notes on the ecology and distribution
of the species

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Rhyacophila pubescens Pictet, 1834 belongs to the *Rhyacophila tristis* group, owning the common larval morphological characteristics typical for this species group: lack of gills on the abdomen, anal proleg without apicodorsal spur, free basoventral hook and anal claw without ventral teeth. The species can be recognized by its nearly parallel-sided head, its smooth and flat ventral surface at lateral view, and the very short basoventral hook. It prefers calcareous waters and is often found in tufa streams. In this study we present the first record of *R. pubescens* in the Republic of North Macedonia. Larvae of the species were collected during the intensive hydrobiological research conducted in the summer of 2018, in a small stream draining from a peat bog located in the close surrounding of the mine "Sasa". The specimens were collected by hand pecking and conserved in 96% ethanol for further examination. *R. pubescens* is widely distributed in Central Europe, i.e. Austria, Belgium, Bosnia and Herzegovina, Corsica, Czech Republic, France, Germany, Hungary, Italy, Luxembourg, Poland, Slovakia and Switzerland; therefore, its distribution in the Republic of North Macedonia presents its most southward record. The results presented in our study aim to highlight the importance of peat bogs in providing suitable microhabitats for maintaining good populations for a variety of species. Additionally, the possible negative anthropogenic impact presented with the mining activity in the mine "Sasa" marks the necessity of the employment of high-level conservation measures towards this caddisfly species as well as its habitat.

Keywords: caddisflies, *Rhyacophila tristis* group, Balkan Peninsula, conservation

DNA barcoding the caddisfly (Trichoptera) fauna of the upper part of Kriva Reka river watershed (Osogovo Mt.): establishing the first DNA barcode reference library for caddisfly species in Republic of North Macedonia

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Republic of North Macedonia is often considered a biodiversity hotspot due to its unique geomorphological characteristics and perfect mixture of climate conditions that offer various habitats that correspond with different ecological preferences of the caddisfly species. However, the caddisfly fauna has never been in the focus of a continuous research and since caddisfly species inhabit ecosystems exposed to negative anthropogenic impact, some species may become extinct before they have ever been known. Although DNA barcoding as a highly effective tool for fast differentiating species is already a routine protocol in many taxonomical studies all over the world, in Republic of North Macedonia there is still no official national DNA barcoding initiative. This study employs DNA barcoding based on ~650-bp long fragment of the mtCOI gene of 30 different caddisfly species previously identified based on morphological characters, collected from the upper part of Kriva Reka river watershed. The ability of the DNA barcoding to rapidly identify and delimit closely related caddisfly has been proven. Our research presents the first comprehensive study that employs DNA barcoding as a molecular tool in caddisfly taxonomy in Republic of North Macedonia, giving the first attempt to establish DNA barcode reference library for caddisfly species in the country. We hope that further application of this approach in the country will lead to construction of DNA barcode reference library for different aquatic biota that will find purpose towards effective and modern bioassessment protocols as well as detecting interpopulation genetic variances within phylogenetic research.

Keywords: molecular taxonomy, caddisflies, mtCOI, DNA

A study of the dietary habits of *Tyto alba* from localities of Greece and Albania

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The undigested remains (pellets) of the Barn Owl *Tyto alba* (order Strigiformes) were analysed, in order to investigate the dietary habits of the species in different ecosystems and, indirectly, to record the biodiversity of small mammals in the under-study areas. An adequate number of pellets were collected from Argirokastro, west of the Pindos mountain range (Albania), Lechaina (Achaia, Greece) and Poriarata (Kefalonia Isl., Greece). The collected material was meticulously cleaned and the contained skeletal remains, both cranial and postcranial, were isolated. The analysis was conducted with the use of keys and reference material, in order to identify the species they belonged to. The MNI indicator (Minimum Number of Individuals) was calculated at ca. 2.7 prey items/pellet and statistical analysis followed. The diet of the Barn Owl in the studied areas consisted almost exclusively of mammals i.e. rodents of the genera *Microtus*, *Mus*, *Apodemus* and *Rattus* and Eulipotyphla of the genus *Crocidura*, although birds were of some dietary significance in Lechaina, which is near the salt pans that are used as nursing grounds for wading birds. Our results showed that wherever voles of the genus *Microtus* are abundant, as is the case in Argirokastro, they constitute the prey of preference for the Barn Owl. In their absence, rodents of the genera *Mus* and *Rattus* are sought after more vigorously instead, such as in Poriarata, where murid species make up 73% of the recorded prey.

Keywords: Barn Owl, Strigiformes, owl pellets, micromammals, minimum number of individuals

Assessment of the genetic profile of a small introduced population of Erhard's Wall Lizard (*Podarcis erhardii*) in the islet of Kambana, Paros

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A population of census size 20 (eight males, twelve females) of Erhard's Wall Lizard (*Podarcis erhardii*) was introduced in the summer of 2014 on the islet of Kambana (Paros isl. complex, Aegean Archipelago) as part of a large-scale, ongoing experiment. The aim of this experiment is to assess the relative role of plasticity and evolution in species colonization to a new environment by combining morphological, ecological, physiological and genetic data. To this end, the islet was visited annually for four consecutive years and lizards were captured, measured, whereas a small piece of tissue was sampled. In order to assess the genetic impacts of colonization, familial relationships were inferred based on a set of 17 microsatellite loci. These loci have been isolated from various lacertid lizards including the species under study, and have been previously proved reliable in inferring parent-offspring relationships. Loci that failed to amplify for most of the specimens or whose genotyping was ambiguous were discarded from further analyses. The remaining loci were polymorphic with the number of alleles ranging from 2 to 16, while none of the loci deviated significantly from Hardy-Weinberg equilibrium. Two likelihood-based parentage analysis approaches, employed in two of the most frequently used software *i.e.*, CERVUS and COLONY2, were used, yielding concordant results and resolving the dynamics of reproduction of this newly established population.

Keywords: colonization, familial relationships, parent-offspring relationships, reproduction dynamics

Sponge diversity and distribution in mesophotic and deep sea grounds trawled in the Aegean and Ionian Seas: preliminary results

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Sponge assemblages show a highly variable species composition in temperate littoral environments with diversity values that tend to increase with depth. Nonetheless, such patterns have barely been studied in areas beyond the conventional SCUBA depth range (> 40 m), while sponge assemblages of the lower continental shelf and the slope have been explored with less intensity. The main goal of this study was to investigate bathymetric and zoogeographical distribution patterns of the sponge fauna in the Greek Aegean and Ionian Seas. A total of 87 fishing hauls were carried out in 2016-2018 as part of the programs EPSAD and XM EOX carried out by the HCMR, with experimental and commercial bottom trawls along the Aegean and Ionian fishing grounds, in five depth strata between 25 and 606 m. A total of 50 poriferan taxa were collected, 20 of which were found only in the Aegean and 13 only in the Ionian Sea. The highest numbers of taxa were found in the Aegean Sea (37) and at the depth zone of 50-100 m (33 species). Wet biomass showed statistically significant differences between different subareas and depth zones ($p < 0.01$ in both cases). Seven of the species caught are included in the lists of endangered and threatened species (Annex II) and species whose exploitation is regulated (Annex III) under the Bern and Barcelona conventions. Overall, this study sheds light at the scarcely investigated sponge fauna of the Ionian and deep Aegean Seas, extending the bathymetric range for 16 species.

