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Editorial

Aquatic Biodiversity: Evolution, Taxonomy and Conservation

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Twenty-one studies on the diversity of aquatic organisms inhabiting water ecosystems in Europe, Asia, Africa, North America, and Oceania were collected for the current Special Issue. The researchers that contributed to the Special Issue belong to 17 countries: Austria, Bosnia and Herzegovina, Canada, Czech Republic, Egypt, France, Kazakhstan, Montenegro, Myanmar, Norway, Russia, Slovakia, Slovenia, Saudi Arabia, Thailand, USA, and Vietnam. The taxonomy of aquatic organisms included in the Special Issue is greatly different: from bacteria (two articles) via unicellular organisms (algae chrysophytes—one article, ameboflagellates—one article, and centrochelids—one article) to multicellular (16 articles). The latter, in turn, are represented by invertebrates (Rotifera, Crustacea, Mollusca, Arthropoda—11 articles) and vertebrates (teleostean fishes—five articles). Some articles on the communities of aquatic ecosystems included a broad spectrum of taxonomic groups. The published studies can be provisionally sorted into several topics—taxonomical diversity, morphological and genetic diversity, ecological diversity, fauna and flora richness, and diversity of communities. They greatly contribute to our knowledge on taxonomy, ecology and the evolutionary biology of aquatic organisms.

1. Taxonomy, Phylogeny, and Evolution

Two papers are devoted to taxonomy and phylogenetic placement of protists. Borodina et al. [1] discovered a new species within a group of heterolobose amoebae (Vahlkampfiidae) in aquatic benthos. They have thoroughly described *Parafumarolamoeba stagnalis* from a small pond in European Russia based on fine morphology using light and electron microscopy, and reconstructed the molecular phylogenies based on the SSU rRNA and ITS loci. Zagumyonnyi et al. [2] revealed a new genus and species of centrohelid heliozoans, *Triangulopteris lacunata* (Pterocystidae) that is broadly distributed from the East European Plain to the North–Eastern Siberia. Authors used morphological (light and electron microscopy) methods as well as phylogenetic approaches (SSU rRNA) to identify the novel lineage and its phylogenetic position.

Four papers are about the taxonomy, phylogeny and phylogeography of invertebrates. Bolshakov et al. [3] presented the results of the identification of the cryptic *Chironomus* species based on an integrative approach that included morphological, cytogenetic, and molecular genetic methods in highly mineralized Kurchatskoe Lake (Russia, West Siberia). In general, three *Chironomus* species were revealed. The authors suggested that the presence of unique zygotic combinations in the *Chironomus* species has adaptive significance for larvae inhabitance in the mineralized water. A new species of the genus *Niphargus* was described from the deep karstic whole of the Tarkhankut Upland in Crimean Peninsula by Marin et al. [4]. The trophic specialization of a new species based on stable isotope composition was clarified. Based on the obtained molecular data, the authors reconstructed the phylogeography for the genus *Niphargus.* Chapurina et al. [5] describe a new subgenus and three new species of the parasitic water mites in the genus *Unionicola* from Myanmar,

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Southeastern Asia. The data obtained by the authors confirm that *Unionicola* mites are narrow host specialists that are associated with either one or a few closely related freshwater mussel species belonging to one or two sister genera. The taxonomic reassessments of freshwater mussels based on an integrative approach were performed by Lyubas et al. [6] on the Western Balkans. Authors present a new data on a cryptic refugium of freshwater mussels in this region. Discovered mussels may represent ancient lineages, which need special conservation planning. Vikhrev et al. [7] investigated the mitochondrial genetic diversification and postglacial expansion routes of the freshwater pearl mussel in Europe. The highest genetic diversity was detected for the populations of Northern and Eastern Karelia. The authors confirm that this region can be considered a major center of genetic diversity within the European part of the species' range. Zubrii et al. [8] studied the phylogeny and phylogeography of the beetle species *Pterostichus* (*Cryobius*) *mandibularoides.* The authors revealed that this species has a wide trans-Beringian distribution being mainly distributed in the western part of North America; a disjunctive range within the northeastern margin of Asia was noted. The additional taxonomic revision of the subgenus *Cryobius* using genetic methods is needed.

Three articles are about taxonomy, genetics, and trophic adaptations of fishes. Genomic ddRAD-sequencing study on wild populations of common carp from the Ponto-Caspian, Balkhash-Ile, and Aral Sea basins by Shalgimbaeva et al. [9] revealed that Aral Sea carp *C. carpio aralensis* inhabiting Balkhash-Ile and Aral Sea basins belongs to Ponto-Caspian or European carp *C. carpio carpio*. Authors also found several loci that can contribute to developing the population-specific, high-density SNP marker panels allowing the trade control of common carp production. Reier et al. [10] explored mitochondrial genetic diversity of cyprinid fishes from the waters of the Dinaric Karst (Southern Europe), a biodiversity hotspot, that drain into the Adriatic and the Black Sea basins. The authors studied four leuciscid genera (*Delminichthys*, *Phoxinus*, *Phoxinellus*, and *Telestes*) that differed in size of the range and degree of specialization to dwelling in sinking streams in karst regions. Reier et al. (2022) have reconstructed the ancestral geographic ranges and revealed different migration potential within studied lineages. Komarova et al. [11] investigated trophic resource partitioning in radiation of the cyprinid fish, the genus *Garra*, from the Ethiopian Highlands in East Africa. Authors revealed that trophically highly specialized (periphytonophagy) lineage could respecialize out of its ancestral specialization. Six sympatric *Garra* ecomorphs partitioned trophic resources using three feeding modes (periphytonophagy, mixed periphytonophagy and zoophagy, and zoophagy). This finding does not support the generalists-to-specialists hypothesis on the origin of specializations.

