



INTERNATIONAL
MALACOLOGY
SYMPOSIUM

October 25-28
BODRUM 2022

PROCEEDINGS BOOK

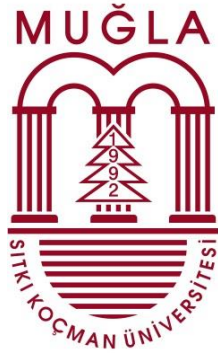
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Muğla Sıtkı Koçman University



Bodrum Maritime Museum

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ABSTRACTS

Chemosynthetic communities in the Mediterranean, with particular attention to the Mollusca

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Abstract

Benthic communities where the primary production of organic matter is achieved through the activity of symbiotic bacteria have been discovered in the second half of the XXth century, both along mid-oceanic ridges with an important volcanic activity, and along continental margins with a thick sedimentary cover from which hydrocarbon fluids seep to the seafloor. In the Mediterranean Sea, the occurrence of deep-water hydrothermal vents is limited to a few sites in the Tyrrhenian Sea, but there are extensive areas, mostly in the Eastern Basin, where hydrocarbon seeps support chemosynthetic benthic communities.

The first discovery of such fauna dates back to the late XIXth century, with one dredge haul of the Austrian "Pola" expedition off the Nile Delta (Sturany, 1896), but those findings were not properly understood at that time. It was not until the end of the XXth century, with the MEDINAUT expedition (1998) and others, that abundant populations of Sturany's species were found and recognized as forming chemosynthetic deep-sea communities. Outstanding species with symbiotic bacteria are the bivalves *Isorropodon perplexum* and *Idas modiolaeformis* and the annelid *Lamellibrachia anaximandri*, which are Mediterranean representatives related to vent and seep chemosynthetic taxa elsewhere in the world. Most of the other species found on those Mediterranean sites are either very close taxonomically to a more widespread Mediterranean congener e.g. *Lucinoma kazani* (similar to *L. borealis*), *Myrtea amorpha* (similar to *M. spinifera*), *Clelandella myriamae* (similar to *C. miliaris*), or widespread taxa which are present in higher numbers around the seeps e.g. the gastropods *Putseysia wiseri* and *Taranis moerchi*. The deeper hydrothermal vents present in the Mediterranean harbour chemosynthetic communities similar to those found on hydrocarbon seeps, with e.g. *Lamellibrachia* and *Lucinoma* in the Tyrrhenian site of Palinuro. The shallow hydrothermal sites do not harbour any habitat-specific element, only higher numbers of the species present regionally (e.g. the gastropod *Tritia neritea*) and able to withstand the harsh conditions, with acidic seawater, around the vents. The general appraisal is that the Mediterranean Sea is so secluded from the world ocean that it received only a very limited share of the taxa specific to vent and seep habitats, and that such sites present in the Mediterranean draw mainly from the regional fauna, with maybe some recently differentiated species adapted to those habitats.

Freshwater molluscs at the extremes: ice, heat, and darkness

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Abstract

The communication is devoted to the freshwater snail communities inhabiting extreme biotopes (high-latitude and high-altitude ecosystems, geothermal sites, subterranean waterbodies, great depths of large lakes). It is shown that, despite the relatively low species richness and abundance, the gastropods living in such habitats demonstrate an array of adaptations, which can be, in some cases, of convergent origin. Some parallelisms are observed in morphology and patterns of genetic diversity of these extremophilic snails. One of the most obvious parallels is that between molluscs of the high-latitude (Arctic, Subarctic) and high-mountainous areas. One of the driving factors of this parallelism may be the so-called “environmental filtering process” creating an invisible and semipermeable barrier allowing only a small portion of preadapted species to invade the extreme biotopes. Many living populations of extremophile gastropods are evolutionary young, and thus, they did not reach status of “full” species. However, the microevolutionary processes in the studied biotopes are going extensively, creating numerous ‘local’ and ‘ecological’ races of various phenotypic prominence. The most obvious exception to this rule is the subterranean ecosystems that harbour diverse and highly endemic fauna of microsnailes (Hydrobiidae s. lato). Another example of prominent evolutionary progress among extremophilic snails is the genus *Tibetoradix*, endemic to the Tibetan Plateau, which contains 6-7 species restricted to a very small geographic area in High Asia. The evolution of this taxon took place in Tibet during the last 17-18 mya and it shows signs of adaptation to the specific conditions of the ‘Roof of the World’. The concept of ‘evolutionary trap’ can be applied to describe this case (and some other similar cases). According to it, the adaptation to an extreme habitat leads to extraordinary adaptations, which make the organisms unable to leave their habitats of origin and to expand their ranges to the less extreme areas.

