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**POTENTIAL BAD AND/OR GOOD IMPACT OF THE SEA LEVEL RISE
INDUCED BY CLIMATE CHANGES ON DELTAS FISH FAUNA
– DANUBE AND RHONE DELTAS STUDY CASES**



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Keywords: climate change, sea level rise, impact, Danube Delta, Rhone Delta, fish.

Abstract

The Danube and Rhône deltas are some of the Europe's major deltas, some of the Earth's main biodiversity hotspots with many bio-eco-economic valuable species, including fish.

These irreplaceable wetland ecosystems have a key role for the Danube and Black Sea and for the Rhône and Mediterranean Sea fish fauna through their role as natural shelter, feeding, reproduction, buffer, transitional zone, and adaptive important ecosystems for fish fauna.

The regional heritage of historic human induced disruptions and the severity of its modern impact distress the aquatic and semi-aquatic ecosystems, lately speeded due to major land use changes and climate change effects.

The rate of global sea level rise was around 1.1 mm/year before 1990 and then grew to 3.1 mm/year since 1990, with a rising trend. Climate changes induce the Black Sea and Mediterranean Sea level rise, a context that anticipates its influence on Danube and Rhône deltas ecosystems, biocoenosis, and escorting biota, including fish.

Based on their bioecological features, some of the potamodromous, anadromous, catadromous, and amphidromous fish of these deltas will be affected by the coming sea level rise. Others will adapt and their ecological positive feedback can fuel further ecological changes. Both situations are predicted to induce changes within these two deltas ecosystems, and also for the areas near Danube River and Black Sea and Rhône River and the Mediterranean Sea.

Sea level variation was and is likely to be one of the decisive stress factors of this deltas fish fauna. In this spatio-temporal context, for the fish under threat, in situ-permanent adapted management measures are highly required to be built on specific prognoses related to this risk.

We bring a prospective approach about the likely impact on the Danube River-Danube Delta-Black Sea and Rhône River-Rhône Delta-Mediterranean Sea coast of some fish communities' in a climate change-sea level rise scenario.

EVALUATING FISH COMMUNITY COMPOSITION
IN A SEMIARID AQUATIC SYSTEM, A MODEL-BASED APPROACH



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Keywords: climate change, biodiversity, generalized linear latent variable models (GLLVMs), environmental predictors, and longitudinal gradient.

Abstract

Understanding the factors that influence biodiversity and species distributions is a central question in ecology, particularly within community ecology, which focuses on the interactions between species and the processes shaping community composition. Ecological communities serve as indicators of broader impacts, such as habitat fragmentation and climate change. Knowledge of current community composition and its abiotic correlates is crucial for predicting future ecological scenarios. Among aquatic organisms, fish communities, recognized as sensitive keystone indicators of environmental degradation, provide critical insights into overall ecosystem health.

This study investigates how fish species in the Karun River Basin respond to environmental predictors along a gradient from upstream to downstream sites using Generalized Linear Latent Variable Models (GLLVMs). The Karun River Basin, a heavily regulated river system located in a semiarid region in the Middle East characterized by its diverse climates, provides a unique opportunity to understand the composition of fish communities in response to the longitudinal climate-related zonation. By modeling fish abundance and environmental data collected from 108 sites during the summers of 2019 and 2023, the study evaluates how different species respond to varying environmental predictors and illustrates the patterns of co-occurrences and interactions among species.

The model identified temperature as the most significant environmental predictor, with alien species responding positively to higher temperatures, suggesting potential shifts in their distribution due to climate change. In contrast, endemic species responded negatively to temperature increases, reflecting their vulnerability. Additionally, the species-specific model coefficients for total nitrogen concentration and average precipitation were often negative, indicating potential threats from nutrient enrichment and changing precipitation patterns. The model explained 62% of the variability in the data and also effectively captured bivariate correlations among fish species, revealing responses to environmental predictors and potentially significant positive and negative interactions that shape community structures.

This research established a baseline of current fish community structures in the Karun River Basin, providing valuable insights for predicting future ecological shifts under different climatic scenarios. The study contributes to broader concepts of diversity and distribution patterns in semiarid river ecosystems, enhancing our understanding of how environmental factors shape biodiversity in complex and rarely studied landscapes.

**A CONTINENTAL SCALE PERSPECTIVE
ON THE IMPACT OF LAND USE CHANGES
ON BENTHIC MACROINVERTEBRATE COMMUNITIES
IN STREAMS**



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Keywords: streams, riparian zones, aquatic communities, spatial scales, land-use changes.

Abstract

Streams and their associated riparian zones comprise strongly linked systems that underpin landscape integrity. They are subject to multiple human uses, which have consequences for biological diversity, cross-habitat linkages, and ecosystem services provision.

Understanding the linkages between human impact intensity and the structure and functioning of aquatic ecosystems and identifying the natural and anthropogenic factors that shape the aquatic communities has become a major issue in stream research and management.

This paper reveals the main patterns that characterize the structure and abundance of benthic invertebrates in relation to the structure and spatial configuration of stream-riparian networks in catchments with varying land use intensities, from less disturbed conditions to those dominated by agriculture or a mixture of agriculture and urban land use.

The results demonstrate that stream ecosystems are controlled by a suite of hierarchically nested biophysical processes operating at varying spatial scales. The local environmental context plays an essential role in shaping these complex interrelationships. The main drivers identified at different spatial scales that significantly affect the structural patterns of benthic macroinvertebrate communities are discussed.

Our results provide crucial insights into key drivers shaping the macroinvertebrate communities under different impact intensities. They are instrumental in designing more effective management strategies to protect these critical freshwater ecosystems, the species that depend on them, and the vital freshwater ecosystem services they provide.

**ARE THE HYGROSCOPIC ADHESIVE DROPLETS
ON SPIDER WEBS
A UNIQUE AQUATIC HABITAT?**



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Keywords: spiders, hygroscopic droplets.

Abstract

The silk of spider webs has often been considered antimicrobial, but our evidence indicates it is not. Spider webs placed into liquid nutrient broth, allowed to sit for 3 hours, and then plated with swabs grew colonies that were TNTC. Silk pressed into Petrifilm aerobic materials also readily grew bacteria. Orb webs that were pyrosequenced included 45, 56 and 118 species/taxa (OTU's) for the three webs. Most of these are associated with aquatic or moist environments.

The sticky droplets on orb webs which facilitate the capture of insect prey are known to be hygroscopic. They form the adhesive droplets which consist of a central protein core and an aqueous layer surrounding this. The droplets are created with 'extremely high-volume directional water collection. These minute aquatic habitats may be important in the maintenance of living bacteria, but may also provide a habitat for some microbial species to live and reproduce.

Spider web droplets may thus serve as unique aquatic habitats for microbial species, but much more research is needed to determine if these habitats are maintained by some means, ephemeral, interact with other environmental habitats, are mostly built by aerial input, and how much growth and reproduction can occur.

Do the bacterial species add to the adhesive and hygroscopic properties, or other silk characteristics?

Also, what are possible means to study this miniature aquatic habitat, and how unique is it?

**NOT AS BAD AS IT IS PAINTED:
DOES THE MONKEY GOBY (*NEOGOBIUS FLUVIATILIS*)
INVASION AFFECT NATIVE SPINED LOACH (*COBITIS TAENIA*)?**



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Keywords: stable isotopes, substrate preferences, diet analysis, competition experiment.

Abstract

Invasive species can negatively impact native ecosystems, but their introduction does not always lead to major ecological changes.

This study examines interactions between the non-native monkey goby (*Neogobius fluviatilis*) and the native spined loach (*Cobitis taenia*) through field observations and controlled laboratory experiments.

We assessed microhabitat use, dietary similarities, and behavioral interactions between the two species. Field results revealed overlapping microhabitats dominated by coarse sand, with no significant displacement of the spined loach by the monkey goby. Laboratory trials further supported these findings, showing minimal competitive interference in habitat selection, with both species co-occupying preferred substrates. Diet analysis indicated limited trophic overlap, suggesting resource partitioning rather than direct competition.

The results challenge the assumption that all non-native species exert harmful effects on native fauna. Instead, our study highlights the potential for coexistence, emphasizing the need for nuanced approaches in assessing the ecological impacts of non-native species.

This research contributes to a broader understanding of biotic interactions under anthropogenic influences, offering insights into ecosystem resilience and management strategies.

**RESILIENCE OF RIVER MICROBIAL COMMUNITIES
TO PRESSURE FROM WASTEWATER TREATMENT PLANT EFFLUENT:
A CASE STUDY FROM THE MUREȘ RIVER,
TRANSYLVANIA, ROMANIA**



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Keywords: WWTP, microbiome, river, sediment, equilibrium

Abstract

Lotic ecosystems are dynamic in terms of their species composition, abundance, and functioning and are shaped by interactions between natural biotic and abiotic elements and forces. Among such elements are rain, underground water, agricultural runoff, effluents from industry and wastewater treatment plants (WWTP).

The wastewater treatment plant effluents bring nutrients, chemicals like pharmaceuticals, and microorganisms into the river. These abiotic and biotic stressors impact the river ecosystem therefore shaping it.

The aim of this study was to assess the impact of WWTP effluents on the sediment microbial communities through the whole length of the Mureș River. To achieve this, sediment samples were collected from ten locations along the river with three collection sites at each location: upstream of the WWTP, downstream of the WWTP, and from the WWTP effluent.

High throughput 16S bacterial metabarcoding was used to evaluate bacterial communities in the sediment samples. Results show bacterial communities' alpha diversity is similar in upstream, downstream, and WWTP samples.

However, community structures differ between sampling sites, with a statistically significant difference between upstream and WWTP samples. Downstream samples do not significantly differ from either upstream or WWTP samples suggesting they are a mixture of the two. Immediately downstream of the WWTP, sediment microbial communities are affected by the input from the WWTP effluent, however the river sediment microbiome recovers its natural microbe composition as evidenced by the similarity in bacterial community structures at all upstream river locations.

This study shows the existence of an ecological equilibrium between the WWTP effluent disruptors and the resilience of the Mures River sediment microbiomes, a fact that suggests the river's stable/balanced ecological status in this regard, partly due to the microbial communities' resilience to the local impact of WWTP effluents.

**ADAPTATIVE POND CREATION FOR MITIGATING INVASIVE CRAYFISH:
HOW TO CONDUCE IN SITU EXPERIMENTS
UNDER GLOBAL CHANGE CONDITIONS?**



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Keywords: exotic crayfish mitigation, ponds, ecological engineering, substrate manipulation, biodiversity.

Abstract

Non-indigenous crayfishes are spreading through Europe's aquatic systems and cause many concern. Limiting the spread of invasive crayfish is a current but quite impossible issue. The burrowing crayfish *Faxonius immunis*, was first observed in the Upper Rhine Valley in 1993 and now disperses along the river catchment. In small standing waters the populations can attain very high densities, reproduce twice a year, turn the pond into a turbid brownish water alternative state and cause the disappearance of macrophyte and macroinvertebrate biodiversity. In order to propose ecological engineering methods to mitigate crayfish invasion in restored small standing waters, we tested preferences of the crayfish for different sediment compositions under controlled laboratory conditions. The study of crayfish habits permit to propose restoration methods that we tested in an in-situ experimentation: newly created experimental ponds' bottoms were covered by different sediment size or mix of sand and gravel fine layer. The gravel was intended to impede the harmful digging of the crayfish and mitigate its deleterious ecosystem effects. Finer sediment were thought to provide regeneration niche for rooted macrophytes and macroinvertebrates. Several technics were tested to both prevent crayfish settlement and allow macrophyte and macroinvertebrate communities to recover. Restoration efficiency was assessed through crayfish, macrophytes and macroinvertebrates surveys as well as estimation of the recovery of some restored standing water functions and services.

The presentation will deliver the first results of this "in field" experiment and will also discuss locks and incertainties (e.g. global changes, hydroperiod fluctuations, landowner and stakeholder involvement, etc.) that could occur when proceeding experimental in situ ecology.

This experiment is a part of project Emys-R (www.emysr.cnrs.fr).

**SEASONAL VARIATION IN RESPONSE OF DIATOM BETA DIVERSITY
TO ENVIRONMENTAL AND SPATIAL FACTORS IN LOWLAND RIVERS
(THE DANUBE RIVER BASIN, HUNGARY)**



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Keywords: periphytic diatoms, diatom guilds, species turnover, distance-decay relationship, environmental filtering, stochastic processes.

Abstract

Understanding the processes and mechanisms that influence the variations of beta diversity, defined as turnover of community composition in space, is one of the central objectives of ecological studies. We examined patterns and drivers of spatial beta diversity of periphytic diatoms in 9 lowland small- to middle-sized rivers (the Danube River Basin, Hungary) sampled in spring and autumn 2021 to assess whether the influence of environmental and spatial factors on diatom community structure varies seasonally.

Distance-based redundancy analysis (db-RDA) was used to assess the relative importance of environmental and spatial factors in shaping diatom communities. The effects of pure environmental and pure spatial factors on beta diversity were tested with partial db-RDA. To test the relationship of diatom beta diversity with geographic distance we used Mantel test. Environmental factors included diatom water quality metrics and land use data as proxy variables for water pollution and eutrophication, river geomorphological characteristics and climatic variables. Geographic distances between sites were used as spatial factors.

