Fakulta rybářství
a ochrany vod
Faculty of Fisheries
and Protection
of Waters

Jihočeská univerzita
v Českých Budějovicích
University of South Bohemia
in České Budějovice
Czech Republic

Ph.D. thesis topics 2023/2024
DSP Ochrana vodních ekosystémů / Protection of Aquatic Ecosystems

Supervisor: doc. Ing. Martin Bláha, Ph.D.

Who eats who: using biomarkers to reveal food links in aquatic ecosystems

Supervisor: doc. Ing. Miloš Buřič, Ph.D.

Fish assemblages in the Slovak part of the Danube River: recent status and possible remediation options in the future

Supervisor: M.Sc. Ganna Fedorova, Ph.D.

The effect of emerging pollutants on the neurotransmission system of aquatic organisms

Supervisor: Ing. Bc. Kateřina Grabicová, Ph.D.

Polar micropollutants and aquatic organisms – a study of fate and effects with application of targeted and non-targeted LC/HRMS analysis

Supervisor: Dr. ric. Phillip Haubrock, Ph.D.

Spatial patterns in biological invasions and impacts on biodiversity

Short annotation about every topic you can find bellow.

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Who eats who: using biomarkers to reveal food links in aquatic ecosystems

Annotation

The availability and quality of natural ecosystems' food resources vary across space and time. In aquatic ecosystems, food quantity and quality vary along changing physical and chemical conditions, among habitats, within watersheds, and across seasons. Accordingly, some food sources can be rare or absent, thus limiting consumer fitness in a given habitat and/or ecosystem.

Food quantity is the dietary energy (i.e. caloric units) available to consumers. In contrast, food quality is its nutritional value as determined by its biochemical composition (i.e. the compounds required for physiological processes such as somatic growth, survival, and fecundity). If nutritionally essential food sources are absent and cannot be substituted, the individuals' fitness can be affected, possibly altering population dynamics. However, other sources can be used just as a ballast matrix (material that fills a digestive tract and support the digestion processes or carry the food source but is not used directly as a source of energy). In contrast, others may be critically important as they are converted into body biomass and used for biochemical processes. Therefore, it is crucial in trophic ecology to investigate how food sources are converted into new biomass and which food sources are most important, i.e. which food sources support consumers at various trophic levels.

This PhD project will be focused on energy pathways and food webs in aquatic ecosystems under different treatments using stable isotopes, fatty acid analysis, and/or the faeces metabarcoding approach. Thus, a PhD candidate will be responsible for i) determining how food sources are used and incorporated into the consumer's body, ii) meta-analysis of current knowledge about energy flow in freshwater ecosystems, and iii) fractionalization of food sources in the consumer's body.

Therefore, PhD candidate should have deep knowledge about stable isotopes, fatty acids, and food webs in aquatic ecosystems. Specifically, this project is focused on fish, zoobenthos, and zooplankton; thus, previous experience with some of these groups is expected. Furthermore, moderate experience with R-language or molecular methods is essential. PhD candidate should be independent and familiar with field sampling. A driving license is an advantage.

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Fish assemblages in the Slovak part of the Danube River: recent status and possible remediation options in the future

Annotation

The PhD topic is a part of the scientific work of an international research team charged to solve LIFE project „Living Rivers“ which is focused on implementation of the „New River Basins Management Plan in Slovakia“ into practice. Based on mutual negotiation among person in charge of the project management at Faculty of Fisheries and Protection of Waters (Bořek Drozd) and a potential PhD thesis supervisor (Miloš Buřič) PhD candidate will arise a specific content of the Ph.D. study. The candidate will help to solve some of the research tasks of the project by its own scientific work as well as co-operation on more complex question with the international team members. The main task of the PhD topic are:

I. Monitoring of the fish assemblages in the Slovak part of the Danube River and evaluation of their time development and interconnections with other measures applied within the LIFE project.
II. Confirmation of the status of passability of the barriers built up on the three target parts of the Danube River in Slovakia (Old Danube, Danube side branch system and “New” Danube using telemetric surveys in fish from different ecological groups.
III. Verification of sturgeons´ natural reproduction in the Slovak part of the Danube.
IV. In situ strengthening of natural populations of Danubian sturgeons using eggs incubation in the wild and juveniles stocking.
V. Exploration of other factors influencing the native fish assemblages and their possible conservations measures.

The scientific work will be financially supported by the LIFE project „Living Rivers“.

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The effect of emerging pollutants on the neurotransmission system of aquatic organisms

Annotation

Topic Description

- Research in the field of environmental analytical chemistry focused on the occurrence, fate, and effects of wastewater-derived pollutants in aquatic environment.
- Effects of psychoactive drugs on the neurotransmission changes in fish and other aquatic organisms.
- Risk assessment connected with wastewater reuse.
- Analytical method development (LC/MSMS; LC/HRMS) for the detection of emerging contaminants in environmental samples; evaluation and publication of obtained results.
- Active team work on scientific projects and other activities of the laboratory.
- Active cooperation with top research groups in the field (Umea University, Hebrew University, SLU Uppsala).