Keywords: Mediterranean Sea, zoogeography, benthos, porifera, endangered and threatened species

A comparative analysis of the factors effecting land vertebrate longevity

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Animal lifespan is determined by extrinsic and intrinsic mortality causes. We examined multiple hypotheses regarding factors related to mortality rates - and their effect on tetrapod (amphibians, reptiles, birds and mammals) longevity. We predicted that large, herbivorous species inhabiting cold, seasonal regions, or islands, will experience lower mortality pressures (via e.g., low predation and disease rates, lowering extrinsic mortality) and, consequently, evolve longer lifespans. We further hypothesized that low metabolic rates, and either burrowing, or flying lifestyles will select for longer lifespans, through effects on harmful metabolic by-products or predation rates. We assembled a dataset on the maximum longevities, and relevant ecological traits, for 4065 land vertebrate species. Correcting for phylogeny, body mass explains a small proportion of the variance in longevity (<20%). Insular species and those living in seasonal, cold environments live longer. Herbivorous ectotherms (but not endotherms) live longer than their carnivorous counterparts. Microhabitat preferences and metabolic rates did not affect longevity. Large species living on islands and in cold, seasonal environments probably experience slower growth, and low predation rates, reducing both intrinsic and extrinsic drivers of mortality. They therefore live longer than smaller animals in stable, warm environments on the mainland.

Keywords: comparative analysis, evolutionary theories of senescence, longevity, temperature, vertebrates

Plankton major players in a red tide event in Thessaloniki Bay,
Thermaikos Gulf (Greece)

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Thessaloniki Bay is a highly eutrophic small enclosed coastal basin of Thermaikos Gulf in the northern Aegean Sea where phytoplankton blooms and red tides frequently occur. Our aim was to examine the plankton community during a red tide event and identify key species with potential major roles in the formation of red tides events and mucilaginous aggregates. For this water samples were collected weekly from 23 October 2018 to 7 November 2018 at 4 inshore sites in Thessaloniki Bay and analyzed for phytoplankton and microzooplankton composition and abundance. During the study period the dinoflagellate *Noctiluca scintillans*, responsible for the red tides in the Bay, was present in all samplings at the 4 sites reaching its maximum abundance (≥ 100000 cells L^{-1}) at 2 November 2018 at the site near the White Tower. At the same time, the phytoplankton community mainly consisted of known mucilage producing species such as the diatoms *Chaetoceros* spp., *Cylindrotheca closterium* and *Skeletonema costatum* while the dinoflagellate *Gonyaulax* cf. *fragilis* and the haptophyte *Phaeocystis* sp. were also present. Furthermore, potentially toxic algae such as *Ostreopsis* cf. *ovata* (meroplanktic), *Karenia* cf. *brevis* and *Alexandrium* sp. were sporadically recorded with high abundances (e.g. *Ostreopsis ovata* > 1000000 cell L^{-1} in 2 November 2018). Regarding the microzooplankton community, copepods dominated; mainly *Oithona nana* and *Euterpina acutifrons* along with nauplius and copepodites. Gelatinous microzooplankton represented by cnidaria, the mucus surrounded appendicularia and rotifers of the genus *Synchaeta* occasionally dominated, while cirripedia and bivalvia larvae dominated the meroplankton community.

Keywords: Eutrophication, Phytoplankton, Zooplankton, *Noctiluca scintillans*

Molecular phylogeny of the two *Algyroides* species (Sauria: Lacertidae) in the Balkan Peninsula, *A. nigropunctatus* and *A. moreoticus*

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The genus *Algyroides* (Lacertidae) is distributed in southern Europe and consists of four species. Two of them (*Algyroides nigropunctatus* and *A. moreoticus*) occur in the Balkan Peninsula. Two main location-specific color phenotypes are recognized for *A. nigropunctatus* that currently correspond to different subspecies, whereas *A. moreoticus* is monotypic and endemic to Greece. Hitherto, no thorough molecular study has been performed on the phylogenetic relationships among the different insular and continental populations of the two species, which is the main aim of the present work. Here, we examined the phylogenetic relationships of 96 specimens of *A. nigropunctatus* and *A. moreoticus* throughout both species' range, using two mitochondrial (Cytb and COI) and two nuclear (NKTR and MC1R) gene fragments, including representatives of the other two species of the genus (*A. marchi* and *A. fitzingeri*) as well as 6 specimens of *Dinarolacerta* and *Lacerta* as outgroups. Several phylogenetic and chronophylogenetic analyses on these data revealed three major clades in all *Algyroides* lineages in southern Balkans. The first correspond to *A. moreoticus*, which appeared sub-structured and having sister group relationships with *Dinarolacerta* lineages, and the other two to *A. nigropunctatus*, which fully correspond to the two main color morphotypes and seem to be allopatric and reproductively isolated. The divergence of *A. nigropunctatus* from *A. moreoticus* dated back to early Late Miocene, whereas the divergence of the two *A. nigropunctatus* clades was estimated in Middle Pleistocene. Our results can contribute to a taxonomic re-evaluation regarding *A. nigropunctatus* radiations.

Keywords: phylogeography, mitochondrial DNA, nuclear DNA, markers, Taxonomy

A checklist of monogonont rotifers (Rotifera: Monogononta) of Lake
Dojran, Republic of North Macedonia

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In the Republic of North Macedonia, extensive field research has traditionally been carried out on rotifers, as a part of the plankton community, in the pelagic zone, while the importance of littoral habitats has been overlooked and a comparatively smaller amount of studies have focused on the littoral rotifers. The aim of our study was to compile a list of the monogonont rotifers in Lake Dojran based on data from field surveys in the pelagic zone and more extensively in the littoral zone, as well as our published data. The study was based on monthly and seasonal collections conducted in 2004–2016, at one pelagic and 6 different littoral sites distributed along the North Macedonian shoreline of Lake Dojran. The study of the monogonont rotifers of Lake Dojran revealed the presence of 56 species, representing 22 genera and 15 families. The high number of species occurred in the littoral region due to the different life conditions in this zone, which allow greater habitat diversification. The highest number of species was observed in the genus *Brachionus* (10 species) and genus *Lecane* (6 species). The fauna of the Lake Dojran rotifers is characterized by predominance of phytophytic and epiphytic species, partially benthic, while a small number are typically planktonic forms, due to the absence of a defined pelagic habitat, the shallowness of the lake and the development of aquatic macrophytes. In general, the Lake Dojran rotifer fauna is composed largely of widespread, cosmopolitan species.

Keywords: Rotifera species, distribution, littoral, pelagial

Some observations on overwintered hatchlings of the freshwater turtles
from the Gediz River basin of Western Turkey

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Western Turkey has numerous habitats suitable for the European pond turtle (*Emys orbicularis*) and the Balkan Terrapin (*Mauremys rivulata*). In general, mating takes place from the beginning of January to June as soon as after hibernation depending on latitude and temperature. Nesting usually starts in late May or early July. Hatchlings of both species usually emerge from their subterranean nest in late summer or autumn and move to a nearby marsh, lake, or stream to spend their first winter. Retardation in emergence is quite common among terrapins, and the neonates may stay in the nest after hatching for short and variable periods or even overwinter in the nest. We, here, present the records of hatchlings of *Emys orbicularis* and *Mauremys rivulata* found active in late March and April, respectively. According to the observations adequate for egg laying and overwintering behaviour of both species, it is not easy to claim whether the overwintering was in the nest or on land after leaving the nest. The more information about life history and breeding biology of those species may help us to create more effective conservation strategies.