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**Current state of knowledge of Mediterranean marine gastropods
(the importance of museums and their scientific collections)**

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Abstract

Mollusca is one of the most diverse groups of marine animals. Thus, they are routinely considered in marine biodiversity surveys as an appropriate indicator group for the rapid assessment of diversity inhabiting any place or habitat. Their shells can remain for a long time after death (otherwise many of them are very difficult to find alive) and rather than background noise to be discarded, skeletal remains of molluscs can be used as an indicator of diversity. The malacofauna of the Mediterranean Sea is probably the best known in the world. The XIX century was considered the “Golden Age of Mediterranean Malacology”, when numerous distinguished malacologists and naturalists laid the foundations of knowledge of Malacology in this sea. During the first half of the XX century there was a break in the study of molluscs due to the world wars. In the second half of this century manuals by Parenzan (1970, 1974, 1976) and Nordsieck’s monographs (1968, 1972, 1982) were the main sources for the identification of the Mediterranean molluscs. The first check-list of Mediterranean marine mollusks after Monterosato (1884) was published by Piani (1980-83), who listed 1502 species of shelled molluscs, later updated by Bruschi et al. (1985: ENEA). Subsequently, Sabelli et al. (1990-1992) listed 2013 species of shelled molluscs with the iconographic support of Giannuzzi-Savelli et al. (1994-2003). All these compilations served as the core of the project CLEMAM (Check-List of European Marine Mollusca). For those times, some researchers also made important contributions to the knowledge of the “opisthobranch” gastropods, such as Alice Pruvot-Fol (since 1925 to 1963), Hans-Rudolf Haefelfinger (since 1959 to 1969), Giorgio Barletta (since 1974 to 1990), and Luise Schmekel (since 1965 to 2001), among others. Further, a new taxonomic perspective began by the routinely application of the Scanning Electron Microscope what allowed a detailed examination of protoconchs and radulae. In the XXI Century the extensive use of molecular tools is established, which allow a new approach to taxonomy for species identification and to unravel cryptic diversity. Thus, an increasing number of new species was described and genus changes are proposed for many species due to regional or worldwide phylogenetic revision of families. The CLEMAM database was taken over by WoRMS database in 2015.

Gastropods are by far the most diverse among the eight major ‘classes’ of living molluscs (more than 75% of the molluscan species are gastropods) and it is one of the most diverse groups of marine animals, not only in numbers of species, but also in disparity of external morphology and biological traits. A new check lists of marine molluscs within the overview of the Mediterranean marine biodiversity by Coll and co-authors (2010) included 1558 species of gastropods. An updated unpublished personal check-list add almost a hundred more species. On the other hand, 227 new species of marine gastropods have been described throughout the Mediterranean during the present century (almost 10 new species/year).

Taxonomic studies and systematic inventories are basic issues to know what species there are and where they are. Thus, taxonomy is a priority field in face of the biodiversity crisis. Systematic

inventories, and the collections that they build, provide a permanent scientific record for documenting patterns of diversity and endemism across habitats and ecosystems. This reference data set (and its derived voucher specimens preserved in museum collections) is necessary for future comparisons. Natural history museums are in charge of preserving scientific collections as heritage for future generations. Preserved specimens are the necessary reference for any comparative research in natural sciences. Thereby the natural-history collections housed in natural history museums constitute huge databases that were accumulated over long periods and can thus provide a historical perspective to complement contemporary field surveys.

A topic of growing interest related to taxonomy is that related to identification of introduced species (NIS = Non Indigenous Species). The progressive conquest of the Mediterranean Sea by an increasing number of non-native species is an unprecedented event regarding the Mediterranean biodiversity. These “alien species” have been the subject of a large number of publications in recent years and, surprisingly, there are nowadays more studies focused on these “alien species” than on the native ones.

In contrast to the high number of taxonomic studies on gastropods, there are comparatively few publications on other topics, such as natural history traits (reproductive biology, feeding habits, autoecology), demography, genetic connectivity, or conservation management. However, the combination of multiple descriptors (shell morphology, anatomy, reproductive biology, genetics, ecological roles or their vulnerability) is probably the best approach thus far to try categorizing a species.

The terrestrial malacofauna of Türkiye — a review

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Abstract

An overview of the terrestrial Malacofauna of Türkiye is presented based on a book in preparation comprising the results of malacological research since Linnaeus. At present, about 740 species and subspecies of Gastropoda have been reported from the area; the specific structure of the Turkish malacofauna is presented and important groups are illustrated. Distribution data on important groups of gastropods are presented, and the underlying patterns are discussed. The degree of endemism is about 70%. Gaps in the knowledge of the fauna are highlighted and the causes discussed.

The outlook yields at future research tasks that are important to advance knowledge of this group of animals. The endangerment of the malacofauna can hardly be assessed at the moment, and it is proposed to achieve a basis for an assessment of the current situation by using a standardised evaluation procedure according to the rules of the IUCN. The data set obtained in this way can then serve as a basis for identifying changes in Türkiye's malacological biodiversity and taking appropriate measures for nature or habitat conservation.

Contribution of molecular tools to advance our knowledge of the evolution and biogeography of freshwater mussels (Bivalvia, Unionida) and guide future conservation efforts

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Abstract

Freshwater mussels of the order Unionida are key elements of freshwater habitats and are responsible for important ecological functions and services. Unfortunately, these bivalves are among the most threatened freshwater taxa in the world. However, conservation planning and management are hindered by taxonomic problems and a lack of detailed ecological data. This highlights the urgent need for advances in the areas of systematics and evolutionary relationships within the Unionida.

Due to their conspicuous and beautiful shells, freshwater mussels have always attracted the attention of collectors and naturalists. Shells were also used in the early classifications of this remarkable group of organisms and shell characters remained as the main diagnostic taxonomical characters for hundreds of years. Throughout the ages other morphological, ecological and behavioural characteristics have helped to understand the evolutionary relationships of freshwater mussels. By the last decades of the last century, the genetics, soon followed by the genomics revolution provided statistical tools that were able to test and better understand the evolution, diversity, and biogeography of this amazing group and guide ongoing and future conservation efforts.