Diatom communities showed significant differences in taxonomic and functional (guilds) structure between high (spring) and low rainfall (autumn) periods. Spring diatom community was characterized by lower species diversity and evenness, and a higher abundance of tightly attached low-profile guild, indicating an increase in hydrological disturbance during spring. Loosely attached motile diatoms dominated in more stable hydrological conditions in autumn. The partial db-RDA revealed that although environmental variables outperformed spatial variables in both seasons, the contributions of environmental and spatial factors to spatial variability of diatom community were significantly higher in spring than in autumn. As a result, the amount of unexplained variation was higher in autumn diatom community compared to spring community. Spring diatom community exhibited a significant distance-decay pattern, whereas in autumn there was no significant relationship between community similarity and geographic distance. Together, our results highlight the importance of hydrological alterations in the balance between environmental and stochastic processes driving beta diversity of diatom communities in river environments.

**SPECIES DIVERSITY AND SPATIAL DISTRIBUTION OF FISH
IN THE SHALLOW COASTAL WATERS OF THE SOUTH BAY,
LIVINGSTONE ISLAND
(SOUTH SHETLAND ISLANDS, ANTARCTICA)**



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Keywords: Livingston Island, fish diversity, assemblage structure, Notothenioidei, coastal waters, Bulgarian Antarctic base.

Abstract

Fish play an important role in the Antarctic marine ecosystem. The fish fauna of the Southern Ocean is taxonomically limited, highly endemic and dominated by the fishes of suborder Notothenioidei. These fish possess a range of unique morphological, physiological and biochemical adaptations to life in cold waters and represent about 45% of all fish species known in the Antarctic region, which comprises about 95% of the fish biomass in the shelf zone. The study presents data about the species diversity and spatial distribution of fish species in the relatively poorly studied shallow coastal waters of Livingston Island. The island is part of the South Shetlands archipelago situated west of the Antarctic Peninsula with total surface area around 798 km². A total of 624 Notothenioidei fish belonging to seven species were found and measured in the South Bay near the Bulgarian Antarctic base. The fish were caught at a depth of up to 25 m, using Nordic-type bottom gill nets in austral summer of 2020, 2023, and 2024. The most numerous species in the study area were *Notothenia rossii* (n=422) and *Notothenia coriiceps* (n=147) followed by *Trematomus newnesi* (n=23), *Trematomus bernacchii* and *Lindbergichthys nudifrons* (n=11). The rarest species in the catches were the icefish *Chaenocephalus aceratus* (n=9) and the dragonfish *Parachaenichthys charcoti* (n=1). The largest number of specimens (n=254) were caught at a depth of 10-15 m belonging to six different species and dominated by *N. rossii* (n=175) and *N. coriiceps* (n=56). A total of 219 specimens were caught in the shallowest waters at a depth of 0-10 m, where only 2 species were found – *N. rossii* (n=152) and *N. coriiceps* (n=67). The greatest species diversity was found in the deep areas at a depth of 15-25 m – 146 specimens belonging to 7 species. Dominant species in this horizon is again *N. rossii* (n=95) followed by *N. coriiceps* (n=24) and *T. newnesi* (n=10).

Notothenia rossii has also the highest frequency of occurrence (95.7%) followed by *N. coriiceps* (69.6%). The rarest species in the samples is *P. charcoti* (4.3%), whereas other species show similar frequency of occurrence – *T. newnesi* (39.1%), *T. bernacchii* (30.4%), and both *L. nudifrons* and *Ch. aceratus* (26.1%).

Data about length and weight, relative abundance, and relative biomass of all caught fish species are also calculated and presented in the study.

**MULTIFACETED PHENOTYPIC ADAPTATIONS
OF *GAMMARUS BALCANICUS* TO CAVES:
HYPOGEAN VERSUS EPIGEAN ECOTYPES**



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Keywords: *Gammarus*, caves, epigean, hypogean.

Abstract

The gammarids are known to colonize occasionally caves, with contrasting morphological, life-history and ecophysiological adaptations compared to their surface conspecifics. In this study, a subterranean and a surface population of the species *Gammarus balcanicus* was surveyed for one year in a sinking-cave stream from the Apuseni Mountains (Romania). Three hypotheses were tested. First, we have investigated if the subterranean population had troglomorphic characters (i.e. longer antennae and smaller eye-size, as well as number of ommatidia) compared to surface populations. Except for the body depigmentation, the cave population did not have any troglomorphic characters. Second, there was observed that the cave-dwelling population comprised individuals that were significantly larger compared to their surface conspecifics, had larger body-size at sexual maturity and that the females produced fewer, but larger eggs, compared to the population situated outside the cave. All these were typical phenotypic adaptations to the subterranean habitats, except for the distribution of body-size, which showed that the lifespan was similar for both populations, indicating recent, and very likely temporarily colonization of the cave ecosystem. Third, we tested the trophic adaptations and nutrient content in amphipods and their food sources, in both habitats. The result showed that the trophic position and niche-width, as well as the omnivory, were significantly higher for the cave-dwelling compared to surface population and that the elemental imbalance for C: P molar ratios lower, but similar for C: N. Potential phosphorous shortcomings and food scarcity for the cave-populations were advanced as potential important drivers of the phenotypic adaptations to the subterranean milieu.

**ABIOTIC AND BIOTIC FACTORS
SHAPING CHIRONOMID ASSEMBLAGES
IN POLISH LOWLAND RIVERS**



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Keywords: dipterans, diversity, Orthocladiinae, Chironomini, co-occurrence.

Abstract

Chironomidae are known as one of the most numerous and flexible semi-aquatic insects in the world. In rivers of Central Poland, two chironomid groups dominated in the chironomid assemblages: Chironomini (Chironominae) and Orthocladiinae. The main aims of our study were to assess the dependence of Chironomini and Orthocladiinae local species richness (LSR) on habitat species richness (HSR) and to identify abiotic and biotic factors shaping the structure of the assemblages.

Chironomid samples were collected over an annual cycle, once a month, from seven lowland rivers of Central Poland. On each sampling occasion values of chosen abiotic variables, velocity, river width, river depth, water temperature, dissolved oxygen, bottom substrate covered by submersed aquatic macrophytes, were measured in the field, while inorganic substrate index, (SI), and the amount of organic and inorganic matter were assessed in the laboratory.

The influence of HSR on LSR was significant in the Orthocladiinae, and insignificant in the Chironomini. Multiple regressions of all LSR values of each taxon on abiotic parameters and seasons explained over 70.0% of LSR variability, in the Orthocladiinae and below 40.0% in the Chironomini. A positive impact on LSR had depth (both taxa), HSR and inorganic substrate index (Orthocladiinae). In turn, LSR was negatively affected by seasons (Orthocladiinae) and velocity (Chironomini).

The pairwise probabilistic model for species co-occurrence indicated that the co-occurrence patterns differed between the Chironomini and Orthocladiinae. Positively associated pairs were numerous within the Chironomini and Orthocladiinae, but negatively associated pairs occurred only in the Chironomini. The null model of co-occurrence confirmed a competitive structure of the Chironomini.

In conclusion, Chironomini seemed to be under stronger influence of biotic factors, while Orthocladiinae are mostly affected by abiotic variables. This results from different dispersal skills, phenology, and ecological requirements of both taxa.

**RESPONSES OF BENTHIC MACROINVERTEBRATE COMMUNITIES
TO SMALL HYDROPOWER PLANTS:
A CASE STUDY FROM ROMANIA**



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Keywords: Benthic macroinvertebrates, small hydropower plants, headwater streams.

Abstract

Small hydropower plants (SHP), considered renewable or green energy sources, are often seen as environmentally friendly. However, in certain situations, they can directly change the natural flow and shape of small rivers, and indirectly impact the physical, chemical, and biological characteristics of these ecosystems at both local and river basin scales. This alteration of habitats can negatively affect various communities, including fish, aquatic algae, and benthic macroinvertebrates (BMIV). For instance, BMIV populations can suffer due to changes in water turbidity, velocity, flow, sediment types, and the uniformisation of microhabitats, which could trigger the lack of depositional microhabitats for leaf packs. In Europe, there is no single set of rules for SHP building and functioning. However, the Water Framework Directive provides guidelines for national implementation, such as reducing hydropeaking, ensuring minimum ecological flows, and managing sediment transport.

This research, conducted during the spring and summer of 2019, examined the ecological impacts of 17 SHP on the macroinvertebrate communities in Romania. The study focused on upstream and downstream areas around the intake points of SHP to measure changes in the taxonomic composition of macroinvertebrates, evaluate how different species responded, and identify the environmental factors that influenced the composition and changes in these communities over time. Generally, fewer types of macroinvertebrate families were found downstream of the intake points. As anticipated, the key species to the community's structure were from the Ephemera, Plecoptera, and Trichoptera groups. The water depth, velocity, and flow were the most significant factors affecting the streambed. Even though the ecological status, as determined by the structure and diversity of the macroinvertebrate communities, was rated as "high quality," which aligns with European standards, the recorded fluctuations of some WFD metrics indicate the need for further monitoring to understand potential future and long-term changes.

**RECONSTRUCTION OF THE SPAWNING GROUND
OF BROWN TROUT (*SALMO TRUTTA*)
IN AN UPLAND POLAND RIVER**



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Keywords: brown trout, spawning ground, fish species, aquatic invertebrates, reconstruction

Abstract

The paper presents the effect of implementation work carried out in the riverbed of one of the rivers in the Polish uplands. The aim was to restore the spawning ground of brown trout. Brown trout is a species dependent on conservation measures. The population of brown trout in the catchment area of the Świętokrzyskie region (Polish uplands) occurs through stocking activities. This project was collaborative, with various stakeholders coming together to restore the spawning ground. One implementation activity that can be carried out is the restoration of spawning grounds that improve the breeding conditions of brown trout, which are also used by other fish species and aquatic invertebrates. The implementation work was preceded by field measurements (hydrodynamic measurements, bottom sediment sampling), which precisely determined the required granulation and amount of gravel needed to restore the spawning ground. After the project was completed, the same level of collaboration was maintained in the repeated hydrodynamic measurements, sediment sampling and analysis, and inventory of spawning nests.

The studies show that this collaborative approach led to a successful restoration of the spawning ground. The velocity of the spawning section increased, and sand accumulation in the gravel sediments significantly reduced. These factors improved reproductive conditions in the spawning grounds, translating into more spawning nests observed after the project was implemented.

**ANALYSIS OF THE INTERACTION BETWEEN MICROPLASTICS AND POPS
IN FRESHWATER ENVIRONMENTS
AN EXPERIMENTAL STUDY UNDER LABORATORY CONDITIONS**



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Keywords: microplastics, persistent organic pollutants (POPs), freshwater habitats.

Abstract

The development of urban settlements in recent decades together with the heavy industrialization of watersheds and the expansion of agricultural activities represent only some of the threats facing freshwater ecosystems. In such conditions where the pressure on nature is great, any external factor is important. Pollution induced by urban settlements has affected both the flora and fauna of aquatic habitats from the beginning. Thus, in order to protect freshwater aquatic species and ensure the normal functioning of ecosystems, it is important to identify the main sources of pollution, the effects of pollutants, and their spatial distribution.

Currently, there are numerous sources of pollution of freshwater inland waters. Among these, having a major impact on the environment, are industrial waste, unregulated domestic waste, discharge and/or untreated domestic water runoff into natural systems, air pollution, deforestation and subsequent soil erosion, use of pesticides and harmful chemicals in agriculture, and the use of inappropriate construction materials. Due to the poor management of these wastes, considerable amounts of persistent pollutants end up in aquatic environments, altering the quality of the surrounding habitat.

This study aims to contribute to the development of knowledge of the effects of persistent pollutants by analyzing the interaction between POPs and microplastics in freshwater environments. This work determined the correlation between the concentration of POPs present in aquatic habitats and the amount of microplastics. The foundations of this study are based on laboratory testing of the absorptivity of plastic materials for POPs. Due to the fact that persistent organic pollutants are hydrophobic and have an affinity to temporarily fix on non-polar surfaces, microplastics represent the ideal transport support for these contaminants in the aquatic habitats. The current study analyzes the synergy of the two classes of pollutants, testing the amount of POPs that adhere to plastics, found as pollutants in the freshwater habitats (PET (Polyethylene Terephthalate), PS (Polystyrene), PP (Polypropylene), PVC (Polyvinyl Chloride), AC (Acrylic), PE (Polyethylene), PA (Polyamide)).

In the end, this work represents the basis of much larger studies that will be able to be continued by analyzing the selective adsorption factors of plastic masses for different persistent organic pollutants and by creating complex models of the fragmentation of contaminated plastics up to the level of microplastics. At the same time, the laboratory analysis carried out in this study contributes to the improvement of the POPs extraction protocol from microplastics, a technique rarely encountered in other toxicology analyses.

ANALYSIS OF PATHWAYS OF INTRODUCTION AND SPREAD IN BULGARIA
OF TWO INVASIVE ALIEN CENTRARCHIDS
LEPOMIS GIBBOSUS AND *MICROPTERUS SALMONIDES*



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Keywords: Pumpkinseed, largemouth black bass, unintentional introductions, aquaculture, recreational fishing.