Keywords: Balkan Terrapin, European pond turtle, *Emys orbicularis*, *Mauremys rivulata*, Overwintered, Gediz River, Turkey.

Which plant species are dangerous for ecosystems? Leaves of ten plant species under flammability tests

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We carried out a series of experiments with target to study the total burning time (TBT) of several plant species both indigenous (native) and exotic ones. We have studied separately fresh and dried leaves of ten species: olive tree (*Olea europaea*), eucalyptus - river red gum (*Eucalyptus camaldulensis*), common ivy (*Hedera helix*), Mediterranean cypress (*Cupressus sempervirens*), Turkish pine (*Pinus brutia*), Mediterranean buckthorn (*Rhamnus alaternus*), southern jasmine (*Trachelospermum jasminoides*), silverthorn (*Elaeagnus pungens*), weeping fig (*Ficus benjamina*) and carob (*Ceratonia siliqua*). We used 30 replicates (leaves) for both distances (5cm and 10cm) and both treatments (fresh and dry), totally 120 leaves from each plant species. All ten species have equal flammability to no one from the four tests (ANOVA 99-100%, $p=0.000$). By the used post hoc indices (Tukey and Duncan), the results of the four experiments are grouped to three until to six groups. The preliminary data analysis of dried specimens, show the ivy (*Hedera*) alone in a group or with another species as the least flammable plant species at all the four tests (test Duncan). At the other end pine (*P. brutia*) is the species with the shorter TBT at 400°C. When we use fresh leaves, is accompanied by *Eucalyptus* as almost equally flammable species. Instead of this, when we use dry leaves, pine is followed by a group of two or four other plant species. The evaporation or degradation of eucalyptus oil from leaves we believe that reduces importantly the relative flammability of dry leaves of eucalyptus.

Keywords: fresh leaves, dry leaves, eucalyptus oil, *Pinus brutia*, *Hedera helix*, *Eucalyptus*

Collembola, Acari, and other endogaeon fauna presence in three
different composts

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Endogaeon fauna is typically used as an ecological bioindicator and as a bioindicator of soil health. Here we test the hypothesis that its abundance and composition can provide important information for the composting stage of organic waste with different composition. Three heaps of about 0.5 m³ consisting of (a) garden waste, (b) mix of garden waste and cured compost, and (c) mix of garden waste and food waste, were set up using commercial aerobic composters. The experiment was conducted between 10-12/2018; heaps were monitored for temperature and moisture at a daily basis and turned thrice. Before each turning, compost was sampled and arthropods were extracted in propylene glycol using Berlese–Tullgren funnels for three days. Extracted invertebrates were identified at the level of order with the most abundant groups being Acari, Collembola, Coleoptera, and Diptera. The Acari fauna was the most important taxon, with six-legged Acari (larva) densities ranging between 32.0-89.3% and eight-legged Acari (nymph/adult) densities ranging between 2.5-47.2%. The density of Collembola increased from 0.0-1.1% in the first two samplings to 7.9-40.0% in the 3rd, depending on compost composition. Presence of Diptera and Coleoptera was low at 0.5%-8.0% and 3.0%-17.0%, respectively. The Shannon index of diversity showed that the biodiversity of all heaps increased to a satisfactory level in about a month from the start of fermentation. Findings suggest that co-composting of food-waste can jump-start endogaeon fauna diversity during the composting process and therefore lead to richer soil amendments.

Keywords: Acari, Collembola, Coleoptera, Diptera, Garden waste, Food waste

Comparison of urban endogaeon facilitation by two shrub hedges in
Crete, Greece

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Urban parks are the most important type of public green space and deliver valuable ecosystem services for residents' well-being. Here two park hedges of *Pittosporum tobira* (Japanese pittosporum) and *Rhamnus alaternus* (Mediterranean buckthorn) are compared for their effectiveness in canopy and soil temperature regulation to support a soil fauna habitat. Plants that hedge the gardens of the Hellenic Mediterranean University were monitored for soil fauna, canopy temperature (Tc) and soil temperature (Ts) for a period of 6 months. For each hedge, Tc and Ts at 2.5 cm below ground were measured with 2 and 3 replicates respectively. Endogaeon fauna was trapped using Berlese-Tullgren funnels whereas for bigger invertebrates pitfall traps were used. Invertebrates extracted during 3 samplings were identified mainly at the level of order with the most abundant taxonomic groups being slugs and seven arthropod taxa. According to the Shannon Index, the biodiversity of the fauna collected in pitfalls under *Rhamnus* was 1.2 times higher than that collected under *Pittosporum*. Specimens from funnels were more abundant, with soil under *Rhamnus* showing a biodiversity 3 times higher than that under *Pittosporum*. This difference may be attributed to soil under *Rhamnus* being more habitable than that under *Pittosporum* during temperature extremes, staying over 2.5 °C warmer for Ta under 5 °C and over 3.5 °C cooler for Ta over 25 °C. Tc of *Rhamnus* was also over 0.5 °C cooler than *Pittosporum* at Ta over 25 °C. Results indicate that, in arid environments, *Rhamnus* sustains better biodiversity hubs than *Pittosporum*.

Keywords: Collembola, Japanese pittosporum, Mediterranean buckthorn, harvestmen, woodlice

Romanos beach, SW Peloponnese, Greece: increase of loggerhead sea turtle nests following a ten-year project (2009-2018)

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The 2.7 km Romanos beach, in southwestern Peloponnese, was first monitored by ARCHELON in the years 1989 and 1998-2000 to assess nesting of loggerhead sea turtles. A large percentage of nests were predated by foxes but due to difficulties in logistics no mitigation measures were taken and the project was eventually interrupted. Nest monitoring in Romanos was re-instigated in 2009 and continues until today. We present herein the results of this ten-year (2009-2018) work. All tracks of emerged turtles were examined whether they resulted in nests. Nests were marked, fenced and monitored until appearance of hatchlings. After a week from hatchlings' departure, nests were excavated to determine clutch size as well as hatching and emergence success. Incubation duration was defined as the elapsed time from egg-laying until appearance of hatchlings. The annual number of nests over the ten-year period shows intense fluctuations (4 to 41) with an average of 18 nests. Clutch size averages 97.3 eggs (N=178 clutches), and hatching and emergence success 83.6% and 76.6% respectively (N=166 clutches). Incubation duration averages 52.9 days (N=170 clutches). The annual number of nests shows an increasing trend over the 10-year period. Part of Romanos beach is included in the EU Natura 2000 network. A large hotel was built behind the beach but construction works did not affect the dunes. The hotel follows protective guidelines, provided by ARCHELON, to manage beach furniture and bright lights. We thank TEMES S.A., the development company of the hotel, for following ARCHELON suggestions and their continuous support.