Here, I present a retrospective review on the use of molecular tools to advance our knowledge of freshwater mussels' phylogeny and biogeography and assist conservation.

From Paleozoic to bathyal: temporal and spatial aspects of the evolution of cephalopod reproductive strategies

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Abstract

Since the Ordovician, the ectocochleate cephalopods have exhibited two alternative reproductive strategies based on the trade-off between egg size and offspring number with lower fitness of intermediate egg and offspring size. Both small- and large – egged strategies might occur with or without parental care (e.g. brooding). In inshore habitats cephalopod either lay either small or large protected unguarded eggs attached to the bottom at asynchronous ovulation (e.g. Sepia and Loligo) or brood them in sheltered places at synchronous ovulation (e.g. Octopus). In slope and upper oceanic waters cephalopods release pelagic egg masses (Ommastrephidae) or single eggs (Enoploteuthidae) as well as might exhibit brooding (e.g. Argonauta), and every type is based on asynchronous vitellogenesis. There is no large eggs in cephalopods inhabiting these waters. In deep seas cephalopod may brood a single egg mass of small or large eggs based in pelagic waters or on the bottom based on synchronous ovulation (e.g. Gonatidae, Benthoctopus), release a single pelagic egg mass based on synchronous ovulation (e.g. Onykia) or attach to the bottom single eggs (e.g. Cirrata). The same habitat-defined strategies were likely present in extinct cephalopods with some variation. Large – egged strategy was not proven for coleoids before Late Cretaceous when cuttlefish appeared, but we suppose it was present as early as in Carboniferous in *Gordoniconus* (large octopus-like eggs, synchronous ovulation).

'Achilles heel' within the life cycle: how the high seas fishery contributes to over-exploitation of abundant pelagic squid resources

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Abstract

Nektonic squid of the family Ommastrephidae are among the most abundant commercial cephalopod resources, exploiting productive frontal zones of continental shelves and the open ocean. Two of the most abundant species, *Illex argentinus* from the Southwest Atlantic and *Dosidicus gigas* from the Eastern Pacific, constitute from one third to almost a half of the total global cephalopod catch taken in the last decades. The life cycles of these two squid species have several common features including pelagic spawning and nursery grounds over deepwater plains and feeding grounds over shallow water shelf areas. Spawning and feeding grounds are located in tropical-subtropical and temperate marine ecosystems, respectively. Juvenile and adult squid undertake long distance migrations (sometimes thousands of miles) within their species ranges during their short life cycles (annual in *I. argentinus* to annual-biannual in *D. gigas*). Their extensive migration range includes areas of the high seas, as well as exclusive economic zones of several coastal countries. Despite being common migratory stocks, both species lack a unified fisheries stock assessment and management strategy. All coastal countries have their own separate management measures for exploiting these squid with a limited exchange and variable types of fishery data. In the high seas, there is little to no control of fishing activity with very limited data on catch and number of fishing vessels. Increasing market demand on squid products contributed to the great expansion of squid-catching fleets mainly of Asian origin. Recently, about 450-500 ocean-going jigging vessels have been catching *D. gigas* outside EEZs of South American countries, and about 500-600 jiggers and trawlers have been taking *I. argentinus* in the high seas of the Southwest Atlantic. This dramatically increased fishing effort in squid fisheries of the high seas together with high inter-annual variability in squid abundance pose a significant threat to the sustainability of these important resources and make them more vulnerable to over-exploitation, especially in years of low abundance. To prevent the looming collapse of squid fisheries, establishing an International Cephalopod Commission (InCephCom) similar to IWC or ICCAT has been suggested to monitor, regulate and manage cephalopod fisheries around the world.

A preliminary study of the land snail and slug fauna of Ankara city

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Abstract

Ankara has experienced subtle ecological changes since becoming the capital city of Türkiye, coupled with recent increase in the urbanization rate. As the city grows, both areally and demographically, the increasing need to recreational areas necessitate implementation of parks and similar areas which serve often as habitats for adventive and native snails and slugs. In the study, within the areal of Ankara city, 8 selected locations as such and their surroundings were surveyed/sampled during the course of more than a decade and malacological results involving taxonomic diversity and succession of terrestrial gastropods are presented here. Mainly due to changes in the habitat quality and management, native and established species still available within the course of the study are observed to be replaced by a few number of invasive species in newly established areas, while in other locations standing out with high β diversity scores, they are mostly in decline. An account of the malacofauna of the city is given, along with a distributional analysis and a discussion on the faunal changes and succession of snails and slugs of studied locations in time.

Mollusca species of lake Gölbaşı (Adıyaman) and the surroundings

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Abstract

The Gölbaşı Lakes (İnekli, Azaplı, Gölbaşı), which constitute our research area, are located in the Gölbaşı depression located on the East Anatolian Fault Zone, within the borders of Gölbaşı district of Adıyaman province. The waters of these lentic systems, which are connected to each other by springs, are discharged into Aksu Stream. The area, which has an area of approximately 2080 hectares and exhibits a rich floristic structure with an endemic rate of 5%, was granted the status of a protected area in 2002 and a Nature Park in 2008.