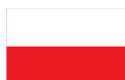
Abstract

Two North American fish species of the family Centrarchidae—pumpkinseed *Lepomis gibbosus* and largemouth black bass *Micropterus salmoides*—have been introduced in many countries around the world and are known for their high invasive potential. Since 2019, the pumpkinseed has been listed as an invasive alien species (IAS) of Union concern according to Regulation (EU) 1143/2014 on IAS. The pumpkinseed was first reported from Bulgaria in 1920 in Svishtov Marsh along the Danube River, and since then has spread widely in Bulgarian river systems. The largemouth black bass is a comparatively recent invader reported in 2018 from reservoirs in the Struma River catchment (Aegean Sea Basin). The aim of this study was to analyse the pathways of introduction and spread of the two fish IAS in Bulgaria. The pathways were analysed based on the method and protocol developed under the ESENIAS-TOOLS project (2017). Data from scientific literature, project reports, databases, social media and other available sources were used.

The two fish IAS have different patterns of introduction and spread by human assistance to water basins in Bulgaria. The main pathways of introduction and spread of the pumpkinseed are unintentional introductions related to fishery and aquaculture. The most probable pathway of the largemouth black bass is escape from confinement as a result of intentional illegal introductions related to angling and recreational fishing. When established, both species spread by natural dispersal through the canal and river systems.

Acknowledgements: This study was financially supported by Sofia Municipality, Agreement COA22-ДC96-1288/04.07.2022, and the EU funded DANUBE4all project, Horizon Europe Programme, Grant Agreement: 101093985.

**CASCADING BLOCK RAMPS ON THE NAREW RIVER IN THE NAREW
NATIONAL PARK AS THE ULTIMATE METHOD TO STABILIZE
THE WATER LEVELS WHILE PRESERVING THE UNIQUE NATURAL HABITAT
OF THE NAREW MARSHES**



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Keywords: block ramp, destroyed weir, CFD numerical modelling, water level stabilize, The Narew river.

Abstract

The paper concerns the innovative application of hydrotechnical technologies for protecting nature, particularly in stabilizing water levels in the Narew National Park. The project's main objective is to modernize the existing, partially destroyed weir on the Narew River by building a new hydrotechnical structure. This structure aims to raise the water level, which is crucial for maintaining marshes and communities of sedge and reed vegetation necessary for the survival of protected species of fauna and flora in the park.

The Narew National Park is a habitat for many endangered species of birds, such as the white-tailed eagle, ruff and aquatic warbler, as well as mammals, including the European beaver, muskrat, European hedgehog and larger animals, such as the moose and red deer. The park has been recognized as an IBA (Important Bird Area) since 2010, emphasizing its importance for protecting migratory and local birds. There are also protected fish species, such as the common bitterling, the stone loach, the spined loach, and the Ukrainian brook lamprey.

The project envisages using a natural barrier made of stone riprap and block ramps, enabling the migration of fish and other aquatic animals. The iterative modelling process and the use of modern CFD numerical calculations allowed for the precise determination of the shape of the block ramps, the size of the chambers and the distribution of stones, which will ensure appropriate water permeability and the migration of organisms. The project's innovative nature lies in using advanced computational technologies to minimize the impact of hydrotechnical structures on the ecosystem while restoring the natural water conditions necessary for adequately functioning the park's ecosystem.

The project is an example of how modern hydrotechnical solutions can be effectively used in nature conservation, combining technical aspects with the need to preserve biodiversity. Implementing this project will contribute to the long-term protection of valuable natural habitats in the Narew National Park, ensuring the stabilization of water conditions necessary for many protected species.

NEW DATA ON UNIONIDAE IN THE BALKAN RIVER BASINS
WITH THE FIRST CONFIRMED RECORD
OF *MICROCONDYLAEA BONELLII* (A. FÉRUSSAC, 1827)
IN REPUBLIC OF NORTH MACEDONIA



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Keywords: Freshwater bivalves, *Unio*, Anodonta, Balkan Peninsula, invasive alien species, conservation.

Abstract

Freshwater bivalves of family Unionidae play vital roles in maintaining healthy freshwater ecosystems. At the same time they are subject to multiple threats, such as hydromorphological changes, water pollution, invasive alien species and climate change. Significant declines of unionid populations in Europe have been reported and several species are assessed of high conservation concern. Most recent large-scale comprehensive phylogenetic studies, which used an integrative approach, based on morphological and molecular data, have revealed a higher taxonomic diversity within genera *Unio* and *Anodonta* in Europe than previously known. The aim of the present study was to review the species composition of Unionidae in selected river basins in the Balkans. The study area covered freshwater bodies in Bulgaria, North Macedonia and Montenegro from Aegean, Adriatic and Black Sea basins, including the Danube River Basin. Data on distribution of the freshwater bivalves were collected through field surveys and review of museum collections, literature sources, project reports, and available databases.

The compiled lists include 12 native and one alien species of Unionidae. Of them 9 species have been reported from the Danube River Basin, 5 species from the Black Sea Basin, 8 species from the Aegean Sea Basin and 7 species from the Adriatic Sea Basin. The presence of the critically endangered bivalve *Microcondylaea bonellii* is confirmed for the first time from Ohrid Lake, North Macedonia. The invasive alien species *Sinanodonta woodiana* was recorded in the water basins in Bulgaria and Montenegro, and it was reported for the first time from the river systems in the Aegean Sea Basin in Bulgaria. This review highlighted the necessity of further studies at transnational river basin level and development of conservation and management strategies to protect the freshwater bivalves of family Unionidae in the Balkan countries.

This study was conducted in the frame of the COST Action CA18239 „Conservation of freshwater mussels: a pan-European approach” (CONFREMU) and financially supported by the National Science Fund of Bulgaria under the project No KII-06-COST-9/20.07.2022, and by the EU funded DANUBE4all project, Horizon Europe Programme, Grant Agreement: 101093985.

**DISTRIBUTION OF MACROPHITES IN THE RIVER RAK
(SLOVENIA)
OVER 5 YEARS (2019-2023)**



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Keywords: Macrophytes, karstic river, ecological status.

Abstract

Rivers are important ecosystem for many organisms, including aquatic macrophytes. They are spatially and temporally heterogeneous systems susceptible to changes caused by anthropogenic influences. Anthropogenic activities significantly alter water quality and river communities, including macrophytes, which are involved in nutrient cycling, energy flow, and sedimentation processes and provide habitats for other organisms. They can also serve as indicators of the state of aquatic ecosystems.

We studied the presence, abundance, and distribution of macrophytes in the river Rak, a karstic river, that is an outflow from the intermittent lake Cerkniško lake. We also classified the river into certain RCE (Riparian, Channel, and Environmental Inventory) quality classes, according to environmental parameters and into ecological status according to WFD. Rivers that flow partly underground are particularly susceptible to human impacts from the hinterland due to their lower self-purification capacity. Using a modified RCE method, we classified the sections of the Rak River as the first or second RCE quality class.

According to the River Macrophyte Index (RMI), the ecological status of the sections of river Rak was assessed as moderate, good or very good. The ecomorphological preservation of the studied river and suitable conditions for macrophyte growth contribute to the high species diversity. We observed 38 taxa in the Rak River. The presence of *Myriophyllum verticillatum* L. was recorded in the river Rak for the first time. Almost a third of the species present in this river are listed on the Slovenian Red list of threatened pteridophytes and seed plants. This supports the evidence of high naturalness of the river Rak and underlines the importance of appropriate management of karst watercourses.

**ASSESSING THE CLEANUP EFFORTS
AT THE HISTORICALLY POLLUTED SITE
IN THE PORT OF LIEPAJA, KAROSTA CHANNEL
– TESTING FOR RESIDUAL HEAVY METALS AND HYDROCARBON
POLLUTANTS IN THE SEDIMENTS TO ESTIMATE THE ECOLOGICAL
IMPROVEMENT (LATVIA)**



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Keywords: Sediment pollution, heavy metals, hydrocarbons, ecological cleaning.

Abstract

The presence of persistent contaminants in the sediments, such as heavy metals and hydrocarbons, can have long-lasting negative effects on marine ecosystems, resulting in harming both wildlife and humanity.

It is critical to rehabilitate the impacted habitats and prevent future contamination for our own good. Such an example is the Port of Liepāja from Latvia, where high levels of pollutants were identified more than two decades ago. Since then many efforts have been made to improve the ecological status of the channel, following a complex strategy of multiple cleaning procedures to ameliorate the negative impact over the Baltic Sea and to exclude the Port of Liepāja from the Red List of "collapsing biotopes" (HELCOM 2013).

The current study aimed to assess the environmental hazard of persistent contaminants and trace the effects of the environmental measures undertaken over time in the Karosta Channel - Liepāja, Latvia. The most recent and consistent dredging activities had the purpose of removing the majority of the remaining polluted sediments from the channel. This created an ideal moment for evaluating the immediate environmental impact of the dredging as such and calculating the rate of ecosystems' regeneration in the near future. Moreover, by analyzing the content of hydrocarbons and heavy metals in the residual sediments, the study provided more information on how successful the ecological cleanup was.

The critical evaluation of the methods applied within this project provided a different perspective over the theorized remediation procedures, thus developing knowledge in this aspect. The results of the study revealed that hydrocarbons and heavy metal pollutants cannot be easily removed from coastal marine habitats. Dredging activities, in the absence of the complementary procedure of "capping", increased the levels of detected pollutants in the remaining sediments and surface water. By disturbing the old deposits of contaminated sediments, the cleaning procedure had a negative impact on the habitat, worsening the overall pollution status. In the end, it was concluded that such actions provide the opportunity for a better ecological state in the near future if certain measures are taken.

This study project contributes to the existing knowledge of cleaning techniques in the coastal zones, emphasizing sediments and other particulate-bound contaminants, by applying new technologies and learned methods.

**PHYLOGENETIC EVIDENCES INDICATING MORE CLOSE RELATIONSHIP
BETWEEN THE CASPIAN SEA AND THE BLACK SEA FISH FAUNA,
LESSONS FROM CLUPEIDAE AND ATHERINIDAE**



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Keywords: Silverside, Ponto-Caspian, Sprat, Phylogeny, Biogeography

Abstract

It is confirmed that About 2 million years ago, the Caspian Sea became permanently landlocked and separated from the Black Sea at the start of the Pleistocene epoch, but the timing of their last connection is a subject of debate.

Two complex groups including silver sides *Atherina* spp. and sprats *Clupeonella* spp. are distributed around Ponto-Caspian region. *A. boyeri* from the Black Sea and *A. caspia* from the Caspian Sea and *C. cultriventrif* from the Black Sea and *C. caspia* from the Caspian Sea are congener species that are taxonomically ambiguous. Their morphological features (body and otolith) and two molecular marker including Cyt-b and CO1 genes Sequence examined for better understanding of their taxonomy and divergence.

Fish Specimens were collected from the coastal waters of the Caspian Sea (Mazandaran and Guilan provinces) and Black Sea (Samsun province) by a beach seine during summer 2023. Morphometric and meristic characters measured and counted. SEM photos and geometric morphometric characters used to compare their Saggita otoliths. COI and Cyt-b genes sequence and species delimitation model (ABGD) used to evaluate their phylogenic status.

Despite some morphological difference in otolith and body, molecular data indicated that samples from *A. boyeri* and *A. caspia* and also *C. cultriventrif* and *C. caspia* belong to the same species and their divergence time as is related to more recent time comparing ecosystem distinction time (Two million years ago).

Lack of genetic species boundaries is possibly related to the recent isolation of the *A. boyeri* and *C. cultriventrif* in the Caspian Sea, during the Pleistocene era (about 50,000 years ago) from the Black Sea.

This information indicates non validity of *C. caspia* and *A. caspia* in species level which described recently based on just morphological character and habitat distinction. Also, connection between the Black Sea and the Caspian Sea during the Late Pleistocene and interglacial periods is suggested.

**THE CHARACTERISTICS OF HABITATS AND PLANTS
OF SMALL GLAVACIOC RIVER FROM ROMANIAN PLAIN**



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Keywords: Glavacioc River, Romanian Plain, nitrates pollution, habitats and plants characteristics.

Abstract

In southern Romania, the Glavacioc River crosses many rural areas. It collects nitrates polluted waters from husbandry (mismanagement of manure), human waste and/or agriculture (excessive fertilization with mineral nitrogen fertilizers). Previous research regarding soil and water chemical content developed in the area highlighted the certitude of river soil and water pollution in some localities thus we aimed to identify the plant species that could survive the river banks and minor riverbed of Glavacioc River.

The field investigations started from localities of the confluence with Câlniștea River (river discharging) toward Ștefan cel Mare locality (river spring), inventorying herbaceous, shrubs and trees species from the minor river bed (hygrophytous vegetation) and river margins (dry and wet riparian areas).

The statistical multivariate analysis with PAST program of the database comprising plant species and vegetal association showed that the vegetation changes occur up downstream, and due to the water pollution with nitrates, the diversity and abundance of most nitrophilous and ruderal species grow downriver. Cutting the woody vegetation growing naturally on the river banks (riparian) represents the highest impact on plant species distribution and abundance.