Keywords: marine turtles, *Caretta caretta*, nesting areas

Migration vs. predation avoidance: age-related morphological adaptations in wing shape of Turtle Doves (*Streptopelia turtur*)

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Wing shape in birds depends on the combined effects of various, potentially contrasting selective forces. In this study, we documented aspects of age-related variation in Turtle Dove (*Streptopelia turtur*) wing morphology (wing length, length of the eight outermost primaries) and functional traits (wing pointedness, wing convexity). A total of 187 bagged individuals (112 juvenile and 75 adults) were analyzed, using one-way ANOVA and Size Constrained Components Analysis. Morphological traits were found to differ between age classes, with adult Turtle Doves being characterized by longer wings and longer primaries than juveniles ($P < 0,001$). Among functional traits, wing pointedness was greater in juveniles ($P < 0,001$), whereas wing convexity did not differ significantly between age classes ($P = 0,28$). In juvenile Turtle Doves, pointed wings are believed to facilitate the first migration trip, since this type of wing shape is more aerodynamic and may boost speed and energetic efficiency during prolonged flights. On the other hand, predation avoidance seems to shape adult wing morphology, with rounder wings being linked with increased capabilities for manoeuvrability. These contrasting adaptations in wing morphology may partially explain why juveniles are more susceptible to predation or hunting, which in turn may have detrimental impacts on the species' population dynamics.

Keywords: *Columbidae*, morphology, wing pointedness, flight type, mortality

Turtle Dove (*Streptopelia turtur*) relative abundance patterns in Evros district, N.E. Greece

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Identifying areas in which the associated environmental characteristics allow the support of sustainable populations of a focal species is essential for conservation planning. Although modeling abundance could be a good indicator of habitat quality; as it relates with factors such as reproductive success, carrying capacity and population viability, it is rarely investigated due to the lack of abundance data and/or statistical complexity. In this study, we examined Turtle Dove (*Streptopelia turtur*) relative abundance patterns and relationship to environmental factors in Evros district, N.E. Greece. We used data from 750 1 km² grid squares, within which three point counts were established, each as a vertex of a triangle. The frequency of occurrence of Turtle Doves in each grid square was used as a proxy of the species' abundance, and was related to environmental factors using Random Forest analysis. We then created an abundance map within the study area, using data interpolation methods in GIS. The species was found to be more abundant in central Evros, and in some areas to the southwest and northwest. Abundance was positively associated with areas found at lower altitudes, containing substantial non-intensive agricultural land, scrubs and forests. Conversely, Turtle Dove abundance was negatively associated with areas of intensive agriculture. Our results suggest that Turtle Dove conservation should focus in preserving areas combining suitable feeding and nesting habitats, and improving the quality of habitats in more intensive agricultural areas.

Keywords: *Columbidae*, conservation, habitat associations, random forest, farmland birds

The diet of *Scyliorhinus canicula* (Linnaeus, 1758) discarded from bottom trawls in Gulf of Chania (Crete)

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The Gulf of Chania is located in the north-west part of the Cretan Sea. Studies in this area are scarce, especially concerning the diet composition of fish. In this study we examined the feeding habits of *Scyliorhinus canicula* (Linnaeus, 1758), a species widely distributed in the North-East Atlantic (from Norway and the British Isles south to Senegal) and the Mediterranean, caught in the Gulf of Chania. Samplings were conducted in December, at depths ranging from 100 to 400 m, during commercial trawl fishery (trawl cod-end mesh size: 40 mm stretched). Overall, the stomach contents of 97 individuals, with total lengths between 16.1-42.4cm (45 Females and 52 Male), were examined. The prey items' occurrence (O%), gravimetric (W%) composition and the vacuity index (VI%) of the stomachs were estimated and compared between the two sexes. Finally, the trophic level values (TROPHs) were estimated using the routine of quantitative data of TrophLab, an MS Access stand-alone application. The values of the %VI for the stomachs from Females and Males was 12.19% and 8.89% respectively, indicating a high stomach fullness of the examined specimens. In general, seven different food categories were preyed (Teleostei, Crustacea, Cephalopoda, Appendicularia, Polychaeta, Sipuncula and Chondrichthyes) by *S. canicula*. The species was mainly feeding on Teleostei and secondarily on Crustacea and Cephalopoda. TROPH of *S. canicula* was overall estimated to be 3.98 ± 0.66 (specifically 4.03 ± 0.68 for the Females and 3.92 ± 0.64 for the Males). Based on the TROPH values the species was classified as a carnivore with preference in Teleostei and Crustacea.

Keywords: Gulf of Chania, Mediterranean, catshark, feeding habits, trophic levels

The challenge of crashing the water barrier: Protected areas in Europe focus on water body but largely ignore the surrounding systems

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Covering more than 18% of the European Union's territory, Natura 2000 network represents an ambitious, supranational initiative for the conservation of European biodiversity. Still, little is known about the efficiency of the network to cover inland water ecosystems. This study aims to explore the extent to which the Natura 2000 network covers 2057 European lakes that host fish species of conservation interest. The analyses are further expanded to the terrestrial surroundings within the catchment of the lakes, in order to investigate whether the protection coverage is limited to the actual water body. Coverage from artificial surfaces and agricultural areas at the vicinity of the lakes are also investigated, as they are linked to human presence, constituting potential factors of freshwater degradation. We identify high protection coverage at water body level in the most cases. Still, as the distance from the water body increases, the conservation coverage is decreased, while the presence of human-related activities intensifies. Concerns are raised on whether the network can protect wetland species against the numerous threats operating at the vicinity of the lakes. This study highlights the necessity of redefining conservation strategies towards integrated approaches. Spatial properties of the landscape and the distribution of potential pressures must be considered at catchment level of water bodies, as they can alter the functionality and services of inland water ecosystems. This research is co-financed by Greece and the European Union (European Social Fund- ESF) through the Operational Programme «Human Resources Development, Education and Lifelong Learning» in the context of the project "Strengthening Human Resources Research Potential via Doctorate Research" (MIS-5000432), implemented by the State Scholarships Foundation (IKY).

Keywords: conservation evaluation, fish, lake, Natura 2000 network, European Union

Soil nematodes in loggerhead turtle nests: A place where soil animals and marine animals are linked together

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Organisms comprising the decomposer food web are drivers of nutrient turnover processes, critical in maintaining ecosystem structure and functionality. Among decomposers, nematodes comprise a group of important animals, both because of high diversity and abundances but also because of a variety of functional roles. Nematodes, being excellent indicators of soil ecological functioning, have been relatively well studied in agricultural lands and forests. However, they have skipped attention in other ecosystems, such as the sandy shores that are used by sea turtles for nesting. Here, we provide a pioneer description of nematode communities in sea turtle nests and, explore potential associations between nematode community characteristics and variables related to sea turtle reproductive output and success. Our study was conducted at the nesting sites of *Caretta caretta* in Zakynthos, Greece. Nematodes were extracted from the samples collected from nests at the end of the 2017 breeding period. Communities were analyzed in terms of generic and trophic composition and structure. Several parameters describing sea turtles' reproductive output and success were measured. We found 14 different nematode genera. The abundances were rather high, while the trophic structure showed an almost exclusive dominance of bacterivorous nematodes and indicated a community in its early successional stage. The interesting finding revealed by our models was that variability in nematode community structure was highly explained by variables showing success or failure of hatching. We argue that this finding could contribute in developing indicators for assessing the condition of sea turtle nests.