It was determined *Theodoxus (Neritaea) anatolicus* (Recluz, 1841), *Valvata (Cincinna) piscinalis* (O.F. Müller, 1774), *Orientalina caputlacus* Schütt and Şeşen 1993, *Melanopsis praemorsa ferussaci* Roth, 1839, *Galba truncatula* (Müller, 1774), *Stagnicola palustris* (Müller, 1774), *Radix auricularia* (L., 1758), *Planorbis carinatus* (Müller, 1774), *Gyraulus piscinarum acutissimus* Schütt & Şeşen 1993, *Oxyloma elegans* (Risso, 1826), *Unio delicatus* I. LEA, 1863, *Potomida littoralis delesserti* (Bourguignat, 1852), *Dreissena caputlacus* Schütt, 1993, *Sphaerium corneum* (L., 1758), *Pisidium casertanum* (Poli, 1795) that the species distributed in the research area and *Pseudochondrula arctespira* (MOUSSON 1874), *Pene kotschy* (L. Pfeiffer 1854), *Eopolita protensa* (A. Férussac, 1832), *Bulimulus corneus* (Sowerby, 1833), *Xeropicta derbentina* (Krynicky, 1836), *Eobania vermicula* (OF Müller, 1774) and *Helix (Helix) lucorum* Linnaeus, 1758 species distributed in the mountainous areas of surrounding the basin,

Among these species, *O. caputlacus*, *G. piscinarum acutissimus* and *D. caputlacus* are endemic. It has been observed that almost all species have populations represented by a very small number of individuals, along with other factors (low dissolved oxygen, pH, conductivity etc) that develop parallel to extreme water temperature values

The area, which is an important biological center for the region, is under intense anthropogenic effects (tourism, irrigation, agricultural activities) as well as being in an area where global warming and its consequences are felt most clearly.

Some new records or little known gastropod species from the Turkish coasts

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Abstract

The present study investigates some little known or new records of species from the Turkish coasts. Among the studied taxa, *Pelseneeria minor*, *Setia amabilis*, *Setia* sp, *Rissoella diaphana* and *Rissoella inflata* are new records for the Turkish mollusk fauna; *Eatonina ochroleuca*, *Eatonina pumila*, *Lamellaria latens*, *Setia pulcherima*, *Setia valvatoides*, *Oscilla galilae* and *Turbonilla cangeyrani* are little known species which were recorded only once or a few times. *Eatonina ochroleuca*, *Eatonina pumila*, *Lamellaria latens*, *Setia amabilis*, *Setia pulcherima*, *Rissoella diaphana*, *R. inflata*, and *Syrnola* sp. were encountered along the Aegean Sea coast, whereas *Pelseneeria minor*, *Setia* sp., *Rissoidae* sp, *Oscilla galilae* and *Turbonilla cangeyrani* were recorded on the Levantine coast of Türkiye. *Setia valvatoides* was the only species found on the Black Sea coast of Türkiye.

The present study also elucidates some ecological and distinguishing characteristics of the investigated species and their distribution along the Turkish coasts.

Records on the microplastics presence in cephalopods

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Abstract

Recently, plastic pollution is identified as one of the biggest environmental issues that oceanic and marine biotas has ever faced. Especially the pollution caused by microplastics (< 5 mm) is increasingly getting attention. There is a substantial body of literature documenting the consumption of these small plastic debris in the aquatic ecosystem, from zooplankton to marine mammals, mistaking it for food; however, the potential presence of MPs in cephalopods has not yet been extensively investigated, although there are many studies on crustaceans and fish. It has also recently been shown that MPs can be dangerous to the living world as a result of not only their direct ingestion, but also indirect uptake via trophic transfer. Cephalopod species are recognized as an important component of many marine ecosystems. Cephalopods are also important elements of marine food webs as they are consumed by ecologically important predators.

In this review, an evaluation of the records of microplastics (color, size and polymer types of MPs found in tissues) observed in the tissues of cephalopods (octopuses, cuttlefishes, squids) is given in the light of the information in the literature. It is known that a comprehensive description of microplastic particles in the tissues of cephalopods is incomplete and many knowledge gaps need to be filled. It is thought that the information presented in this review will be a good start for MP research and will be useful for researchers.

Types and type localities in zoological taxonomy with examples from land snails of Türkiye

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Abstract

We will discuss the requirements of the International Code of Zoological Nomenclature regarding the designations of type specimens and type localities in the descriptions of new animal species. Examples of type localities in the literature going back to Linnaeus (1758) will be given. These include several localities that would now be considered unsuitable, inadequate and possibly incorrect. We will present the results of our attempts at relocating the type localities of some land snail species described from Türkiye since the 19th century. Some of the type localities we have searched for are those of *Isaurica lycia* (Martens, 1889), a species common in southwestern Türkiye, and several *Albinaria* species. The village of Üçağız in the Kekova region (Antalya) is noteworthy for being the type locality of five species Johannes Roth described in 1839. We will also discuss the type localities of several land snail species described more recently. These include the type localities of *Mediterranea xylocola* Örstan & Yıldırım 2020 and *Albinaria latelamellaris kekovensis* Örstan, 2019. Finally, recommendations will be given for the geographical information to include in the descriptions of type localities.

Further reflections and horizon scanning on the introduced and potentially new invasive snail species in the Lake Ohrid region

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Abstract

Due to the highly diverse and endemic fauna of Gastropoda, Lake Ohrid could justifiably be entitled “a gastropods` paradise.” Namely, the high biodiversity consisting of seventy-two species of snails, is additionally emphasized by the high percentage of endemic snails, which add up to 78% or fifty-six species of the total gastropod`s diversity.