From up to down river the vegetation changes, the diversity and abundance of the species grows in favor of most nitrophilous and ruderal species. The extent of the riparian zone of the Glavacioc and its tributaries had shrunk or it disappeared on large areas, due to clear cut of the trees and has been replaced by agricultural fields.

The aquatic vegetation was species-poor and degraded, dominated by communities of eutrophic water. The typical habitats are represented by Natura 2000 type **3260** 'Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitriche-Batrachion* vegetation', the plant communities of still water are related to Natura 2000 type **3150** 'Natural eutrophic lakes with *Magnopotamion* or *Hydrocharition* – type vegetation'.

The most important management practices for decreasing the entrance of pollutants into the water are represented by maintaining most of the herbaceous natural vegetation and re-vegetation of natural woody vegetation from the river banks.

**MORPHOLOGY, MOLECULAR CHARACTERIZATION AND ECOLOGY
OF A NEW MARINE LEECH SPECIES OF BRANCHELLION SAVIGNY, 1822
(HIRUDINIDA: PISCICOLIDAE) IN THE GULF OF TUNIS**



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Keywords: Torpedinidae, Molecular phylogeny, Taxonomy, Leeches, Hirudinea, Gulf of Tunis.

Abstract

Studies of Hirudinea species infesting elasmobranchs are scarce and scattered worldwide and they are inexistent off the Tunisian waters. In this work, we aimed to assess the occurrence of these parasites on a ray species in the Gulf of Tunis (Tunisia).

Between 2017 and 2021, 254 fish specimens belonging to common torpedo, *Torpedo torpedo* (Linnaeus, 1758) were examined for leech infection. Morphological and molecular characterizations based on 18S rDNA and cytochrome c oxidase (COI) sequences allowed us to identify a new Branchellion Savigny, 1822 species *Branchellion tunisensis* sp. n.

This new species exhibited distinctive traits unlike other Branchellion, including a transparent body marred with dark green along the abdomen and neck, long trachelosome (about 1/3 of the length of the body), distinctive two eye spots, the presence of a pair of lateral branchiae per somite except for the last 2 somites and cup-shaped posterior sucker. Molecular analysis of the 18S rDNA and COI gene fragments shows more than 10% divergence of *B. tunisensis* from other *Branchellion* spp.

The study of parasitological indices shows that this leech species exhibited relatively high infestation rates (P=8.03%; MI=1.2) and those rates presented a significant differences between seasons. Moreover, we noted that *B. tunisensis* was fixed on the dorsal and the ventral surfaces of its host *T. torpedo*. During the extraction, we were able to notice the occurrence of many lesions near the edges of both body surfaces. The trauma left by this parasite species was not very conspicuous macroscopically with any hemorrhage or lesion.

The present study allowed us to identify a new species of Branchellion, increasing the number of known species belonging to this genus to ten. In addition, it seems very interesting to study the presence of these parasite species on other host species and from different locations along the Tunisian coast. Indeed, our findings prove that our knowledge about the diversity and geographical distribution of leech species is far from being complete and studies of these parasites are still needed.

**ECOLOGICAL ASSESSMENT AND RESTORATION POTENTIAL
OF WAR-DAMAGED AQUATIC ECOSYSTEMS IN UKRAINE:
HYDROCHEMICAL AND MICROBIOLOGICAL EVALUATION**



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Keywords: assessment, water bodies, hydrochemical indicators, microbiological assessments.

Abstract

The war in Ukraine has had far-reaching effects on the country's economic, social, and environmental development. Among the most significant environmental issues is water pollution, resulting from various military activities. Pollutants enter water bodies through mechanisms such as the use of conventional weapons, improper burial of human and animal remains, massive fish falls, and the destruction of industrial facilities, including metallurgical plants, artillery emplacements, and dams. These pollutants have led to reduced biodiversity, habitat destruction, and a decrease in ecosystem services, making the restoration of these ecosystems critical.

Since the purpose of this stage of the study was to conduct an environmental assessment of water bodies affected by military operations, the research was conducted in different regions of Ukraine. For this purpose, the tasks included the determination of the general condition of water bodies by means of hydrochemical indicators, as well as their microbiological assessment.

The study involved water sampling from various regions of Ukraine affected by the large-scale invasion by the Russian Federation. Samples were collected in the autumn of 2023, five months after the destruction of the Kakhovka hydroelectric power station, from conditionally polluted areas within Kherson Oblast, as well as from Lake Chernoye and Lake Kalinovka in Kyiv region, and the riverbeds of the Chichiklia and Yuzhny Bug in Mykolaiv region. Hydrochemical indicators were determined using the standard methodology outlined in the Industry Standard "Water of Fishery Reservoirs." Microbiological assessments were conducted to determine the total number of heterotrophic bacteria, providing insights into the pollution levels of these water bodies.

The ecological assessment revealed significant regional differences in the hydrochemical indicators of water bodies. In the Kosheva and Dnieper rivers (Kherson region), there was a noticeable increase in organic pollution levels, with permanganate and bichromate oxidisability indicators either close to or exceeding permissible limits. Nitrite and nitrate levels were also elevated, indicating ongoing pollution.

Microbiological assessments showed fluctuations in the number of heterotrophic bacteria, ranging from 3.51 to 10.60 thousand CFU/mL. The Kosheva and Dnieper rivers, in particular, showed bacterial levels close to the threshold at which the normal existence of aquatic organisms, including fish, could be threatened.

The ecological assessment of water bodies in Ukraine, particularly in regions affected by military operations, reveals significant environmental degradation. The study's findings emphasize the need for comprehensive restoration strategies to mitigate the impact of pollution and ensure the recovery of aquatic ecosystems. This research provides critical insights into the current state of these ecosystems and lays the groundwork for future restoration efforts.

The work is carried out within the framework of Creating a Strategy for Assessing and Restoring War-affected Aquatic Ecosystems (RestoAqua, no. G6085) the project is supported by Science for Peace and Security Programme. Project Coordinator: Nature Research Centre (Lithuania) Partners: D.K. Zabolotny Institute of Microbiology and Virology of the National Academy of Sciences of Ukraine and the Institute of Fisheries of the National Agrarian Academy of Sciences of Ukraine.

HOW TO MANAGE INVASIVE ALIEN SPECIES IN AQUATIC ENVIRONMENT



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Keywords: aquatic alien species, human consumption, utilization of aquatic alien species.

Abstract

Due to globalization and anthropopressure on aquatic environments, we can observe a loss of biodiversity, mainly caused by invasive alien species (IAS) which are included in the Global Biodiversity Framework and by 2030 eradication or control of IAS are priorities. Tackling IAS is considered as an important task to restore nature and recover it by 2030 for the benefit of people and the planet. IAS cause habitat destruction and represent a major threat to native species, causing damage to economy. Moreover, many IAS can carry diseases, posing a threat to humans and wildlife.

The implementation of the Global Biodiversity Framework aims to manage pathways for the introduction of IAS, preventing or reducing their rate of introduction and establishment, and control or eradicate IAS to eliminate or reduce their impacts, focusing on priority species and priority sites. However, growing economic costs of aquatic IAS need more advanced management actions.

We promote the responsible use of aquatic IAS, harvesting of aliens and their human consumption. Controlling aquatic alien species populations by reducing their numbers via utilisation is an economically viable way by turning the species into resources rather than simply trying to eradicate them. It can be a viable management option leading to their reduced environmental impacts. It has been reported that the consumption of aliens can prevent food insecurity and is an important advantage in solving biodiversity loss. Aquatic alien species can be a source of protein and other nutrients. Promoting their consumption can diversify food sources and reduce pressure on overfished native species. Additionally, the use of these species in industry (e.g. pharmacy, medicine) may provide alternative materials and essential substances for humans. Different sectors may benefit from the utilization of aquatic alien species: consumers, chemicals and materials, tourism, medicine, pharmaceuticals. Use of alien species is a better alternative than their removal and/or chemical treatment. Therefore, international mechanisms for the control and responsible utilization of such species should be promoted. This approach should be part of a broader management plan that includes other control methods, monitoring, and education to ensure responsible success.

**MONITORING THE MICROBIAL PRESENCE
IN FARMED FISH SPECIES
FROM AN AQUACULTURE FACILITY IN KOSOVO**



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Keywords: rainbow trout, golden trout, aquaculture, mesophilic microorganisms.

Abstract

Rainbow trout (*Oncorhynchus mykiss* Walbaum, 1792) and golden trout (*Oncorhynchus mykiss* Stevanovski, 1987) are cultivated in a cold-water aquaculture facility in Kosovo, in an aquatic environment supplied by the streams of the Istog River. “Istog trout” as it is known, is widely used in the Kosovar market, especially in restaurants, as a food that is consumed throughout the year. These fish species have a high nutrition quality due to their composition and good environmental growth conditions. The purpose of this study was to analyze the presence of mesophilic microorganisms on the fish surface/ skin, as well as in fish muscle. A total of 10 fish samples were collected from the cold-water aquaculture facility in the summer season, from both fish species, rainbow trout (n=9) and golden trout (n=1). During the transport to the laboratory, the samples were placed at a temperature of +5°C. The method used for the determination and enumeration of mesophilic microorganisms (Total viable count TVC), by incubation at 30°C is based on EN ISO 4833-1:2013 and EN ISO 18593:2018. The obtained results show that the microbial load in the samples taken from the surface of the fish skin by swabs of 10 cm² expressed in logarithms ranges from log 0.55 cfu/cm² to log 1.99 cfu/cm². While the results obtained from the fish muscle in the amount of 10 g, range from <0.1x10¹ cfu/g to 4.66x10² cfu/g. The findings can serve as a basis for future testing of other fish species, and perhaps as a model for developing a system for continuous control not only in this facility but also in the other environments where the trout live.

**HABITAT AND FEEDING BEHAVIOUR
INFLUENCE MICROBIOME COMPOSITION
IN RHABDOCOELA (TURBELLARIA)**



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Keywords: Host-microorganism associations; *Gyratrix hermaphroditus*; *Mesostoma ehrenbergii*; *Phaenocora evelinae*; Rhabdocoela.

Abstract

Microbiome studies in Platyhelminthes have predominantly focused on a limited number of taxa, overlooking the vast diversity of turbellarian hosts. Here, we aimed to expand our understanding of microbial associations in a selection of free-living representatives of Rhabdocoela, a group of turbellarian flatworms that is very species-rich and ecologically diverse. Using 16S rRNA sequencing, we characterised the microbiomes of three species of Rhabdocoela, representing the two major lineages within this taxon: Dalytphloplanida and Kalyptorhynchia. The specimens were captured in the wild and obtained from marine or freshwater habitats. *Gyratrix hermaphroditus* (Kalyptorhynchia) and *Mesostoma ehrenbergii* (Dalytphloplanida) were both dominated by Proteobacteria, while *Phaenocora evelinae* (Dalytphloplanida) was predominantly associated with Cyanobacteria, more specific Oxyphytobacteria (chloroplasts). Based on the observed genera, our analysis revealed distinct microbial patterns, possibly associated with the habitat and lifestyle of the studied species. We could not exclude the presence of a phyllosymbiotic signal as a limited core microbiome was present for each rhabdocoel species, although no set of bacteria common in all three rhabdocoel species was found. This explorative study contributes to the expanding knowledge of invertebrate microbiomes, providing new insights into the microbial associations of a selection of turbellarians. The descriptive results presented here open up several promising avenues for future research, including the search for functional roles of turbellarian bacterial symbionts and exploring potential correlations between microbiome compositions, turbellarian phylogeny and environmental parameters.

**RIPARIAN PLANT INVASIONS
AND SEDIMENT ACCUMULATION IMPACT STREAM DECOMPOSITION:
A MICROCOSM STUDY**



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Keywords: Leaf litter decomposition, invasive species, fine sediments, shredder diversity, stream ecosystems, microcosm experiment.

Abstract

The decomposition process in stream ecosystems is vital for nutrient cycling and ecosystem functioning, yet multiple anthropogenic stressors increasingly threaten it. This study explores how the invasion of riparian zones by *Fallopia japonica* and the accumulation of fine sediments in streams influence leaf litter decomposition in low-order streams. Using a full factorial microcosm experiment, we investigated the individual and combined effects of these stressors on the survival and growth rates of key shredder species and on litter decomposition rates.

Our results reveal that both stressors negatively impact shredder survival, with a more pronounced effect when the stressors are concurrent. The study highlights the critical role of shredder species diversity in mitigating these impacts. Assemblages with higher diversity showed greater resilience to the stressors. Notably, the decomposition rate of invasive *F. japonica* leaf litter was significantly slower than that of native *Alnus glutinosa*, further highlighting the detrimental effects of invasive species on stream ecosystems.

These findings underscore the complexity of multiple stressor impacts in stream environments and the importance of preserving shredder biodiversity for maintaining ecosystem functions. The study offers valuable insights for stream management practices, particularly in regions facing increased riparian invasions and sedimentation due to human activities.