Keywords: community succession, decomposition, reproduction success, bioindicators for turtle nests

Creation of a high-quality stopover habitat for migrating passerines on a remote island: A case study of good agricultural practices for tackling climate change and land-abandonment impacts on avifauna

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Antikythira is a small island (ca. 20km²) located in the southernmost point of the Ionian Sea, Greece, known to be an important stopover area for migrating passerines. Furthermore, it hosts one of the largest colonies of Eleonora's falcons (*Falco eleonora* Gén , 1839) at global level with approximately 500 breeding pairs. During the last decades, agropastoral habitats on the island have been constantly degrading, mainly due to land abandonment and overgrazing by free-ranging goats. Increased xeric conditions as a result of climate change are expected to accentuate the ongoing habitat degradation. This may incur significant impacts on the stopover pattern of passerines, including their refueling rate and stopover duration, resulting in inadequate replenishment of energy reserves that could imperil successful migration. Consequently, prey availability for the Eleonora's falcons' breeding in the area is expected to decline. In the framework of the LIFE EIClimA project (LIFE13NAT/GR/000909) we established a "refueling oasis" for staging passerines on the island of Antikythira, in order to provide a high-quality stopover site and minimize the anticipated climate change impacts. Site selection and determination of the planting design were based on preliminary surveys regarding habitat-preferences for key-species of staging passerines that are also common prey items for Eleonora's falcons. Following the creation of the "refueling oasis" surveys were carried out in order to assess its impact on habitat use patterns of staging passerines. The implemented agricultural practices are expected to secure long-term sustainability and to increase habitat resilience to climate change, thus constituting a successful case study.

Keywords: *Falco eleonora*, Antikythira island, migration, Mediterranean Sea, Sahara Desert

Species distribution modelling of invasive pufferfish for conservation planning in the Mediterranean Sea

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The progress on species distribution modelling methods has brought new insights into the field of biological invasion management. World climate has changed significantly in the last century and the number of alien species penetrated from Indo-Pacific Ocean and South part of the Atlantic in the Mediterranean continue to increase over the next decades. The purpose of the present study is to predict the potential geographic distribution and expansion of pufferfish species (Lessepsian, Eritrean, Atlantic) with ecological niche modellings along the Mediterranean Sea. The Tetraodontidae constitute a striking example of the tropicalization of the Mediterranean fish fauna. In the last 40 years, the number of pufferfish species recorded for the Mediterranean waters rose from three to 10 species. Some of pufferfish species are highly toxic and the worst invasive species in the Mediterranean. Temporal and spatial occurrence data from the first occurrence of pufferfish species for each country having coast along the Mediterranean Sea were used to develop for robust predictions of pufferfish species richness. Twelve climatic data layers were collected from the WorldClim global database. Different statistical models were evaluated to establish predictions of absolute and relative alien species distribution and expansion. Of a total of 19 models, 12 gave acceptable results at 1-km resolution and 12 passed the cross-scale validation test. All of the pufferfish species distribution models were good predictors of the validation data set, however, the mapped habitats differed considerably among the spatial distribution models which suggest that choice of model and variable set could influence the identification and conservation of marine protected areas.

Keywords: Species Distribution Modelings, Pufferfish, Future Scenarios, Mediterranean Sea

Length-weight relations, mouth morphometry and feeding habits of
boarfish *Capros aper* (Linnaeus, 1758) in the Aegean and Ionian Sea

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The boarfish (*Capros aper*) is a gregarious, demersal species, which is distributed mainly in the Eastern Atlantic and the Mediterranean Sea, by-catch in bottom-trawl fisheries. Despite the large catches of the species mainly in the Atlantic, the available data on its biology is rather limited. The aim of this work is to provide information on the morphology and feeding ecology of the boarfish in the Aegean and Ionian Seas. Overall, 807 individuals were examined (715 from the central Aegean Sea; 92 from central Ionian Sea), caught in July and August 2014, with the MEDITS experimental bottom trawl. In the laboratory, total weight (W, g), total length (TL, mm), vertical (VMO, mm) and horizontal (HMO, mm) mouth openings were measured, and stomach contents of 444 individuals were examined for diet. Trophic level was estimated using the routine for qualitative data of TrophLab. W-TL relations indicated a negative allometry with similar growth parameters in the Aegean ($a=0.02$, $b=2.9$, $r^2=0.972$) and the Ionian ($a=0.025$, $b=2.82$, $r^2=0.954$) Seas. Moreover, HMO and VMO demonstrated positive allometric relations with TL (Aegean Sea: $HMO=0.49*TL^{1.3}$, $VMO=0.82*TL^{1.14}$; Ionian Sea: $HMO=0.41*TL^{1.16}$, $VMO=0.76*TL^{1.14}$). Boarfish displayed a feeding preference towards Crustacea both in the Aegean (mainly Amphipoda; %N=67) and the Ionian (mainly Copepoda; %N=56) with Polychaeta, Annelida, Mollusca and Hydrozoa also participating in the diet. Finally, the trophic level was 3.27 (± 0.48) for the Aegean and 3.11 (± 0.29), for the Ionian Seas, indicating that boarfish is an omnivore with preference to animal prey.

Keywords: boarfish, by-catch, diet, trophic level, mouth opening

Land gastropods' view of the Aegean. Key islands and key species

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The Aegean Archipelago is among the largest archipelagoes of the world, comprising more than 7,000 islands and islets. It presents a complex geological history, extreme and sharp climatic variation, variety of ecosystems and habitats and continuously long-term human activities. All these characteristics have shaped the diversity of the islands. Greece is the richest country of Europe as far as land gastropods are concerned. Up to now 695 species have been recorded. However, this richness is due mainly to the very high diversity of the Aegean islands, where 400 species have been listed so far. In nearly all islets and islands land gastropods are present. The richest island is Crete. Endemic species can be found on any island, restricted to one islet/island or to a group of islands. However, species with a Holarctic distribution, or alien species are also present. We have to point out that there are strong differences from northern to southern islands and from western to eastern islands. However, there are taxa that can be characterized as “the islanders of the Aegean”.

Keywords: Biogeography, diversity, Aegean archipelago, endemism, terrestrial molluscs

The effectiveness of Natura 2000 area coverage for threatened river fish species in Greece: insights from site-based surveys

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The Natura 2000 protected area network (hereafter N2K) is the backbone of the EU nature conservation policy and aims to preserve species and habitat types of community interest (i.e. species and habitat types listed in the Annexes of the Habitats Directive 92/43/EEC). The N2K network in Greece currently includes 446 sites (approximately 28% of the land territory). Although Greece's N2K sites cover a large territory including many rivers, fish are underrepresented as target species for selecting and delineating N2K sites. Here we explore if threatened or near-threatened fish species present in N2K river sites are effectively protected, in order this knowledge further to be used for site conservation evaluation. More specifically, we reviewed the distribution of 103 species, 33 of which are included in the IUCN red list as CE (10), EN (14), VU (9) and NT (6), consisting 606 electrofished samples; 39.6% of the samples were inside N2K sites while 60.4% outside. The results showed that almost all threatened and near threatened fish species were present within at least one N2K site, with only one exception, the species *Gobio skadarensis*. All threatened species were also observed in areas outside N2K sites. No differences ($p>0.05$) were found between sites inside and outside N2K concerning the local abundance of the species explored.