The registration of the first two invasive species of snails (*Ferrissia fragilis* and *Physella acuta*) in Lake Ohrid in the first decade of this century opened a series of assumptions, forecasts, and predictions regarding their negative effect on the biodiversity of the gastropod fauna, especially since some of the endemic species have extremely limited areal of distribution.

The latest research on the gastropod fauna of Lake Ohrid (2019-2020) aimed to develop a clearer picture of the status of the populations of the two invasive species, their distribution, and the negative effect on the native gastropod populations.

The results of the research indicated that the species *F. fragilis* was not registered in the Macedonian part of the Lake Ohrid, while the species *P. acuta* advanced its spread and increased its range of distribution in the region of the tributaries in the north-western part of the Lake Ohrid.

Comparison of the results with previous research indicated that, for now, *P. acuta* populations are isolated in the shallow littoral or lower reaches of tributaries and have no visible effect on native lake gastropod populations.

To assess the risk of introduction of other invasive gastropod species into the lake basin and the lake itself, a horizon scanning for invasive and non-native species was undertaken using the AS-ISK software. An assessment was made for the possibility of the introduction of the species *Melanoides tuberculata* and *Potamopyrgus antipodarum*, and the results of the assessment indicate a high risk of introduction. They are present in the immediate vicinity and in general in the Balkans and according to the results of the assessment it is expected to also reach Lake Ohrid.

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New records of Emsian (Lower Devonian) ammonoids from the Istanbul Zone of Turkey

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Abstract

Emsian (early Devonian) ammonoids have long been known from the Istanbul Zone Turkey, but their occurrences are rare. The most representative faunas were collected from Gebze area in the Kartal (Pendik) Formation, and some records are known from the Princes' Islands. In 2018, new material of Emsian ammonoid in the unmetamorphosed Palaeozoic series of the Istanbul Zone (NW Turkey) was recorded on the southwestern coast of Büyükada Island. Ammonoids come from the lower part of the thick, mostly micaceous siliciclastic shales of the Kartal (Pendik) Formation which represents a shelf environment with increasing sediment input to the basin. The assemblage includes: *Archanarcestes obesus* (Erben, 1960), *Mimagoniatites erbeni* Kullmann, 1960, and *Mimagoniatites* cf. *fecundus* (Barrande, 1865) suggesting the presence of the *Mimagoniatites* (LD-IIID) Zone. This level represents a higher Emsian horizon than the ammonoid-bearing beds previously recorded from the Gebze area (lower Kartal Formation, Istanbul Zone): *Erbenoceras* sp., *Erbenoceras solitarium* (Barrande, 1865), ?*Mimagoniatites* cf. *zorgensis* (Roemer, 1866) from the Lower Emsian *Erbenoceras-Anetoceras* Zone (LD III-B, LD III-C).

All these ammonoid taxa have also been reported from the Emsian of Western Europe (Northern Spain, Montagne Noire, France, Germany) and North Africa, suggesting that the marine basins of the Istanbul Zone and those of the Peri-Gondwanan and Armorican terranes had connections and faunal exchange in the early Devonian. Beds with ammonoids also contain trilobites, brachiopods, gastropods, ostracods, corals and crinoids showing a diverse benthic fauna. The crinoids from the Kartal (Pendik) Formation of Gebze (*Calleocrinus*, *Glyphidocrinus*, *Urushicrinus*, *Facetocrinus*, *Anthinocrinus*, *Kasachstanocrinus*) have also been reported from the Armorican Massif in western France and Altai in Siberia. This also suggests that the Devonian basins in the Istanbul Zone had extensive connections with Peri-Gondwana, and also had faunal exchange with marine basins in eastern regions, including Siberia, thereby contributing to cosmopolitanism of the ammonoid faunas. The nature of sedimentary facies and paleobiogeographic distribution suggest a shelf marine habitat for the early Emsian nekto-benthic ammonoid fauna of the Istanbul Zone.

Using compound specific isotope markers to characterize dietary niches of *Mytilus* sp. along an environmental gradient in the Baltic Sea

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Abstract

Blue mussels (*Mytilus edulis*; *Mytilus trossulus*) are suspension filter feeders living in coastal areas of the northern Atlantic Ocean, including North America, Europe, and the northern Palearctic. Despite their seemingly indiscriminate feeding behavior, it is not well understood whether they selectively or indiscriminately assimilate suspended detritus and phytoplankton biomass. An important step towards answering this question is characterizing their dietary niches along an environmental gradient. In this study, we analyzed *M. edulis* specimens samples across different seasons (early spring – late summer) and geographical locations (9°54'00.0"E – 14°50'06.0"E) in the brackish waters of the Baltic Sea. To probe the mussels' dietary breadth and potential as bioindicators of temporal changes in phytoplankton communities, we determined the $\delta^{13}\text{C}$ and d^{15}N values of amino acids (AA) of their abductor muscles. According to the $\delta^{13}\text{C}_{\text{AA}}$ fingerprints, the essential AAs in the mussel tissues originated from phytoplankton rather than bacterial or terrestrial sources. The results also showed that the $\delta^{13}\text{C}_{\text{AA}}$ patterns were location specific reflecting that the mussels indeed ingest and assimilate a wide variety of phytoplankton sources. However, more work is needed to assign the taxonomic assemblages of the assimilated phytoplankton sources. The trophic levels, which we inferred from the offsets between the $\delta^{13}\text{C}$ values of phenylalanine and glutamic acid, were almost identical across all locations. This finding underscores that the mussels' assimilated fresh phytoplankton rather than bacterially reworked detrital matter. Interestingly, the $\delta^{13}\text{C}$ offsets between phenylalanine and glycine were significantly different between locations. Further studies are warranted to understand the ecological and physiological controls of this isotopic offset. For a subset of specimens, we also compared the isotope values of muscle tissue, periostracum and shell calcite. Our results showed that $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ values were similar between muscle and periostracum for most amino acids (ANOVA, $P \leq 0.05$). The calcites were ^{13}C enriched relative to muscle for 8 amino acids ($2.7 \pm 1.0\%$, ANOVA, $P \leq 0.05$), and ^{15}N depleted for 4 amino acids ($-1.5 \pm 0.6\%$, ANOVA, $P \leq 0.05$). Some of the isotopic offsets can be ascribed to the fact that the tissues integrate different time periods. Despite some differences in isotopic offsets, our findings support that hard tissues that preserve well in historical and geological