VARIETY OF PROTEIN SYSTEMS IN *ACIPENSER BAERII* FROM THE
"GOLD-FISH" FARM OF CHERNIVTSI REGION (UKRAINE)



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Keywords: sturgeon, variability, locus, heterozygosity, protein systems.

Abstract

Siberian sturgeon (*Acipenser baerii*) in Ukraine has a high commercial value today. Some Ukrainian fish farms solve tasks related to the cultivation, breeding, reproduction and storage of sturgeon breeding material and obtaining high-quality food products. However, intensive aquaculture of Siberian sturgeon can potentially lead to a decrease in genetic diversity in populations from fish farms. Control of genetic heterogeneity during artificial reproduction is very important for ensure the long-term genetic stability of the species.

Assessment of sturgeon genetic variability has a high importance for creating broodstocks, especially when we have limited number of brood fish. Molecular genetic analysis, in particular analysis of blood protein polymorphism, can give valuable information about population structure and genetic diversity. We investigated heterogeneity level and analysis of population structure of *A. baerii* at the "GOLD-FISH" fish farm. The results demonstrated the peculiarities of the distribution of alleles and genotypes in the blood serum according to polymorphic loci of transferrin (TF), albumin (ALB) and two loci of esterase (Est-1, Est-2, 3.1.1.1). The allelic variant Tf A had the lowest frequency (19.2%) by the transferrin locus. The frequency of other variants approached 35% (Tf C) and 46% (Tf B). The following genotypes were found by the TF locus: ABC, BB, VS. The Tf ABC genotype was most common (42%).

Blood serum albumin in *A. baerii* has five allelic variants: Alb A, B, C, D, E. Among them, Alb B, C, D were the most common (from 25 to 30%), but the Alb A was found only in 5% of individuals. Six genotypic variants were identified for the ALB locus: ABCD, BCD, BCDE, ALL, BD, BDE. The Alb BCD genotype had the highest frequency (33%).

Esterase of investigated *A. baerii* had two loci: Est-1 with three allelic variants and Est-2 with two alleles. The Est-1 locus had three genotypes (AB, ABC, BC) and Est-1 ABC was most often (50%). Three genotypes were also found at the Est-2: AA, AB, BB.

No statistically significant excess of heterozygous individuals, compared to the expected was observed ($\chi^2=3.127$; $P>0.05$, ns). The investigated *A. baerii* group was characterized by a high level of heterozygosity at various loci from 75 (TF and EST-2 loci) to 100% (ALB and EST-1 loci). The average level of observed heterozygosity was 87.5% and exceeded the expected level (63.5%). The FIS inbreeding coefficient by loci ranged from -0.191 to -0.520. Average level indicated about 38.7% excess of heterozygous individuals. This phenomenon indicates the absence of inbreeding in the studied group of *A. baerii*.

Thus, the established level of average heterozygosity (87.5%) and the inbreeding coefficient (FIS = -0.387) indicates high heterogeneity of the studied broodstock of *A. baerii* and the high level of its genetic variability.

**NUTRITION OF *BUFO BUFO* TADPOLES
FROM ZLATAR MOUNTAIN
(REPUBLIC OF SERBIA)**



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Keywords: Bufo bufo, tadpoles, algae, nutrition.

Abstract

Tadpoles inhabit various aquatic environments, such as flowing and still water bodies. They forage in several habitats, such as the pond floor, the middle layer of water, and the water's surface, and they fulfill various important ecological functions.

Although tadpoles are plentiful in their habitats, researchers have not extensively investigated them, especially regarding their nutrition. The absence of thorough investigation has resulted in a restricted comprehension of their genuine nutritional condition and their function within food chains. At first, we performed a detailed examination of the food consumed by the tadpoles.

We collected a total of eighty-four tadpoles belonging to the *Bufo bufo* species from three different locations on Zlatar Mountain. Subsequently, we analyzed the contents of their digestive systems. Examinations of the contents in the digestive system verified that the tadpoles primarily consumed algae and debris. The algae genera that were most commonly recorded are *Penium* and *Cosmarium* from the Charophyta division and *Trachelomonas* from the Euglenophyta division.

Therefore, it can be inferred that algae play a crucial role in nourishing tadpoles. Aside from algae, they consume crustaceans, bacteria, and plants, but in limited amounts.

Direct approaches offer a deeper understanding of nutrition, whereas indirect methods can identify the source of amino acids and other chemical components. However, indirect methods cannot directly specify the objects to which chemical traces belong. In addition, we carry out the research using a substantial sample size.

The acquired results signify a notable progression in resolving the trophic status of the larvae of specific species of anuran amphibians. Additionally, they establish a solid basis for future investigations that are more comprehensive and detailed.

**COMPETITIVE EXCLUSION
OF NATIVE SPECIES
BY INVASIVE SPECIES
WITHIN *CARASSIUS* GENUS**



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Keywords: aquatic conservation; *Carassius carassius*; iEcology; competitive displacement; reintroduction programme.

Abstract

Successful invasive non-native fish species can cause enormous damage to native biodiversity. On the European mainland, the introduction of the gibel carp (*Carassius gibelio*) has led to a decline in populations of the formerly widespread native crucian carp (*Carassius carassius*). Due to the effects of the invasion of the gibel carp, the crucian carp has been moved from the status of least concern to the status of critically endangered in Czechia in recent decades, and its population has also declined in other countries where the gibel carp has invaded. This contribution summarises the findings on the competitive displacement of native species by invasive species from both experimental approaches and historical trends. The recent findings demonstrated that the gibel carp utilises food sources much more efficiently than its native counterpart. The gibel carp are not only more aggressive and utilise shared resources faster, but also use plant material that is not available to the crucian carp as an effective food source. Finally, this contribution provides circumstantial evidence that the gibel carp is behind the transition from the relative abundance of large crucian carp to near extirpation in Czechia, while large gibel carp have taken over the reports of record angling catches in the genus *Carassius*. Taken together, the current findings strongly suggest that the crucian carp is being locally extirpated by the gibel carp. Due to the uneven competition between *Carassius* species, programmes to repopulate selected waters with crucian carp are necessary.

**POPULATION DEPENDENT DIFFERENCES
OF FRESHWATER BIVALVE MOLLUSCS
IN THE TOLERANCE TO MULTIPLE STRESSORS**



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Keywords: Bivalve mollusc, micropollutants, stress on stress response, interpopulation variation.

Abstract

The tolerance of ecologically relevant organisms to multiple environmental challenges can derive on the totality of the internal and external exposures over the lifetime in the certain biotope. However, the approaches to assess the particular features and limits of the adaptivity are not developed. To recognise the ability of bivalve molluscs to withstand the impact of pharmaceuticals and personal care products, we treated freshwater bivalves *Unio tumidus* from distinct pristine (Pr) and antropogenically loaded (Ct) sites by microplastics PET (MP, 1 mg L⁻¹, size 0.1–0.5 mm), pharmaceutical ibuprofen (IBU, 0.8 µg L⁻¹), or their combination (Mix) for 14 days. Untreated specimens (C) from both sites were also compared. The biomarker set included the indexes of oxidative/reductive stress, metallothionein (MT) and GSH/GSSG, and enzymes of biotransformation and apoptosis. The comparison of C-groups indicated the substantially higher levels of NAD⁺/NADH, MTSH, cytochrome P450-related EROD and glutathione-S transferase (GST), and lower levels of GSH/GSSG caspase-3 and cathepsin D (CtD) in the Pr-group. These data indicate a multi stress impact in the Ct population. Under exposures, we found an almost common strategy of typical for facultative anaerobes redox shift (NAD⁺/NADH decrease), MT depletion and CtD induction in both populations. However, other responses to MP and IBU were different and even opposite in two populations. Only the Pr groups demonstrated the suppression of caspase-3 in the exposures to IBU and Mix (typical response to IBU), dramatic increase of CtD efflux as response to MP (MP- and Mix- groups), and suppression of biotransformation activities (EROD and GST in the Mix-group). According to discriminant analysis, Pr-groups were highly inter-distinguished, indicating the specific manifestations in each exposure, whereas Ct-control and exposed groups had close localization demonstrating tolerance to contaminants. Thus, the same exposures resulted in different adverse outcome pathways depending on the population. These comprehensive results confirm the different vulnerability of wild organisms to the environmental chalengers depending on the history of population and provide the set of markers for its indication.

**CHAROPHYTES (CHAROPHYTA, CHARACEAE)
OF COASTAL REGION OF MONTENEGRO**



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Keywords: charophytes, distribution, important plant areas, Mediterranean, Montenegro.

Abstract

During the 2022-2024, a survey of different aquatic habitats on the coast of Montenegro was carried out, as well as an analysis of samples from the collection of the Natural History Museum of Montenegro (NHMM Charophyta collection), to update knowledge about charophytes of this area. It covered the whole coastal region delineated with a watershed divide, where most areas looking suitable for charophytes at satellite images were checked. Fourteen species including *Tolypella* sp. from 13 localities were known before 2022 in the area of study (Vilhelm, 1913; Filarszky, 1931; Blaženčić et al., 1998; Lovrić and Rac, 2006; Urbaniak et al., 2008; Biberdžić and Blaženčić, 2013; Blaženčić and Blaženčić, 2015). Checking of specimens stored in NHMM allowed us to exclude *Chara aspera* Willd., *C. tenuispina* A. Braun, and *C. virgata* Kütz. from the species list.

During our survey ca. 200 sites of 18 species from 4 genera were found. *C. vulgaris* L. was the most common species. Eleven species and one genus, *Sphaerochara* Mädlar, were new for the coastal part and 7 species were new for Montenegro: *C. corfuensis* J. Groves in ex Fil., *C. galioides* DC., *C. squamosa* Desf., *Sphaerochara intricata* (Trentep. ex Roth) Soulié-Märsche, *Tolypella hispanica* Nordst. ex Allen, *T. nidifica* (O. F. Müll.) A. Braun, and Mediterranean *Chara*, a taxon of uncertain affiliation (see Blindow et al., 2024). We confirmed the actual presence of 7 species known before our studies but were not successful in the re-collection of *C. papillosa* Kütz. (reported as *C. intermedia* A. Braun), *Nitella confervacea* (Bréb.) A. Braun ex Leonh., and *N. syncarpa* (Thuill.) Chevallier. According to the last taxonomy implemented in the monograph “Charophytes of Europe” (2024) and considering 30 species known from Montenegro before this study (Blaženčić and Blaženčić, 2015; Biberdžić et al., 2023), the actual species richness can be estimated in 37 species from all seven extant genera of charophytes. It makes Montenegro one of charophyte species-rich countries in Europe. Also, these studies have brought new knowledge about charophyte communities, including the most interesting ones with aquatic liverworts of the genus *Riella* Mont., a new genus for Montenegro.

Most habitats of charophytes were temporary, existing during late autumn, winter to the end of spring, or the beginning of summer. Few species, i.e. perennial species of the subsection *Hartmania* R.D. Wood: *C. corfuensis* and *C. hispida* L. were associated with permanent waterbodies with water levels severely dropping from spring to autumn. Some populations of *C. vulgaris* from small concrete basins of captured springs appeared perennial too, because the plants can be found at the same site at any season. Few areas harboring numerous populations of different species and supporting populations of locally rare species known in Montenegro from them only can be tentatively suggested as important botanical areas for Montenegrin charophytes – Ulcinjska solana and its vicinities, vicinities of Velika plaža and coastal wetlands southern of Buljarica. They are important for the long-term persistence of charophyte species, rare and threatened in South Europe and worldwide.

**DISTRIBUTION AND ECOLOGY OF THE VAUCHERIA GENUS
(HETEROKONTOPHYTA) IN SERBIA**



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Keywords: Xanthophyceae, aquatic ecosystems, indicator, autecology

Abstract

Species of the *Vaucheria* genus are cosmopolitan and often found in inland waters, where they usually form sterile mats. Identifying *Vaucheria* species is impossible without reproductive structures, as their appearance represents distinguishing characteristics. According to the literature published between 1889 and 2024, *Vaucheria* spp. were recorded at 26 sites in 16 Serbian aquatic ecosystems, but the species could only be identified at 5 of them: *V. bursata* (O.F. Müll.) C. Agardh (reported as syn. *V. repens* Hassall and *V. sessilis* (Vauch.) DC.), *V. fontinalis* (L.) T.A. Christ. (reported as syn. *V. ornithocephala* C. Agardh and *V. ornithocephala* f. *genuina* Heering), *V. bilateralis* C.-C. Jao and *V. frigida* (Roth) C. Agardh. This study aimed to extend the knowledge about the distribution and ecology of the *Vaucheria* genus in Serbia.

The research was carried out at 425 sites across over 200 aquatic ecosystems in Serbia during 2017-2024, with *Vaucheria* spp. collected at 87 sites in 47 rivers and waterfalls. Compared to previous studies, its occurrence was confirmed at 11 sites, while it was reported for the first time at 76 sites. Reproduction was observed in four samples collected, while in five samples under ex-situ conditions, the formation of reproductive organs occurred within one month of sampling. Two species were identified: *Vaucheria geminata* (two sites) and *V. bursata* (nine sites). This is the first record of *V. geminata* in Serbia, while *V. bursata* was found at new locations. *Vaucheria* spp. were found during March-November in a wide range of environmental conditions, with temperature 9.3-27°C, conductivity 250-800 $\mu\text{S cm}^{-1}$, hardness 120-380 mg L^{-1} , oxygen concentration 7.43-12.98 mg L^{-1} , ammonium ions <0.03-1.35 mg L^{-1} , phosphates <0.06-1.37 mg L^{-1} and nitrates <4-16 mg L^{-1} . Mats were most commonly found on larger rocks, stones, or concrete in well-lit and shallow water.