Keywords: IUCN red list, site conservation evaluation

Assessment of the trophic state of Lake Ohrid littoral zone during the summer period based on physical-chemical and biological indicators

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The lake systems, especially the littoral region of the lakes are highly dependent on their environment, i.e. on the physical, chemical and biological variables of the watershed area. Human activities in the watershed area contribute to the increased flow of nutrients, which can accelerate the process of eutrophication and can result in a change of the lake trophic state. The aim of this paper is to estimate the trophic state of Lake Ohrid littoral zone during the touristic season 2017, based on physical-chemical parameters (biodegradable organic matter, total phosphorus and total nitrogen concentrations) and biological indicators (heterotrophic bacteria, total number of coliform bacteria and rotifers). To realize this goal, 10 measuring points were defined: Radozda, Kalishta, Evrohotel, Sateska R. littoral, Daljan, Grashnica, Metropol, Peshtani, Ljubanishta and St. Naum. The numeric values of the Carlson's Trophic State Index (TSI), based on the concentration of total phosphorus, showed mainly oligotrophic state of the water in the defined localities, with exception in Sateska littoral, Kalishta and Grashnica, where TSI belongs to mesotrophic and meso-eutrophic state. The identified Rotifera species mainly belong to waters of I, I, II and II category. Saprobic Index ranged from 1.5 to 1.97, which correspond to oligosaprobic, oligo- β -mesosaprobic and β -mesosaprobic waters. In the region of Grashnica, where relatively high organic and fecal pollution was registered, the saprobic index is 2.63, which correspond to α -mesosaprobic water. This part of the lake is under the pressure of communal waste water rich with pollutants and nutrients.

Keywords: nutrients, bioindicators, bacteria, rotifers, water quality

Brown bears (*Ursus arctos*, L. 1758) activity patterns and spatial behaviour during the mating season in the region of Florina, NW Greece

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Telemetry is a robust and reliable tool to track movements, activity levels and spatial behaviour of wildlife species for conservation purposes. In the framework of the LIFE15NAT/GR/001108 project, we used GPS/GSM telemetry to monitor spatial behaviour and activity patterns of (4) adult male bears during mating season (May - July 2018) in the area of Florina. A total of n=6.128 radiolocations were processed to understand the circadian activity levels and microhabitat use of the radiotagged bears over the 3 months mating period. Over a total home range that ranged from 44 - 399 km² (Minimum Convex Polygon) and a max travelling distance from 1,7 to 11 km, bears were, on average, active for approximately 48% of the 24h period. Bears were on average 25% more active during night hours (20:00-6:00). The individualized behaviour is generally high among bears but some patterns are common. Bears were more active during the months of June and July rather than May. The average duration of the weekly inactivity period of the 4 male bears ranged from 69 hours to 101 hours. The overall activity pattern of the males is characterized by lower frequencies of medium and high activity levels. Using SaTScan software we produced cluster maps using a space-time permutation model. The 4 bears appeared to intensively and repeatedly use specific sub-units of habitat (ranging from 3000 to 6000 m²) within their home range, mostly characterized by forest cover and/or forest edges while the distance from the closest human settlements ranged from 1-3 km.

Keywords: Brown bear, telemetry, activity, mating period, Greece

NGS corroborates cryptic diversity within the Epiros riffle dace (*Telestes pleurobipunctatus*)

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The geological history of the Ionian basin is genuinely complex and it has deeply influenced aquatic species evolution. The Ionian's inland waters host the largest proportion of the Greek endemic ichthyofauna. The Epiros riffle dace (*Telestes pleurobipunctatus*, Leuciscidae, Cypriniformes) is an Ionian endemic distributed from southern Albania (Butrint lagoon catchment) to Western Peloponnese (Alfios River basin). We applied the NGS method of ddRAD (double digest restriction-site associated DNA) sequencing to study the evolutionary relationships between *T. pleurobipunctatus* populations. 99 individuals from 11 river basins were analyzed, covering the known distribution range of the species. Genome wide data have confirmed the existence of five well-supported allopatric lineages, revealed previously based on mtDNA analyses: Alfios lineage, Evinos-Kotichy-Pinios lineage, Acheloos lineage, Arachthos lineage and Northwestern lineage (Acheron-Kalamas-Kerkyra-Butrint). Occurrence of two lineages was detected in the Louros river basin. Taxonomic revision of this species complex is urgently needed. Our results should be taken into account for the conservation management of *T. pleurobipunctatus* species complex.

Keywords: endemism, mtDNA, lineage, taxonomy

First results towards a new atlas of reptiles and amphibians for Greece

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This paper presents the first results from the effort to create a new Atlas of Reptiles and Amphibians for Greece. We used data from three different sources, namely the collections of the Natural History Museum of Crete, the data from the monitoring program (2014-2015) of the Ministry of Environment and Energy, and bibliographical data from published papers. The reptiles from the Greek area that have been studied so far are the snakes *Natrix natrix*, *Natrix tessellata*, *Telescopus fallax*, *Malpolon insignitus* and the lizards of the genus *Podarcis*. Similarly, the studied amphibians are the species of the *Ranidae* and *Salamandridae* families that are present in Greece. The species distributions were produced, edited and graphically visualized by GIS programs in order to ultimately produce an interactive map which will be available on line. In addition, text was produced for each species with basic information about their distribution in Greece and the world, the status of their protection, their synonyms and the Greek common names.

Keywords: Atlas, GIS, reptiles, amphibians, Greece

Applying the Landscape Assessment Protocol (LAP) within and beyond
Natura 2000 sites in Attika, Greece

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Assessing the conservation condition of landscapes is particularly difficult in the Mediterranean. Most landscapes have been altered by humans following millennia of land use. However, modern landscape changes are considered a serious pressure and threat for biodiversity since they may affect protected species and ecosystems in multiple ways (often even within Natura 2000 sites). Certain cultural landscapes also have intrinsic values and they provide important cultural ecosystem services in protected areas. New methods and tools are required to identify, evaluate and promote the protection of landscapes. The Landscape Assessment Protocol (Vlami et al. Sustainability, 11, 2019) is a conservation evaluation field method utilizing 15 easy-to-use metrics. The present application in Attika focuses on 30 non-urban landscape sites of high nature conservation value, both within Natura 2000 protected areas (Schinias, Vravra, Makronissos, Sounio) and outside them (Artemis Wetland, Rafina's Megalo Rema, Anavyssos Bay). The assessment identifies and ranks the most prominent degradation types and metrics in these areas (i.e. landscape pattern, road network, buildings) and defines areas of exceptionally high landscape integrity (i.e. Vravra, parts of Schinias-Marathon, Petreza valley of Rafina's Megalo Rema, the eastern part of Markronissos). Our results depict the need to embrace the protection of landscape integrity within and beyond statutory protected areas in this rapidly urbanized coastal region.

Keywords: conservation evaluation, spatial prioritization, cultural ecosystem services

Occurrence of native Greek reptiles and amphibians on Attica Zoological Park grounds

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Attica Zoological Park (AZP) is a 20 hectare private zoo in east Attica. As a member of the European Association of Zoos and Aquaria it conforms to strict guidelines on animal husbandry, conservation, education and safety. Situated on what was mainly agricultural land the Park territory now comprises of naturalistic enclosures and natural spaces that are enriched with different plant species, also maintaining the local plant diversity. Reptiles play a vital role in the proper functioning of the world's ecosystems. We were interested in observing which species of wild Greek reptiles occurred in AZP grounds living on zoo grounds. Observations were made during a particularly active period (May-July 2018) in potential microhabitats. 11 reptile and two amphibian native species were captured, photographed and identified to species. These comprised of ~80% of native reptiles typically found in Attica and ~20 % of native reptiles found in Greece. Due to local residential development in the region, AZP may prove to be a safe haven for such species. Wild species on zoo grounds can be introduced in educational programs to sensitize the public regarding their importance in nature. Furthermore, naturalistic spaces in the zoo can provide visitors with opportunities for wildlife watching and connecting with nature, important for pro-environmental behaviour and thus wildlife conservation.