records are excellent recorders of past food sources. Taken together, our findings suggest that the $d^{13}C_{AA}$ and $d^{15}N_{AA}$ values of *Mytilus* sp. is a promising tool for investigating dominant organic matter sources and understanding trophic linkages in food webs.

Freshwater bivalve fauna of the Mediterranean Region of Türkiye

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Abstract

Freshwater bivalve fauna of the Mediterranean Region of Türkiye has been studied most extensively during the previous century, as compared to other regions, although taxonomic confusion in many groups has been continued till present. According to the revised and corrected fauna list, freshwater bivalve fauna of the geographical region includes 30 recent species: Sphaeriidae (16 species), Unionidae (8 species), Dreissenidae (4 species), Margaritiferidae and Corbiculidae (1 species each). Taxonomy and distribution of these species are discussed, along with current conservation problems.

Land snails (Gastropoda, Pulmonata, Stylommatophora) of Ankara and its vicinity

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Abstract

Ankara province and its surroundings, located on the Central Anatolian region, are separated from the Black Sea by the Karadeniz mountains in the north, and the Mediterranean Sea by the Toros Mountains in the south. According to Köppen-Geiger Climate Classification cooler climate (Csa: warm winter, dry, and hot summer) is seen in the region. Thus, steppe vegetation is dominant in the region. Previously, other researchers reported twentythree terrestrial gastropod species from Ankara. Within the scope of our study, land snails were collected from twentyfive stations; twenty species belonging to six families and sixteen genera were identified most of which prefer steppe vegetation. Sixteen of the species are Palearctic and four of them are endemic. In this study, *Vallonia costata*, *Pupilla triplicata*, *Truncatellina cylindrica*, *Pseudojaminia seductilis*, *Chondrus lycaonicus*, *Xerocrassa cretica*, *Helicopsis striata*, *Xeropicta krynickii*, *Eobania vermiculata*, *Helix nicaeensis* and *Helix escherichi* are recorded for the first time from Ankara. *P. seductilis* categorized as "Vulnerable (VU)" in Europe according to the IUCN Red List 2019 data. However, no data were found on the status of endemic *C. lycaonicus*, *Helicopsis subcalcarata*, *H. nicaeensis* and *H. escherichi* in the study area. The presented study will be an important data source for future fauna, biomonitoring, and conservation.

Soft bottom molluscs (Caudofaveata, Polyplacophora, Gastropoda and Scaphopoda) fauna of the Sea of Marmara

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Abstract

The present study deals with the mollusc species, except for Bivalvia and Cephalopoda, sampled from the soft substrata of the Sea of Marmara in 2013. The benthic material was collected in 50 sampling sites taken from different depths (10 m, 25 m, 50 m, 100 m and 200 m) using a Box Core sampler. As a result of the faunistic analysis of the benthic material, a total of 210 species and 22244 individuals belonging to the identified taxa were counted. *Ondina dilucida* (Monterosato, 1884) is a new record for the mollusc fauna of Türkiye, and 19 species [*Ischnochiton rissoi* (Payraudeau, 1826), *Sinezona cingulata* (Costa O.G., 1861), *Cerithiopsis diadema* Monterosato, 1874, *Melanella levantina* (Oliverio, Buzzurro & Villa, 1994), *Setia fusca* (Philippi, 1844), *Setia turriculata* Monterosato, 1844, *Granulina occulta* (Monterosato, 1869), *Liostomia clavula* (Lovén, 1846), *Odostomia angusta* Jeffreys, 1867, *Ondina diaphana* (Jeffreys, 1848), *Parthenina dollfusi* (Kobelt, 1903), *Parthenina juliae* (de Folin, 1872), *Parthenina palazzii* (Micali, 1984), *Turbonilla gradata* Bucquoy, Dautzenberg & Dollfus, 1883, *Turbonilla hamata* Nordsieck, 1972, *Turbonilla pumila* Seguenza, G., 1876, *Acteon monterosatoi* Dautzenberg, 1889, *Antalis panorma* (Chenu, 1843), *Dischides politus* (S. Wood, 1842)] are new reports to the faunistic inventory of the Sea of Marmara. The most dominant species were *Bittium reticulatum* (da Costa, 1778) (59.1%) and *Megastomia conoidea* (Brocchi, 1814) (3.4%). Besides, *Bittium reticulatum* and *Hyala vitrea* (Montagu, 1803) were with the highest frequency values (37.1% and 28.7%) in the area.