Since members of the *Vaucheria* genus are common in Serbian aquatic ecosystems, they could potentially be used as water quality indicators. However, accurate species identification and knowledge of their ecology is crucial. Since reproductive structures are required for species identification, in order to find them, more frequent field research is necessary. Another potential solution is to find the most efficient method for ex-situ cultivation of the collected material.

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**EVALUATION OF THE EFFECTS
OF COMMON CARP STOCKING SIZE
AND DENSITY STOCK BIOMASS AND YIELD**



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Keywords: Stocking common carp, biomass.

Abstract

Lake Dega, one of the largest among the 84 karstic lakes in the Dumrea area, Albania, spans 28.7 hectares and is situated at an altitude of approximately 160 meters above sea level. Recognized for its precious natural significance, Lake Dega has been designated as a Natural Monument (Category III according to IUCN). The provisioning services offered by Lake Dega emphasize the critical role of natural lakes, not only for their ecological significance but also for their direct contributions to human economies and livelihoods. Among these services, the lake's provision of fish for human consumption stands out as a key benefit. Catches from the lake vary based on demand, ranging in the recent years from 5 to 5.5 tons per year. To optimize resource use, maintain water quality, and increase production to support fishery activities, the lake is stocked annually with common carp, silver carp, bighead carp, grass carp, and black bream. None of these species reproduce naturally in the lake. The study aims to assess the costs and benefits of stocking Lake Dega with common carp, as well as to evaluate the potential social and economic impacts of this fish stocking using an integrated bioeconomic model. The effects of stocking common carp at different densities – using fry, juveniles, and adults – along with the impact of size restrictions on exploitation, were modeled to determine biomass yield. The results showed that stocking juveniles at a density of 50 fish per hectare produced a higher biomass of 0+ aged fish (35 kg/ha more) at lower costs compared to stocking fry at a density of 1,000 fry per hectare. A similar trend was observed for 2+ aged fish, where stocking juveniles at 50 fish per hectare increased biomass by 85 kg/ha, compared to 53 kg/ha when stocking fry at 1,000 fry per hectare. Biomass yield (kg/ha/year) is twice as high when stocking juveniles compared to fry, using the respective densities mentioned above. With the same stocking cost and a minimum capture size of 30 cm, stocking with juveniles boosts stock yield by 3.5 times compared to stocking with fry. Stocking Lake Dega with common carp juveniles, compared to fry, is shown to be significantly more effective in enhancing biomass yield, optimizing resource use, and ensuring a more productive and sustainable fishery.

**NEW DISCOVERY OF A RARE FRESHWATER BROWN ALGA
BODANELLA LAUTERBORNI W. M. ZIMMERMANN
(SERBIA, SOUTHEAST EUROPE)**



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Keywords: Phaeophyceae, spring, crystalline shales, Vlasina Plateau.

Abstract

Bodanella lauterborni W.M. Zimmermann is one of seven freshwater members of brown algae (Phaeophyceae) and one of the rarest algae in the world. The species has been previously reported from four deep locations in Europe, in glacial Alpine lakes: Bodensee, Lunzer Untersee, Traunsee, and Zeller See, and last time observed in nature almost 50 years ago. Due to the changes in environmental conditions concerning eutrophication and *Dreissena polymorpha* (Pallas) immigration, the species has been considered locally extinct at the type locality (Lake Bodensee) since 2019, and its presence in the other three lakes has become questionable owing to eutrophication too.

We performed field surveys from April 2017 to June 2024, including 445 localities and over 200 Serbian aquatic ecosystems, with the aim of macro-algological studies. The thalli of *B. lauterborni* were collected from three springs located at the Vlasina Plateau (Southeast Serbia). *Bodanella lauterborni* was detected as brownish-black cushions firmly attached to wooden and stony substrates at three groundwater springs. The thalli were composed of creeping, uniseriate, and richly irregularly branched filaments, while filaments were composed of thick-walled elongated and inflated cells, with numerous small discoid plastids. Environmental conditions in which this alga was found were as follows: fast-flowing water with temperatures ranging from 5.8°C to 10.3°C, pH ranging from 7.28 to 7.59, conductivity up to 60 $\mu\text{S cm}^{-1}$, water hardness up to 20 $\text{mg CaCO}_3 \text{ L}^{-1}$, low concentrations of ammonium and nitrates, and orthophosphates concentrations ranging from 0.14 mg L^{-1} to 0.21 mg L^{-1} . The species was found on a geological base of crystalline shales, which is consistent with previous findings, in conditions of full shadow, partial shadow, or full sunlight.

Our findings represent the first finding of the species in Serbia and the third discovery of freshwater brown algae in this country. Besides, our findings also represent the first finding of *B. lauterborni* in southeast Europe and the fifth discovery in the world, in environmental conditions not previously described as suitable for the species. Additionally, these findings of the species undoubtedly prove that the species is not extinct in the wild, as well as it is not an exclusively lacustrine species.

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**WATERBIRDS AS TOOLS
FOR BIODIVERSITY CONSERVATION IN WETLANDS
(INDIA)**



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Keywords: wetlands, waterbirds, apex predators, biodiversity, conservation.

Abstract

Wetlands rich in biodiversity face many anthropogenic threats, resulting in their loss in the long run. The wetland biodiversity encompasses every life ranging from microorganisms to apex predators. Waterbirds are apex predators that indicate the overall health and quality of the wetlands. Waterbirds, due to their conspicuousness, can serve as tools in wetland conservation, as the assessment of aquatic organisms for conservation purposes is often challenging and demands intrusive methods.

This study was an attempt to change the perspective of considering the predator as the threat to the prey population and understand nature's way of sustaining the complex wetland ecosystem. This new perspective adopted the non-intrusive method of surveying technique for finding the status of waterbirds in wetlands of the Kanyakumari region of South India.

The total count method (from selected vantage points) was followed for surveying the waterbirds at the Azhathankarai Uppalam, Theroor, and Suchindram tanks of the Kanyakumari region. The recorded data was statistically analysed for calculating the diversity indices of waterbirds. Species richness was 24, 17, 15; species abundance was 159, 75, 75; Shannon diversity index was 2.98, 2.51, 2.54 at the Azhathankarai Uppalam, Theroor, and Suchindram tanks, respectively. The study has revealed that Azhathankarai Uppalam, an unprotected area, was high in terms of waterbird species richness, abundance, and diversity compared to Theroor and Suchindram tanks, which are part of Suchindram Theroor Wetland Complex, a protected Ramsar Site. The highest waterbird diversity of Azhathankarai Uppalam is attributed to the management steps taken by the local people for aesthetic purposes by installing several wooden posts to attract waterbirds for perching, resting, and waiting (to hunt prey).

This study emphasises the use of waterbirds to identify unprotected wetlands rich in biodiversity and the importance of conserving those wetlands to prevent biodiversity loss. In the light of the global nature crisis, it is vital for the governments to frame future conservation and management strategies involving the local communities for combating biodiversity loss in unprotected wetlands.

**THE VITAL ROLE OF SEAGRASSES IN A CHANGING INDIA:
THREATS, CONSERVATION STRATEGIES AND MONITORING
ADVANCEMENTS WITH REMOTE SENSING**



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Keywords: Seagrass, habitat, carbon sequestration, bioactive metabolites, climate change, remote sensing, machine learning.

Abstract

Sustaining the health of our near-shore environments, seagrass meadows are the foundation of coastal ecosystems. These underwater jungles act as primary producers, anchoring sediments and providing crucial habitat for diverse marine life. They offer vivacious feeding, breeding, and nursery grounds for numerous species while filtering water and essential nutrients. Furthermore, seagrass meadows are gaining recognition for the production of pharmacologically important metabolites. These ecosystems also play a critical role in mitigating climate change by repossessing atmospheric carbon. They significantly contribute to the economic well-being of coastal communities by supporting fisheries, tourism, and various recreational activities.

Unfortunately, these vital meadows face significant threats from climate change and anthropogenic activities such as pollution, resource extraction, and slapdash coastal development. However, the crucial role of seagrass meadows has only recently earned widespread recognition, prompting a surge in efforts to inventory, identify and monitor key hotspots of these underwater ecosystems in India. This study delves into the challenges faced and the research conducted in recent decades, highlighting the evolution of monitoring techniques from traditional in-situ methods to cutting-edge remote sensing technologies. It further explores the immense potential of remote sensing and machine learning advancements to enhance our capabilities for monitoring and safeguarding these invaluable ecosystems.

This study delves into the challenges faced and the research conducted in recent decades, highlighting the evolution of monitoring techniques from traditional in-situ methods to cutting-edge remote sensing technologies. It further explores the immense potential of advancements in remote sensing to enhance our capabilities for monitoring and safeguarding these invaluable seagrass ecosystems.

**SPATIAL AND TAXONOMIC PATTERNS IN FISH SAMPLE SIZES
USED AND ANALYSED IN CONTEMPORARY
ACOUSTIC TELEMTRY STUDIES**



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Keywords: acoustic transmitter, journal impact factor, movement ecology, salmonid, spatial ecology, tagging.

Abstract

Acoustic telemetry (AT) allows researchers to track fish movements but presents challenges, such as high equipment costs, difficulties in capturing sufficient numbers of target species, and the need to optimize the positioning of acoustic receivers. Through a systematic review, we examine how these challenges influence the fish sample sizes in AT studies and the proportion of tagged fish that provide usable data for analysis. Data from 578 studies tracking 255 species showed sample sizes as small as a single fish, with 77% of studies tagging fewer than 100 fish per species. Sample sizes were largest in North America and Europe, and were higher in freshwater environments compared to marine settings, as well as in studies involving salmonids versus non-salmonids. The median number of tagged fish per species was 40 (interquartile range 18-93), while the median number of fish contributing data to analyses was 27 (13-58). These findings suggest some strong species and spatial biases in AT samples sizes, and that the number of fish generating data suitable for movement analyses is often considerably fewer than the number tagged. Together, these issues could limit the potential of AT to substantially improve contemporary understandings of fish spatial behaviour at global scales.

**NEW DESIGN IDEAS
FOR FISH FRIENDLY BRIDGES**



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Keywords: fish passages, restoring watercourses, longitudinal connectivity.

Abstract

The first presented system (metal sheet pile) that helps the fish climb into the concrete tube can also help the fish climb over a spillway threshold. In the spillway a semicircular crenel is created that has a direct connection with the fish migration system or part of the river flow upstream of the spillway is redirected into the system by means of concrete or metal sheet piles. The price of this hinging system up to the concrete tube and then into the concrete tube is much lower than all other existing systems. This system can afford any country even if it is poor which is an important advantage. The metal sheet pile with variable geometry on which the worn tires are fastened by screws can be detached during the winter or for any repairs. Flexi Baffles systems are cheaper than conventional systems but can be stolen shortly after installation. Old tires are not stolen by anyone and they are also free and in case of deterioration you can always find others for free. Systems with rectangular (metal sheet pile) and triangular surfaces can be used separately or together depending on the case studies. If there are no major floods or anthropogenic damage, the system can operate for several years without changing any component.

The second presented system is a migration system for eel over small and medium sized weir can be folded down into a medium-sized box and can be transported by sea, air and land. The metal semicircle has a triple role: redirecting water outside the system, protecting the fish migration system during floods and redirecting floating elements that can clog the system. The system can be used by eel for all ages because it has a variable slope. The maintenance costs are minimal and the execution costs are average.

THE TRICHOPTERA
OF CROATIA



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Keywords: caddisfly, central Europe, Mediterranean, diversity, distribution, DNA barcoding.

Abstract

The Republic of Croatia is geographically located in the central and southern part of Europe, and it belongs to the Central European and Mediterranean countries. It has a surface area of 56,000 km². Based on the climatological, geological, and geographical characteristics of the Croatian territory, three main regions can be distinguished: the Pannonian-Peripannonian area, the central-mountainous area, and the Mediterranean area.

Caddisflies, along with other groups of aquatic insects, comprise one of the most abundant segments of aquatic fauna inhabiting all types of aquatic habitats, e.g. springs, streams, rivers, lakes.

Caddisfly studies began in Croatia at the end of the 19th century, but systematic studies of diversity, distribution, taxonomy and ecological features of caddisflies started 28 years ago by researchers from the Croatian Natural History Museum in Zagreb and Faculty of Science, University of Zagreb. So far, 220 species of caddisflies have been recorded in the fauna of Croatia, with more than 90 species recorded in all three biogeographical regions. During investigations in the last ten years, several new species of caddisflies have been found or described in the fauna of Croatia, e.g. *Rhyacophila delici* Kučinić & Valladolid, *Agapetus kamos* Oláh, *Hydroptila simulans* Mosely, *Crunoecia irrorata* Curtis, *Ecclisopteryx asterix* Malicky, *Limnephilus graecus* Schmid, *Ceraclea riparia* Albarda, *Oecetis notata* Rambur. We have not included several questionable species (subspecies) from literature into the systematic list of the Trichoptera of Croatia, e.g. *Glossosoma boltoni* Curtis, *Diplectronea felix* McLachlan, *Psychomyia fragilis* Pictet, *Sericostoma personatum* Kirby & Spence.