Keywords: naturalistic enclosures, natural spaces, captivity, wildlife watching, conservation, Athens

No native trout on Cyprus

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Cyprus is the third largest island in the Mediterranean Sea. Approximately 340 kilometres of streams on Cyprus are considered perennial or semi-perennial (about 13% of its river network). Cool running waters are found almost exclusively in the uplands of the Troodos Mountains and cover at least half of the total perennial stream network. In this sense, there is adequate habitat for cool- and cold-water fishes on the island. A presence of native trout can be expected on this island, like on Corsica, Sardinia or Sicily, where native trout are present. However, there is no historic record of native trout populations on Cyprus. We collected trout from five localities, representing three independent river basins in 2015 and 2016. Seventy-four specimens of trout (*Salmo* spp.) were fin-clipped. We used sequence analysis of the mitochondrial DNA marker *Control region* and Restriction Fragment Length Polymorphism (RFLP) with BseLI endonuclease for the nuclear marker *Lactate dehydrogenase gene* (*LDH*, partial sequence of 428 bp length). Both molecular markers revealed that all specimens from Cyprus belong to the north group of Atlantic lineage of brown trout, which is not native in the Mediterranean region. The most frequent allele was *LDH-C1*90* (92%) which dominantly characterizes trout populations of the north Atlantic origin. The most common *Control region* haplotypes were ATcs2-4, characteristic for the commercially used strains of the north Atlantic group, supporting the non-native origin of the Cypriot populations. Investigated specimens may be the descendants of the established populations introduced in the 1940s.

Keywords: DNA marker, taxonomy, introduced fishes, freshwaters

Application of ground-based optical and acoustic sensors and use of information technology for the monitoring of fauna and human activities in protected areas of Greece

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Effective biodiversity protection requires a good understanding of the conservation status of species and habitats in an area where they occur and their changes within time and space, achieved by updated data from fieldwork. New tools and state of the art technologies for collecting and managing large amounts of data over time and space, including fixed ground-based optical and acoustic sensors, the support of integrated information systems in cloud-based infrastructures and Geographic Information Systems (GIS) are of key importance and can contribute to: (a) the implementation of effective monitoring programmes for endangered species and their habitats, providing information on the evaluation of their conservation status for national reports and the assessment of the environmental European Directives and (b) to record the pressure of human activities for combating illegal wildlife activities and to assist to effective law enforcement, especially in PAs. The Rhodope Mountain Range has been selected as the study area of the project for the pilot implementation of its actions. The site supports populations of all large carnivores and herbivores occurring in Greece (bear, lynx, wolf, wild boar, red deer and roe deer). Large mammal species are considered as "umbrella" species for maintaining the functioning of ecosystems in forests and for protecting biodiversity. The project will monitor large mammals and human activities in protected areas by deploying a ground-based system of optical sensors (120 cameras) and 17 acoustic sensors. An innovative mobile app and cloud computing applications will also be developed to collect, store, and evaluate data collected within the PA during patrols the guards/wardens of the Management Authorities of PA, forestry services, scientists, etc.

Keywords: Camera traps, Acoustic Sensors, Large Carnivores, Herbivores, Rhodope

Bycatch in Bulgarian territorial waters of Black Sea

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Fisheries bycatch poses a significant threat to many populations of cetaceans around the world. The bycatch (incidental catch) in fishing gears is recognized as a major threat to cetaceans in the Bulgarian territorial waters of the Black Sea during the last century, but there is no reliable information on the amount and the impact of this bycatch. According to fishers the turbot gillnets are among the most dangerous fishing gear in the Bulgarian territorial waters. However their impact has not been systematically studied yet. Three species representative of odontocetes (porpoise and dolphins) occur in the Black Sea – Black Sea Harbor Porpoise (*Phocoena phocoena* ssp. *relicta*), Black Sea Common Dolphin (*Delphinus delphis* ssp. *ponticus*) and Black Sea Bottlenose Dolphin (*Tursiops truncatus* ssp. *ponticus*). Due to the isolations of the Black Sea, they are defined as separate subspecies that occur only here. We estimated cetacean bycatch in Bulgarian part of the Black Sea from 2014 to 2019 using data from the fishers. Data from over 200 kilometers gillnets are included in the present study. The results suggest that bycatch is likely to have significant demographic effects on the populations of Black Sea cetaceans. The most bycatch cetacean is the harbour porpoise – 84 %. However, more data and monitoring are needed to better understand the impact of these interactions.

Keywords: incidental catch, fishing gear, common dolphin, bottlenose dolphin, harbor porpoise

Population size and distribution of the Roe deer (*Capreolus capreolus*) in the Dadia-Lefkimi-Soufli Forest National Park

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The roe deer is of particular importance for the Dadia-Lefkimi-Soufli Forest National Park, both for maintaining forest-openings and as prey for large carnivores and vultures. The aim of this study was to provide a reference density value for future studies and identify the most important environmental parameters for the species. We implemented the Faecal Standing Crop method along 109 line transects, during July-October 2014. Sampling was random, stratified, with proportionate representation of each of five main land-cover types. Population density was estimated using that of faecal pellets, as a function of defecation rate and decomposition time, for each land-cover type, with the distance sampling method. Species distribution was mapped with Maximum Entropy models. During sampling we recorded 172 faecal pellets in 45 line-transects. The roe deer density was estimated to an average of 3,573 ind/km² and a total population of ca 1000 individuals (95%CI: 467 – 1667 individuals). The roe deer was found to avoid areas close to farms, while low vegetation in the area burnt in 2011 provides both food and cover from predators. It also preferred higher altitudes with steep slopes and coniferous or mixed forests. Ensuring low vegetation availability in forest openings and the preservation of mixed forest stands are essential for increasing the roe deer population to a density high enough to contribute to the maintenance of the openings and provide food to other animals. We recommend that roe deer counts are repeated every six years, using the same protocol, in order to imprint the population trend.

Keywords: faecal pellets, low vegetation, forest openings

Habitat composition and distribution of Persian squirrel (*Sciurus anomalus*) in Greece

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The Persian Squirrel (*Sciurus anomalus*) is a SW Asian species with an isolated population on the Greek island of Lesvos. The species is considered Near Threatened in Greece and based on IPCC's climate change scenario its population is predicted to suffer a 98% decline by the year 2100. However, there is a shortage of quantitative data concerning its distribution, habitat usage and its ecological requirements in Lesvos. The aim of this research is to examine the distribution of the species on the island and to quantify its habitat composition at its western distribution limit. For this purpose 240 observations of different individuals, collected from 2009 to 2018, were plotted on a map with spatial information layers for vegetation types, land use and tree cover density. Habitat characteristics were extracted from a circular area of 500 m and 50 m radius for each point. A PCA was performed to summarize vegetation variable information into principal components in order to identify the prevailing factors of habitat composition, followed by an HCA and ANOVA comparison. The analysis showed a dependence of *S. anomalus* on (a) broad-leaved deciduous or evergreen trees and (b) on canopy cover density of *Olea europae*, *Castanea sativa*, *Quercus coccifera* and/or *Q. ithaburensis*. Moreover, observations were grouped into three clusters with significant differences between them regarding the vegetation and canopy cover variables. In summary, the Persian Squirrel is widely distributed in wooded and other tree-covered areas on the island but it seems to be absent from coniferous forests.