Specific Requirements for Open Competition

- Master's degree (or equivalent)
- Good knowledge of English language
- Basic skills on LC/MS techniques are advantageous
- The vision of the PhD student´s work in this workplace, motivation

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Polar micropollutants and aquatic organisms – a study of fate and effects with application of targeted and non-targeted LC/HRMS analysis

Annotation

Polar micropollutants (e.g., pharmaceuticals and personal care products, pesticides, etc.) are ubiquitous in the aquatic environment due to continual anthropogenic activities. Although their concentration is relatively low, typically nanogram to lower micrograms per liter, their impact on aquatic organisms is not negligible.

Pharmaceuticals and personal care products enter the aquatic environment mainly via wastewater treatment plants (WWTPs) in developed countries. These compounds are continuously discharged from highly centralized sources with approved seasonal variability reflecting prescription patterns and removal efficiency in WWTPs. Contrary, pesticides sources are diffusive following their application in agriculture. Transformation of parent pesticides in soils leads to the wash-off of pesticides and their metabolites to the aquatic environment. Both pollution pathways meet in the freshwater environment.

Mentioned polar micropollutants are a broad group of chemicals with highly diverse physicochemical properties. However, all were designed to have biological activity. Based on their mode of action, these compounds could have different effects on fish, crayfish, benthos, and other aquatic organisms. The goal of the topic is to study the fate and the impact of micropollutants under environmental conditions. We will apply liquid chromatography with high-resolution mass spectrometry (QExactive instruments) to trace the pollution fate and develop a non-targeted HRMS-based approach for effects evaluation in biomarker organisms (environmental metabolomics). Applicant's background in chemistry (the analytical or environmental chemistry) and toxicology fields is expected for the topic.

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Spatial patterns in biological invasions and impacts on biodiversity

Annotation

Invasive species are among the main threats to native biodiversity and are a leading cause of extinction. Globalisation and climate change facilitate their spread without signs of amelioration. Especially in aquatic ecosystems, which are highly connected and poorly monitored, non-native species introductions have been a concern for conservation efforts.

With increasing rates of biological invasions, it is essential to understand spatial patterns of ecological impacts, respectively, how invasive species affect biodiversity over time. In recent years, scientific efforts focused on individual 'high-profile invaders' such as those species listed among "the 100 worst invasive species". Especially in aquatic environments, species introductions and successive impacts on invaded habitats, native communities, and biodiversity trends have gained less attention. Hitherto, impact assessments for invaders have focused on just a few individual species, localised scenarios, or presented anecdotal evidence, hampering broad management actions to mitigate invasions. Moreover, understanding how invasions interact with other anthropogenic impacts (e.g. climate change and pollution) is limited.

Commonly, the presence of invasive aquatic species is linked to established pathways such as aquaculture, the pet trade, and angling, the construction of canals or ballast water, thereby directly associated with anthropogenic activities. Yet, the importance of the manifold socio-cultural and political indicators has not been explored adequately. Commonly considered indicators are, for instance, the Living Planet Index (LPI) as a measure of the state of biological diversity based on population trends of vertebrate species, economic and wealth indicators describing macroeconomic performance like the gross domestic product (GDP) per capita, international trade or demographic indicators like population density and urban agglomeration, or education indicators that describe key aspects of schooling. In addition, indicators describing the stringency of governmental legislation or the willingness to open up to other cultures (cultural access and participation), as well as Trompenaars seventh dimension of cultural orientation, i.e. the internal direction versus outer direction, concerning the understanding of the specific relation of people with their natural environment have not been considered to explain spatially differing invasion rates.

As climate change, anthropogenic stress and globalisation continue, impacts of invasive species may differ substantially, leading to differing patterns in detectable impacts. Nonetheless, drivers that interact and facilitate aquatic invasions are not well understood under relevant context-

dependencies, making predictions of future trends difficult. This is despite the availability of long-term monitoring projects that have documented trends in invasions over time across many taxa but often remained unharnessed in invasion science (e.g. Haubrock et al. 2020). For this purpose, this PhD program will use a multidisciplinary approach and focus on three major aspects related to the spatially differing but increasing threat of aquatic invasive species as well as their intertwined relationship with humanity:

- Using a spatially comprehensive, long-term European dataset of aquatic organisms (fish, macroinvertebrates, and macrophytes), the successful PhD candidate will investigate spatial patterns of invasive species and how these fluctuated over time;
- We will compare invasion records from publicly accessible databases like GBIF, GISD, InvaCost (etc.) to manifold so far in the context of biological invasions understudied indicators.
- Utilising functional response and behavioural experiments, the successful PhD candidate will compare the impacts of native and invasive species under varying stressors (e.g. temperature, pollution) and biotic contexts (e.g. intra/interspecific predator density, prey species).