In addition to several new species, about 180 species of Trichoptera from the Croatian fauna have been DNA barcoded to date, with 600 DNA barcoded specimens submitted to the BOLD database. Faunistic studies and DNA barcoding of Croatian Trichoptera will continue in the future period.

**THE INFLUENCE OF WASTEWATER DISCHARGE
ON TĂBĂCĂRIE LAKE WATER QUALITY**



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Keywords: nitrates, phosphates, shoreline development index, Tabacarie Lake.

Abstract

Tabacarie Lake, situated at the northern limit of Constanta city, is an urban lake, affected by the fast development of the city. The rainwater runoff and wastewater discharge in Tabacarie Lake, led to its environmental decline over time.

In the south - eastern part of the lake we identified four discharge channels and pipes, so the aim of this study was to determine how these channels and pipes influence the water quality of the lake. Thus, during 2022-2023, water samples were collected from all four discharge channels and pipes and a 5th station, close to Tabacarie Park, was selected as a reference station. The water samples were analyzed based on the following parameters: temperature, dissolved oxygen, nitrates, phosphates and ammonia.

The dissolved oxygen the highest value was recorded in station 1 (1th class) and the lowest in station 3 (2th class) according to Order 161/2006.

Regarding the nitrates, during the monitored period (2022-2023), water samples were mostly within first class quality for all stations, according to Order 161/2006. The level of phosphates fell into the lowest quality category (5th class) for most of the monitored stations, which meant a high degree of phosphate pollution. For ammonia, the analysis of water samples indicated that the largest amount was recorded in Station 4 (4th class quality).

By determining the main physico-chemical parameters of Tabacarie lake and correlating them with the pollution sources and the values of the shoreline development index, the study can have a great contribution in taking measures to prevent the pollution of the lake's waters through a more careful monitoring of these identified sources of pollution and by restoring those shoreline areas affected by degradation.

**THE DISTRIBUTION OF *FRAXINUS PENNSYLVANICA*
IN THE COMMUNITIES OF FLOODPLAIN FORESTS
IN UKRAINE**



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Keywords: *Fraxinus pennsylvanica*, distribution, floodplain forests, invasion, Ukraine.

Abstract

Fraxinus pennsylvanica Marsh. (Oleaceae) is the native species in the United States and Canada. It has spread and become naturalized also in Europe from Spain to Ukraine. The wide range occupied *F. pennsylvanica* implies a wide tolerance of climatic conditions. This species is a component of many vegetation types across its range. But seedlings of the tree have a high tolerance to waterlogging which explains why the natural habitat of the species is almost exclusively river sides and moist flats. Green ash tolerates flooding through a variety of physiological and morphological adaptations. For example, adventitious roots, increased lateral root production coupled with decreased downward root growth, and succulent roots with large air spaces.

The aim of our study was to investigate the character of distribution of *F. pennsylvanica* in the floodplain forests of Ukraine. The dataset contains 223 relevés made during 2014-2023. The coverage of the species fluctuates in 1-100% range. The database of floodplain forest and shrubland vegetation currently involves more than 2630 personal vegetation sampling across floodplains of all territory of Ukraine. The main ecological parameters (altitude, aspect, inclination, microrelief, plant cover structure) are recorded for each plot. *F. pennsylvanica* is counted into almost 10 % of total number of relevés of the study area.

F. pennsylvanica spreads in all regions of Ukraine. But the most invaded by this species are floodplains of the Steppe region, especially in the delta areas of Dnipro and Danube river (Kherson, Odessa region). We selected relevés with high coverage of *F. pennsylvanica* (30-100%), where this species is a dominant of the tree layer. We collected 53 relevés. Almost all of them are linked to the southernmost territory of Ukraine. The species belongs to a group of invasive species with high impact on the environment and very high distribution potential. But compared with *Acer negundo*, another invasive species that occurs in floodplains, its invasive potential is not so high. There are no reports of coenoses of this species in Ukraine, but the new association *Salici albae-Fraxinetum pennsylvanicae* Golub et E. G. Kuzmina in Golub 2001 was described from the nearby territory of Lower Volga. It includes communities where flood regime is artificially reduced and which comprise the high number of ruderal and mesophyte species compared with typical floodplain willow forests.

**THREE AQUATIC MICROHABITATS:
A FIRST DIATOM STUDY FROM SEVERAL KARSTIC SPRINGS
(ROMANIA)**



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Keywords: crenic diatoms, bryophytes, substrate preference, Apuseni, Cheile Nerei-Beuşniţa.

Abstract

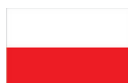
Karstic springs have unique geomorphological and hydrological characteristics which shaped them into being a suitable aquatic habitat for a high number of microorganisms. The Romanian Carpathians are rich in crenic microhabitats, nonetheless a low number of studies have been published on diatoms inhabiting them.

We aim to contribute to the knowledge of crenic habitats by identifying the diatom communities which display distinct preferences for a specific type of available substrate. The present study includes qualitative and quantitative diatom samples taken from 32 karstic springs located in the Apuseni Mountains and Banatului Mountains (Carpathians, Romania). A number of 15 diatom samples were taken from each spring, choosing 5 distinct locations in the eucrenal area for each of the three microhabitats: epibryon, epilithon and epipsammic. Physical and chemical measurements were performed for each sampling site.

Result show a total of 256 diatom taxa in the analyzed samples, with 15.7% taxa expressing a preference for sand and 18% expressing a preference for bryophytes. The number of taxa found in each spring range from a minimum of 19 to a maximum of 90 (in the same number of slides for each aquatic ecosystem), a high diversity observed in other karstic springs from Tatra Mountains or Alps. *Gomphonema elegantissimum* and *Caloneis fontinalis*, along with other taxa have been identified for the first time in Romania. A high number of taxa are included in the red algae list (2008) such as: *Cyclotella bodanica* var. *lemanica*, *Cyclotella planctonica*, *Eucoconeis flexella*.

Positive correlation was observed between a higher coverage of bryophytes, a more shaded eucrenal area and higher concentrations of HCO₃ in water. The microhabitat with the lowest number of taxa was the epilithon, whereas in samples from bryophytes and above sand the diversity was higher in all karstic springs.

**DO ENDANGERED LAMPREYS BENEFIT FROM POLLUTION?
EFFECT OF MUNICIPAL CONTAMINATION
ON GROWTH AND ABUNDANCE
OF THE UKRAINIAN AND EUROPEAN BROOK LAMPREY**



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Keywords: non-parasitic lamprey, ammocoetes, weight-length relationship, municipal sewage, condition, water quality, co-occurrence.

Abstract

The impact of municipal pollution on the larvae of the Ukrainian brook lamprey and the European brook lamprey was studied in the River Gać, a left-bank tributary of the River Pilica.

Both lamprey species share similar morphology and habits, filtration-based feeding, and burial in soft river sediments. The study focused on a 200-meter stretch of the river, divided by sewage discharge from a municipal wastewater treatment plant into unpolluted (above the discharge) and polluted (below the discharge) sections. The Ukrainian brook lamprey exhibited higher densities compared to the European brook lamprey.

To determine age, survival method, e.g. body length frequency diagrams were employed. These diagrams, showing multimodal distributions, facilitated the differentiation of age groups and the application of the von Bertalanffy growth function to determine growth parameters.

The growth curves revealed that the Ukrainian brook lamprey achieve greater body lengths at the same age and asymptotic lengths compared to the European brook lamprey. Furthermore, the European brook lamprey exhibited inferior growth in the polluted river section compared to the Ukrainian brook lamprey.

The response of both lamprey species to municipal pollution suggests that such pollution could promote the expansion of the Ukrainian brook lamprey while causing the decline of European brook lamprey in areas of their overlapping occurrence.

ICHTHIOFAUNA OF THE GILORT RIVER



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Keywords: fish, ichthyofauna, population, freshwater, Gilort River.

Abstract

Fish are organisms that can be used as bioindicators of the quality and health of an aquatic ecosystem, and therefore, many of these organisms require the implementation of protective measures. These animals are generally sensitive to various fluctuations in temperature, the presence of certain toxic substances, and other changes in their living environment.

The Gilort River, located in Gorj County, is characterized by both swift and clear waters with a rocky substrate upstream and calmer waters with a muddy substrate downstream. These characteristics make the Gilort River a suitable habitat for several fish species, some of which are protected at both national and international levels.

To conduct a study on the ichthyofauna of the Gilort River, we began data collection on November 30, 2023, and continued until September 3, 2024, with further collections planned. For this study, we employed various fish capture methods, including direct netting in the water. Additionally, we used fishing rods to capture individuals in areas where the water was deeper than one meter, with all fish being released after identification. The area where fishing has been conducted so far is downstream from the town of Novaci but upstream from the village of Bălcești, in the northern part of the Natura 2000 site "Râul Gilort" reserve.

As of the current stage of the study, 633 individuals from six fish species have been captured, two of which are nationally protected under Government Emergency Ordinance 57/2007. These species are *Barbus meridionalis petenyi* and *Sabanejewia romanica*, the former also being protected internationally under the Bern Convention, which also protects *Alburnoides bipunctatus*.

These three species show a relatively stable population, as indicated by the fairly large number of individuals captured from these species. The other species captured include the European chub (*Squalius cephalus*), the European minnow (*Phoxinus phoxinus*) and the stone loach (*Barbatula barbatula*).

The same can be said for the other fish species present in the Gilort River, most of which have high population numbers, with the most frequently captured species so far being the European minnow (*Phoxinus phoxinus*).

This information can be used for future studies of the ichthyofauna of the Gilort River, and could also be considered for the implementation of protective measures for these fish species, or even for the protection of the river itself.

**COMBINED TECHNIQUES FOR TRICHOPTERA
IDENTIFICATION IN AQUATIC BIOASSESSMENT STUDIES:
MORPHOLOGICAL, MOLECULAR
AND DEEP LEARNING APPROACHES**



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Keywords: biomonitoring, caddisflies, identification, morphology, DNA barcoding, machine learning.

Abstract

Aquatic insects play a crucial role in water quality assessment studies because they respond effectively to perturbations in abiotic factors. Trichoptera, one of the three sensitive insect orders within the EPT taxa group (Ephemeroptera, Plecoptera, and Trichoptera), is particularly useful for detecting early signs of ecosystem pollution. While Trichoptera larvae are generally recognizable and can be easily identified at higher taxonomic levels (e.g., family or genus), accurate species identification can be a challenging task in biomonitoring assessment programs. For instance, taxonomic keys often rely on the last larval instars, making it difficult to identify earlier developmental stages. Additionally, phenotypic variations among different populations can lead to misidentification. Therefore, these challenges should be addressed using supplementary techniques.

In our study, we employed three different methods to identify caddisfly larvae: traditional taxonomy, DNA barcoding, and deep learning, to evaluate the effectiveness of each approach. We identified a total of 48 caddisfly species morphologically, while DNA barcoding provided sequences for 35 species, which were confirmed using the BOLD database. Some sequences revealed species whose larvae have not yet been described. The deep learning method, a machine-based identification approach recently introduced in biodiversity research, utilizes Convolutional Neural Networks (CNNs) model to process and classify images with high accuracy. As part of the deep learning analysis, heat maps were generated that highlight the most significant regions of the images (head, thorax, abdomen) for species classification. In our study, closely related taxa, such as the three species of the genus *Hydropsyche* and three different species of the family *Goeridae*, achieved a classification accuracy of 100%.

The deep learning technique shows great promise for monitoring studies, especially when a large number of samples need to be processed. By integrating traditional taxonomic methods with DNA barcoding techniques, we achieve more accurate species identification. This integration provides a strong basis for preparing samples for the development of machine learning methods, with the aim of training on a larger dataset for more precise species classification.

**RIPARIAN HABITATS
BETWEEN URBAN PLANING AND BIODIVERSITY
– THE CASE OF LAND SNAILS**



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Keywords: Land snails, urbanization, Cibin river valley, biodiversity, urban planning.

Abstract

Globally, urbanization is now documented as a major threat to the biodiversity, land snails, being often considered among the most vulnerable taxa to disturbance because of their very limited mobility and dispersal, and their strong dependence on microhabitats.

The edges of urban rivers are usually forming a continuous vegetated area acting as an urban riparian ecological corridor. These corridors can be effective in providing habitats and resources for wildlife, improving the connectivity of habitat areas and thereby mitigating urban biodiversity loss caused by habitat fragmentation. As other urban green areas, they also play a significant role in enhancing microclimate conditions, reducing pollution, and providing opportunities for leisure, sports, and recreation.