Keywords: habitat requirements, distribution limit, land use, Lesvos, rare species conservation

Preliminary assessment of small mammal species composition, using Barn owl pellet analysis in three different habitats on the island of Lesbos

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Owl pellet analysis is considered one of the most efficient sampling approaches for assessing the diversity and composition of small mammalian communities, for it can provide information about species distributional changes and species-habitat associations with respect to land use differentiation. The aim of this study is to provide a detailed evaluation of small mammal community composition with relation to habitat characteristics around Barn Owl roosting/breeding sites. Owl pellet samples were collected at three sites on the island of Lesbos which were highly differentiated with respect to surrounding habitats: (a) traditional olive groves, (b) a mixed non-intensive crop and pasture habitat, and (c) natural vegetation (phrygana and maquis). Data on environmental descriptors of the Barn owl foraging habitat were extracted from Corine Land Cover data in combination with Copernicus high-resolution layers on tree cover density using circles with a 3 km radius and centred at each locality. Prey items were identified at the lowest taxonomic level possible using identification keys while their number was estimated by counting skulls and lower jaws. Results showed a total of 620 individuals from 10 species. The predominant prey species differed among the three sites: *Apodemus mystacinus* showed the highest abundance in the natural vegetated site, *Mus musculus* in the olive grove site, and *Microtus guentheri* at the crops site. The overall composition of prey items also differed significantly among the three sites suggesting that the composition of small mammal assemblages are very differentiated among the studied habitats in Lesbos.

Keywords: Rodentia, owl pellets, small mammal assemblages, Mediterranean landscape, agricultural habitats

Preliminary results of the Lesvos Wildlife Roadkill Monitoring Scheme:
implications for mammal conservation

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Lesvos is an island with a higher biodiversity than most other Mediterranean islands of a similar or larger size, including a large number of small and medium-sized mammal species. As in other parts of Greece, in recent years, new roads are being constructed on Lesvos, either by modification of the existing road network or along new routes. This promotes a heavier traffic load with a higher average speed, often in combination with increased habitat fragmentation, resulting in frequent roadkill incidents involving mammals as well as reptiles and other animals. In order to address such challenges and given the nonexistence of adequate data on road impacts on the island's mammals, the Lesvos Wildlife Roadkill Monitoring Scheme was established in 2017. The main purpose of this effort is to assess the frequency and geographical distribution of wildlife carcasses resulting from mammal-vehicle collisions (MVC) across the island's road network. Mammal roadkills have been recorded beginning in April 2017. Preliminary results for the first two years of data collection revealed a total of 120 roadkills, comprising five different terrestrial mammal species. In particular, the highest roadkill rates corresponding to 88% of MVC cases concerned the Red Fox (*Vulpes vulpes*) and the Beech Marten (*Martes foina*). The island's two major highways had the highest rate of roadkills. Continued monitoring of MVCs on Lesvos in the years to come will enable us to detect (a) the factors which influence roadkills, and (b) landscape connectivity issues with a view in assisting mammal conservation.

Keywords: Road ecology, Wildlife-Vehicle Collisions, road mortality, fragmentation, infrastructure impacts

The importance of abandoned crops as stopover areas for a globally threatened species: the case of turtle dove on the South Aegean island of Antikythera

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Seasonal movements are considered a very important part of the annual cycle of migratory birds. Each spring, Turtle Doves (*Streptopelia turtur*) cross the Sahara Desert and the Mediterranean Sea towards their European breeding grounds, incurring a large energy consumption. Land areas for refueling and resting are crucial for the survival of birds making long sea crossings. Moreover, stopover areas can provide shelter in case of adverse weather conditions. The aim of this study is to assess the migration flow of the Turtle Dove, which is considered a globally threatened species, at an intermediate stopover site, the island of Antikythera. Data were collected during spring migration using distance sampling methodology and was analyzed using the Distance 7.0 software, in order to estimate the detection probability and density of individuals in different habitats of the island. Data were also collected on microhabitat characteristics. Results showed that the largest number of Turtle Doves used the abandoned crop habitats, with a detection probability of 0.7 and an average density of 0.7 individuals per hectare. Turtle Doves seem to select a microhabitat consisting of dense trees in Maquis vegetation when resting and low herbaceous vegetation ground cover when feeding. This study indicates that Antikythera is an important stopover area for Turtle Doves and that abandoned crops are a crucial habitat type for this species when spending time at a stopover area.

Keywords: spring migration, *Streptopelia turtur*, distance sampling

Thermal imaging as a conservation physiology tool for assessing vertebrate physiological stress response during field handling procedures

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Modern interdisciplinary approaches such as Conservation Physiology provide a variety of methodological tools that aim to develop and implement effective strategies in order to address challenges regarding the physiological response of organisms to stressful stimuli. However, cases of vertebrate physiological responses to stressors remain scarce as the techniques used until now pose significant problems due to their invasiveness and their implementation under fully controlled conditions. From this viewpoint, the purpose of this research is to investigate the physiological stress response of vertebrates to stressful stimuli that arises during handling procedures, using non-invasive methods in field sampling conditions. Therefore, two different groups of vertebrate taxa were examined, rodents and passerine birds. For each group two common species were selected: (a) *Apodemus mystacinus* and *A. sylvaticus* for rodents and (b) *Acrocephalus schoenobaenus* and *A. scirpaceus* for passerines. To assess possible species differences in physiological stress, the temperature of each individual's eye was analyzed using infrared thermography; this method is considered to be the most precise non-invasive indicator of vertebrate physiological stress. The effectiveness of this methodological approach proved successful as it showed statistically significant differences in the physiological state of all species before and after the handling procedures. Furthermore, it provides a possibility for comparing the physiological state of vertebrates at different levels of both community organization and taxonomic ranks. Overall, thermal imaging as a physiological tool is providing remarkable insights into the effects of handling procedures and can lead to a standardized sampling protocol for handling vertebrates.

Keywords: Thermal imaging, physiological status, stress, handling, non-invasive methods

Study of heat shock proteins (hsps) in different land snail species

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In view of climate change projections, it is anticipated that Europe's natural ecosystems and biodiversity will be substantially affected, and a great majority of organisms and ecosystems are likely to have difficulty in adapting. In this context, the study of thermal tolerance of terrestrial animals is important in our attempt to understand their probable future response to ongoing global warming. Land snail species occur in habitats of different climatic types and exhibit seasonal variations in their physiology and biochemical composition. Our study aimed to determine thermal tolerance in populations of three land snail species, *Helix lucorum*, *Eobania vermiculata* and *Cornu aspersum*, which differ in geographical distribution and in habitareas of different climatic characteristics. As a measure of thermal tolerance, we studied the expression of heat shock proteins (hsps), especially hsp70 and hsp90. Snails were exposed at high temperature (33°C) for two months and the expression of hsps was determined in tissue samples from hepatopancreas at regular time intervals throughout this time period. Our results showed an increase in the expression of hsps within the first 10-15 days of thermal exposure. However, the response pattern differed among the three snail species studied and reflected both differences in the geographical distribution of the species as well as adaptations to the different climatic characteristics of their habitats.

Keywords: Land snails, biogeography, thermal tolerance, hsps

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