2. Communities, Environmental Factors, and Reproductive Biology

Mulec et al. [12] studied microbial communities and an ecotone in a sulfidic spring in the Reka River that was sinking into the karst underground in Slovenia, Europe. The spring's microbial diversity was assessed using classical methods of cultivation and microscopy as well as metagenomics. Metagenomic analyses revealed 175 distinct operational taxonomic units in spring water and biofilms with Proteobacteria as the predominant group in developed biofilms. A 'core' microbiome was represented by methylotrophs, including *Methylobacter*, *Methylomonas*, and *Methylotenera*. Aksenov et al. [13] estimated the impact of peat and peat pore water chemical composition on bacterial and archaeal diversity and community structure in a permafrost peatland of Western Siberia. Based on real-time PCR and metabarcoding analysis, the authors established the total bacterial number decreasing from the surface down to the mineral frozen layer of the peat core. At the same time, the largest genetic diversity of microorganisms was found in the bottom organic and mineral layers. Gusev et al.'s [14] article focuses on the flora of synuralean algae (Chrysophyceae) from four Northern provinces in Vietnam. The authors explored fifty-five water bodies including territories within national parks and Nature Reserves. They discovered 39 taxa that belonged to the genus *Mallomonas* (37 taxa) and the genus *Synura* (2 taxa). Five taxa were reported for the first time in Vietnam. The most diverse flora was observed in natural

protected water bodies. Alprol et al. [15] studied the physical and hydrochemical characteristics, level of eutrophication and zooplankton community of the Lake Burullus in Egypt. Lake Burullus is subject to a high level of pollution as a result of anthropogenic load. The authors assessed the significant impact of physicochemical parameters on species richness and abundance of zooplankton and recommended the purification of drainage waters before entering the lake. The diversity of freshwater calanoid copepods from the different habitats of Southern Vietnam was investigated by Boonmak and Sanoamuang [16]. In total, 13 species belonging to eight genera and three families were recorded. Among these, four species were discovered for the first time. The authors demonstrated that pH and conductivity have a significant impact on the distribution of calanoid species. The results of the study on diversity and geographical distribution of copepods in Cambodia are presented in the work of Chaicharoen and Sanoamuang [17]. The fauna of freshwater diaptomid copepods in Cambodia remains poorly studied so far, and only seven taxa were known previously. The study of Chaicharoen and Sanoamuang [17] revealed 24 species, and 14 species among these were recorded for the first time in Cambodia. The authors emphasize that the revision of the copepod fauna is far from complete and further research is required.

Two articles of the Special Issue are devoted to the study of the reproductive biology of *Corbicula* clams. The clams of the genus *Corbicula* have a wide spectrum of reproductive strategies that might contribute to their invasive success. Bespalaya et al. [18] provides new data on the reproduction of invasive *Corbicula* clam in the manmade channel of the Arkhangelsk Thermal Power Plant in Northern European Russia. The authors revealed that the *Corbicula* clam has a continuous reproductive period which may be adaptive in unstable environments. These results could be applied to control, monitoring, and management action. Kropotin et al. [19] described the reproductive mode of Indonesian endemic species *Corbicula tobae* based on combining anatomical and histological data for the first time. The authors detected several specific reproductive traits that may have evolved in narrow endemic *Corbicula* clams within their native ranges.

Two papers are devoted to fish communities in the water bodies of Eurasia. Mamilov et al. [20] reviewed state-of-the-art systems of fish diversity in the Alakol Lakes in Central Asia. The region and certain water ecosystem significantly suffer from the naturalized alien species that are dominant in the numbers over aboriginal fishes. The authors stated that poor water management and habitat change resulted in fish fauna homogenization and note that the future of the indigenous fishes is unpredictable. Uspenskiy et al. [21] investigated the composition and distribution of coastal fish species and the impact of abiotic and biotic environmental factors in the eastern Gulf of Finland (Northern Europe) during 2011–2017. The authors recorded 34 fish species. The coastal fish community demonstrated a low degree of heterogeneity despite a highly heterogeneous environment. Three key environmental variables (salinity, filamentous algae presence, and macrophytes presence) were most influential.

The papers in this Special Issue provide important knowledge on various aspects of aquatic biodiversity. These contributions are important not just to certain biological objects, but provide valuable insights for biodiversity in a wider context.

Conflicts of Interest: The authors declare no conflict of interest.

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