**Influence of water level fluctuations and thermal regime on FM native populations:
the case study of Lake Maggiore**

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Abstract

Lake Maggiore and its River Ticino outlet is one of the largest reserves of freshwater and biodiversity, shared between Italy and Switzerland, threatened by user conflicts that make its management complex since the '50s. The Italy-Switzerland Interreg Cooperation Parchi Verbano Ticino Project aims to assess the threshold limits beyond which anthropic use conflicts with the conservation of biodiversity to help attaining a sustainable water management strategy. Based on their extreme susceptibility to habitat changes freshwater mussels are used as indicators of the impacts of current management. The project aims at: 1) assessing the major threats to native mussels, and 2) evaluating the feasibility of using mussels as potential warning sentinels of the impact of water level fluctuations. Since the native populations are undergoing a strong decline in recent years, the demographic parameters (size structure, sex ratio, reproductive condition) are examined according to the characteristics of the habitat, the presence of invasive species and the presence / prevalence of parasites. Major drivers of native populations decline are invasive bivalves (i.e., *Corbicula fluminea*) and trematode parasites. Both factors are expected to be correlated with changes in the lake's water level. In fact: i) in an unstable habitat *C. fluminea* benefits from its greater capacity for recolonization; ii) the impact of parasites is expected to be related with habitat changes induced by the regulation of water level. Since water level changes affect the thermal regime, we evaluated the effect of temperature on reproductive capacity and the prevalence of castrating parasites on FMs. To this aim, mussels were sampled in surface waters (depth < 1,5 m; temperature range: 6 to 30°C), and at higher depths above (- 6 meters; temp range: 6 to 15°C) and below the thermocline (- 15 meters; temp range: 6 to 10°C;). The samples were analyzed to determine: presence of parasites, status of gonadal tissues, presence/number, and size of offspring. By comparing different study methods, we highlighted that only by histological techniques the parasites' early stages detectability can be improved. Improved detectability meant an increase of the estimated prevalence of the parasite in the target population

to over 80%, highlighting a previous underestimation of this impact factor. Hence the need to re-evaluate the role of habitat variations induced by current water management for the development and maintenance of this unusually high parasitosis.

Effects of dietary *Rosmarinus officinalis*, L.) supplementation on the growth, survival and feed conversion ratio in land snail (*Helix aspersa maxima*, MULLER 1774)

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Abstract

In this study, it was aimed to investigate the effects of rosemary (*Rosmarinus officinalis*, L.) used as a feed additive at different levels on growth, survival and disease resistance and immunity of land snail (*Helix aspersa maxima*, MULLER 1774). In the study, the control ration and rosemary (*Rosmarinus officinalis*, L.) were added to the feeds at the rate of 0.5%, 1% and 2%, and feeding was carried out for 90 days. At the end of the experiment, deaths were observed in land snails (*H. aspersa maxima*, MULLER 1774) fed rosemary (*Rosmarinus officinalis*, L.). Six hundred Land Snails (*Helix aspersa maxima*, MULLER 1774) weighing three grams were placed in six crates by dividing them equally. After feeding, it was about 7.25 g. A mortality rate of 92% was observed after the trial. It has been determined that rosemary, which is added to the 2% feed ration, has a toxic effect. It was concluded that rosemary is not suitable for use in land snail cultivation.

Microbial Quality and Protection in the Processing of Snails

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Abstract

Nowadays, snails are consumed by millions of people all over the world, especially in some European countries such as France. The nutrient composition of snails (high-quality protein, low fat, high calcium and magnesium content) contributes to human diet and health. *Cornu aspersum*, *Helix* spp., *Achatina* spp. and other species are cultured and eaten mainly in the USA, Europe and the Far East. The raw materials are live snails mostly from collectors of local origin or imported from neighbouring countries. Due to their natural habitats, snails have a high level of microorganisms. In the processing (washing, shell and intestines removal) steps of snail meat, it should be evaluated by considering this situation. Hand hygiene of the processing equipment and personnel is among the most critical points. At the same time, fresh meat is a very good culture medium for microorganisms due to its high moisture content, near-neutral pH and rich in many nutrients. The common microorganisms involved in snails meat spoilage are bacteria, yeasts and mold. Bacterial of many genera are found snails. Some of the more important genera include *Staphylococcus*, *Pseudomonas*, *Alcaligenes*, *Micrococcus*, *Streptococcus*, *Clostridium*, *Escherichia* and *Salmonella*. Different preservation methods and processing techniques are used to preserve snail meat with its nutritional quality. Among the applications; packaging in vacuum or modified atmosphere together with cold storage, irradiation, smoking, drying, high hydrostatic pressure technique, ultrasound application, use of edible coatings, treatment with natural (vinegar, lemon) or artificial (K-sorbate, Na-Lactate) antimicrobial agents can be listed. These methods have been reported to reduce microbial load of snail meat and help to extend shelf life and keeping quality of snail meat.