In order to evaluate the contribution of Cibin River riparian area to the general diversity of land snails in Sibiu city, a survey was initiated in 2024 by sampling the most important natural and seminatural habitats in the urban area of Sibiu, as a follow up of a previous study conducted in 2011. Of the 33 identified snail species, only 7 (21%) were found along Cibin River, all of them exclusively at the points of entry and exit of the river from the city, while previously, 14 species (36% of the total diversity) were reported. As expected, the highest diversity was found in the forested areas – Dumbrava Forest and Sub Arini Park, were, although a decrease was also registered, it was less important than that found in the Cibin area. *Drobacia banatica*, species of conservation interest, was found in a few samples, while *Helix pomatia*, *Cepaea hortensis* (introduced) and the invasive slug *Arion vulgaris*, were the most common.

We identified two main factors responsible for the biodiversity loss: the construction of a bicycle path on one of the banks of the Cibin River for which the old willows were cut, and the climate change with increase in temperature and a decrease of the rainfall with a subsequent humidity drop. While the last one is impossible to control, a responsible urban planning policy could help preserving if not increasing the biodiversity of the urban area. We underline the necessity to align future spatial development projects in Sibiu, with sustainable development principles.

**RESPONSES OF FISH AND MACROINVERTEBRATES
IN A MOUNTAIN RIVER SUBJECT TO VARIABLE HUMAN IMPACTS
VARY ACROSS TAXA AND ECOLOGICAL GROUP**



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Abstract

One of the greatest threats to running water ecosystems is water pollution derived from anthropogenic activities. The increasing nutrient and pollutant loads in Carpathian rivers and streams are generated not only by large facilities but also by the presence of numerous diffuse sources of pollution, especially in rural areas. Fish and macroinvertebrates are ecologically indicative in aquatic ecosystems, owing to their position in aquatic food webs, and thus of great potential to assess ecological effects of diverse pressures to which a particular river system is exposed. Fish and invertebrates abundance and trophic groups diversity can provide a good measure of human-induced pollution. The main advantage of the guild approach is its ability to simplify community analysis by aggregating taxa with similar roles or functions into groups. The study covered two segments of a mountain river (Biała, Polish Carpathians) subjected to variable human impact and degree of pollution load. Hydromorphological parameters of the studied river segments were assessed as good, while the physico-chemical water parameters were worse than expected for an undisturbed or revitalised mountain rivers. The decrease in water quality resulted from the numerous, small and dispersed sources of nutrient pollution. This study has documented response of aquatic fauna in the Biała River to water pollution. Negative changes were observed in the structure of ichthyofauna and macrozoobenthos, both in terms of species composition, ecological groups, as well as in the age structure, and fish health. Grayling (*Thymallus thymallus*) was historically recorded in the Biała River, however, the habitat alterations resulted in permanent, major reductions to grayling numbers and distribution. No grayling was found in this river during electrofishing. Significant decreases in abundance of brown trout (*Salmo trutta fario*) and large-bodied, river-migrating, rheophilic cyprinids, i.e., barbel (*Barbus barbus*) and nase (*Chondrostoma nasus*) were also noted. The responses of aquatic invertebrates were reflected primarily in the absence or decrease of the densities of the most sensitive taxa (e.g., Perlidae, Glossosomatidae, Rhyacophilidae, Gomphidae, Cordulegastridae), while the frequencies of functional feeding groups did not change. The abundance of macrozoobenthos was dominated by gatherers and predators. Our results indicate that responses of aquatic fauna to pollutants vary across taxa, but consistent patterns can be observed when analysing ecological groups. A key element of restoration measures carried out in the Biała River should be the improvement of sewage management. Despite the development of sewage infrastructure, the problem of water pollution has not been eliminated so far, especially in small towns and is causing a decrease in the number of cold-water and litho-rheophilous taxa. This problem requires the development of comprehensive solutions.

WATER QUALITY ASSESSMENT OF LAKE AMARA DURING 2022-2023



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Keywords: Lake Amara, pollution, water quality, shoreline development index.

Abstract

Lake Amara is a natural river-estuary lake, located in Ialomița county, Amara city and resort. The lake is the main natural therapeutic factor in Amara resort, due to the therapeutic properties of the water and of the mud that has a sapropelic character. Activities as extraction of the mud from the bottom of the lake and its use in the medical procedures by the many balneary complex that exist along the lake, water pollution, agricultural activities, sport and leisure structures, urbanization have a high impact on the water quality of the lake.

The impact of these anthropic activities was analyzed in the period 2022-2023, by taking water samples from 5 stations spread along the lake that contain various distinctive elements that may or may not have a role in the anthropic influence. Parameters like temperature, dissolved oxygen, turbidity, conductivity, salinity, nitrates, phosphates, ammonia were analyzed. Also, a shoreline development index analysis was performed.

Following the analysis of the main water quality indicators, there was observed a good correlation between the pollution sources at the level of each sampling station and the value of these indicators; for example, in the case of Station I – the natural reserve area, where there are no direct sources of water pollution, very good values of water quality indicators were observed. Instead, in the case of Station 3, which presents the highest value of phosphates in the water (5th quality class), followed by Station 5 (3rd quality class), the values can be correlated with the major anthropogenic impact at the level these stations, either as a result of the machines that collect the mud and resuspension of sediments or due to agricultural activities and the uncontrolled storage of waste.

There was also a strong correlation between water quality results and the shore development index in all the five stations.

By determining the main physico-chemical parameters of Lake Amara, and correlating them with the pollution sources and shoreline development index, the study can have a great contribution in taking measures for prevention of water pollution of Lake Amara, through a more careful monitoring of the main pollution sources and by restoring those shoreline areas affected by degradation.

By determining the main physico-chemical parameters of Tabacarie lake and correlating them with the pollution sources and the values of the shoreline development index, the study can have a great contribution in taking measures to prevent the pollution of the lake's waters through a more careful monitoring of these identified sources of pollution and by restoring those shoreline areas affected by degradation.

**PASSAGE EFFICIENCY THROUGH FISHWAYS OF SPECIES
OF THE FAMILY CYPRINIDAE AND THEIR MANAGEMENT IMPLICATIONS
FOR FRAGMENTED RIVERS**



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Keywords: acoustic telemetry, PIT tag, fish passage, non-salmonid, vertical slot.

Abstract

The current management of fragmented river systems involves balancing the societal benefits of instream barriers, such as hydropower and flood control, with the ecological damage they cause to fish populations. One way to mitigate this fragmentation is by constructing fishways, with their effectiveness often measured through species-specific passage rates and efficiencies. However, research on passage efficiency has predominantly focused on diadromous fish, leaving a gap in understanding for Cyprinidae, a family that plays a crucial role in river ecosystems worldwide. This study conducted a systematic review and meta-analysis to evaluate the passage efficiencies of cyprinid fish through fishways, using telemetry methods as the primary assessment tool. Passive integrated transponder (PIT) telemetry was the most frequently used method due to its high detection rates and cost-effectiveness compared to other telemetry techniques. The findings indicated that cyprinid passage efficiency was highest in vertical slot fishways and lowest in nature-like fishways, with overall passage rates comparable to those of anadromous salmonids. Fish activity peaked during spring and summer, often correlating with spawning periods. Passage rates of non-native fishes were also higher than for native fishes. This scarcity of information hinders the ability of managers and policymakers to make well-informed decisions on the most effective passage solutions for diverse fish species in heavily fragmented river systems.

**EVALUATION OF THE IMPACT OF SIMPLE AND MIXED
PHARMACEUTICAL SUBSTANCES (VALPROIC ACID AND KETOPROFEN)
ON THE *DANIO RERIO* MODEL ANIMAL,
USING ENVIRONMENTAL CONCENTRATIONS**



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Keywords: zebrafish, ecotoxicology, behavior, pollution.

Abstract

Improper storage of medications presents a significant threat to aquatic ecosystems, despite their crucial role in maintaining human well-being. Pharmaceutical residues, which frequently bypass wastewater treatment systems, contaminate water bodies, impacting both aquatic organisms and human welfare. This study investigated the effects of individual and combination pharmacological agents (valproic acid and ketoprofen), which are frequently prescribed medications, on the behavior of zebra fish (*Danio rerio*). The findings indicate that the presence of valproic acid resulted in heightened exploratory behavior near the walls. In contrast, ketoprofen induced anxiety-like behavior, as evidenced by an increased frequency of time spent at the bottom of the tank and counter-clockwise rotations. The drug treatments had a complex effect on sociability, revealing an antagonistic interaction between the two chemicals in the cocktail. Specific pharmacological interventions enhanced exploratory behavior, whereas substances diminished social interactions. These alterations in behavior emphasize the potential ecological impacts of pharmaceutical pollution. Alterations in swimming performance can have detrimental effects on the fish's survival, foraging abilities, and predator evasion. In summary, the study emphasizes the urgent requirement for efficient wastewater treatment and appropriate drug disposal to protect aquatic environments. Additional inquiries are imperative to comprehensively comprehend the enduring ramifications of pharmaceutical pollution.

**DIVERSITY AT OUR DOORSTEP.
AQUATIC MICROCRUSTACEANS FROM CLUJ-NAPOCA,
TRANSYLVANIA: INTRA MUROS VS. EXTRA MUROS COMMUNITIES**



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Keywords: microcrustaceans, species richness, beta diversity, functional diversity..

Abstract

Since more than half of world human population is now living in cities, urban ecology faces new challenges, like management of biotic diversity within city limits. Urban or periurban water basins became increasingly important, due to their numerous ecosystem services: water source for drinking and agriculture, recreation, regional climate regulation etc. In this context, biotic diversity of aquatic communities must be well understood and maintained.

Presence data for 48 microcrustacean species were analyzed for the present study, from 8 sites located within the city (intra muros: 3 water pools from the "Alexandru Borza" Botanical Garden, Lake Iulius, Lake Gheorghieni 3, Lakes Pepinieră 1 and 2, Lake Chios) and from 5 sites located outside the city center (extra muros: 2 water pools from the Fânațele Clujului Nature Reserve, part of Natura 2000 site ROSCI0295, 2 habitats from Lake Florești and Lake Chinteni).

We hypothesized that intra muros communities will have lower diversities compared to those from extra muros areas, in terms of taxa richness, beta and functional diversity.

Our findings supported only partially this assumption. The lowest number of taxa was indeed found in a lake from the Botanical Garden (the Circular Lake, 2 species), but other lakes located inside the city reached higher species richness (Lake Gheorghieni had 17 taxa, similar to other periurban lakes). We found species characteristic for artificial, *intra muros* basins, like *Ceriodaphnia reticulata* or *Eudiaptomus zachariasii*; and species related to natural, *extra muros* ecosystems, like *Cyclops strenuus*, using the Co-inertia analysis performed with the Canoco 5.15 software (www.canoco5.com).

The beta diversity assessed using the Whittaker index revealed completely different microcrustacean communities in lakes located in the Botanical Garden compared to those from Fânațele Clujului. However, the similarity index Jaccard indicated a high affinity between microcrustacean communities from Lake Florești (extra muros) and Lakes Gheorghieni and Pepinieră 1&2 (intra muros), due to particular habitat characteristics. In fact, local conditions like the presence of riparian and aquatic vegetation, the absence of concrete banks or the total area of the water pool might be more important than the location itself.

QUANTITATIVE ANALYSIS OF MICROPLASTICS
IN THE SEDIMENT AND IN THE LARVAE OF TRICHOPTERA,
EPHEMEROPTERA AND CHIRONOMIDAE.
CASE STUDY CIBIN RIVER



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Keywords: Microplastic, Sediment, Trichoptera, Chironomidae, Ephemeroptera.

Abstract

Plastic production has grown exponentially in the last few decades, from 1.5 million tonnes in 1950 to 360 million tonnes in 2018 (Plastics Europe, 2019). This increased production, coupled with high consumption, rapid disposal, insufficient collection and recycling, and also the physicochemical properties of plastic such as very slow (bio)degradation, have led to an increase in plastic waste in the environment. Plastic in the environment fragments into particles with sizes of 1 to 5000 μm called microplastics. They come in various shapes: spheres, fragments, and fibers. Microplastics, in turn, can fragment into smaller and smaller particles, becoming nanoplastics. Microplastics represent a transitional state between macroplastics and nanoplastics.

The present study aimed to identify the accumulation of microplastics in sediment and benthic macroinvertebrates: Trichoptera, Chironomidae, and Ephemeroptera along the Cibin River. These taxonomic groups were selected because they have a wide distribution along the Cibin River, are constant components of benthic macroinvertebrate communities (Curtean-Bănăduc, 2005) and have trophic behavior that favors the accumulation of microplastics (Aranha et al., 2000).

In order to assess microplastic accumulation we collected samples from 20 stations along the Cibin River, spaced at distances of about 3 km. Microplastics were separated from sediment and organic matter using a digestion method, stained and then photographed in order to be identified and numbered. Three types of microplastics were identified in our macroinvertebrate samples (particles, fibres and fragments) and in sediment only two types (particles and fragments). The maximum microplastic accumulation was for Ephemeroptera 3454,5 microplastics/g dw (dried weight). The minimum amounts accumulated in the analysed matrices were 1 microplastic/g for sediment and dw Trichoptera. Our study found microplastics in all matrices analysed some in very high amounts, emphasizing the contamination of natural ecosystems with this emerging pollutant.