Notes on the place of freshwater mussels in ecosystem services

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Abstract

The Millenium Ecosystem Assessment is a collective effort of scientists and experts from different fields to determine the condition and trends of the world's ecosystems, the services they provide to support human life, and also an analysis of the options to restore, conserve or enhance the sustainable use of ecosystems. The scientific resources on the freshwater mussels (Bivalvia: Mollusca) show that these organisms perform numerous important functions in aquatic environments. Correspondence of their ecological functions in the ecosystem services concept can grouped as regulating, supporting, provisioning and cultural services. Current presentation was prepared by bringing literature information on highlights of mussels ecology and the concept of ecosystem services together to create an emphasis particularly to mussels' regulating and supporting services. Considering IUCN Redlist statuses of some mussels species (ie. *Unio crassus*) are currently being enlisted as "Endangered", pointing out some suggestions to ensure their conservation through a holistic approach can be useful also for the mussel species of Turkish freshwaters. Interpretation of to-the-date information on the mussel ecology and its blending with future data/approaches are expected to add in further policies and tools also for managing their habitats.

The first record of *Unio tumidus* from Anatolia, Türkiye

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Abstract

This primary research was conducted on the detection of Unionidae species in June 2021 at Uzun Lake (one of the Bafra Lagune Lakes). *Anodonta cygnea*, *Unio tumidus*, and *Unio pictorum* species were identified through morphological identification. The occurrence of *Unio tumidus* is reported for the first time from Anatolia in this lake. *Unio tumidus*, the swollen river mussel, has a wide distribution in Europe. The present finding in Anatolia extends the known distribution area of the species.

Status of fan mussel (*Pinna nobilis*) diseases in Turkey

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Abstract

The fan mussel, *Pinna nobilis*, is endemic to the Mediterranean Sea but almost all population are facing to under threat of extinction cause of mostly microorganisms. *Mycobacterium* sp., *Vibrio* spp., *Haplosporidium pinnae* and *Perkinsus* sp. were found to be associated with diseases in fan mussels lived different area of Mediterranean sea. Especially *H. pinnae* spread very quickly and was very effective in mass mortality. This study briefly summarizes fan mussel diseases and their status in Turkey. The mortality information in Turkey waters, which was given without knowing the source of death in 2018, became clear in 2021 when the causative agents were found to be *Vibrio* spp. and *H. pinnae* co-infection. These findings were obtained from the fan mussels of Çanakkale Strait, and no parasites were found in our research conducted in the Marmara Sea in 2020. Coastline monitoring surveys should be routinely undertaken, given the ongoing mass mortality in fan mussels.

Contribution to the knowledge of the marine Mytilidae (Mollusca/Bivalvia) fauna of Turkey

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Abstract

As a result of the evaluation of the samples collected from the Aegean and the Levantine coasts of Turkey within the frame of various projects conducted between 2000 and 2021, four mytilid species new for the Turkish Seas were determined. Among them, *Idas simpsoni* (J. T. Marshall, 1900), *Gregariella semigranata* (Reeve,1858) and *Crenella arenaria* (Monterosato, 1875 ex H. Martin, ms.) are new for the mytilid fauna of the Turkish Seas whereas *Lioberus agglutinans* (Cantraine, 1835) is new for the Aegean coast of Turkey. Within the scope of the present study, the number of mytilid species identified from the Turkish seas increased from 21 to 24, while the number of mytilid species known to be distributed in the Aegean Sea increased from 16 to 20.

***Toxoplasma gondii* infection in Mollusca species, as a potential source of food contamination**

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Abstract

Consumption of contaminated raw shellfish and mussels can be considered a significant health danger due to their ability to infect a wide variety of hosts such as other marine animals and humans. However, they are particularly at risk for *Toxoplasma gondii* infection, and therefore, they can be considered a bioindicator for monitoring waterborne pathogens. The current systematic review and meta-analysis aimed to determine the prevalence of *T. gondii* infection among Mollusca species worldwide and highlight the existing gaps. Data collection was systematically done through searching databases, including PubMed, Science Direct, Google Scholar, Scopus, and Web of Science from 1997 to July 2021. Our search strategy resulted in the retrieval of 10 eligible studies reporting the prevalence of marine *T. gondii* infection. The pooled prevalence of *Toxoplasma gondii* infection in Mollusca (oysters, mussels, shellfish) in throughout the world was 7.45% (95CI: 2.06–15.81). The most useful diagnostic techniques for detecting *T. gondii* in mollusk species were particularly polymerase chain reaction (PCR) and HRM methods. Our results indicated the geographic distribution and spectrum of infected Mollusca species with *T. gondii* in different parts of the world. The spread of *T. gondii* among Mollusca can affect the health of humans and other animals; in addition, it is possible that marine mammals act as sentinels of environmental contamination, especially the parasites by consuming water or prey species.

Changes in the natural malacocenoses along the Vacha River following the invasion of the New Zealand mud snail *Potamopyrgus antipodarum* (J. E. Gray, 1843) – a preliminary study

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Abstract

Eight lotic and one control lentic site along the stream of Vacha river (Western Rhodopes Mountains, Bulgaria) were three times sampled. The species composition and dominant structure of the freshwater malacocenoses were defined. The role of the invasive New Zealand mud snail *Potamopyrgus antipodarum* (J. E. Gray, 1843) in formation of the freshwater gastropods communities along the river of Vacha was analysed. According to preliminary results seems that the geographical location plays a main role in the species composition of malacocenoses. We found also that the local River Limpet (*Ancylus fluviatilis* O. F. Müller, 1774) and the invasive New Zealand mud snail are the dominating gastropod species in Vacha river. It seems that the invasive species does not have a significant negative impact on the population of *A. fluviatilis*. The possible explanation is the microhabitat preferences of both species. While the River Limpet was found mainly on the stony bottom of the river, the New Zealand mud snail prefers the sandy bottom or organic sediments, where it burrows.