In 2018 Mitsubishi Motors company, namely its dealer AUTOPROFI ČESKÉ BUDĚJOVICE supported the work of our Institute by giving us a very beneficial deal in purchasing universal off-road vehicle L 200. As you see from the field work in the Jordán Reservoir (Tábor, Czechia), it is indispensable tool for transporting the research fleet and equipment to the field work. The first year of demanding tests revealed high quality of this vehicle in multitude of use.

Photo by Jiří Peterka.
Biology Centre of the Czech Academy of Sciences
Institute of Hydrobiology

RESEARCH REPORT
Cover photo: Gas bubbles on the surface of the Dehtář Pond. Photo by Petr Znachor.
Figure on pages 2–3: Aerial view on cyanobacteria blooming in the Lipno Reservoir.
  Photo by Petr Znachor.
Figure on page 4: Chara – a branching filamentous green alga. Photo by Martina Čtvrtlíková.
Figure on page 8: Giant individual of red scorpionfish (Scorpaena scrofa) photographed in Medes Islands marine reserve, Spain. Photo by Jiří Peterka.
About institute (Director’s preface)

Dear reader,

In your hands is the fifty-ninth edition of the annual report of the Institute of Hydrobiology, Biology Centre of Czech Academy of Sciences. Starting as the Hydrobiological laboratory of the Czechoslovak Academy of Sciences sixty years ago under the lead of Dr. Jaroslav Hrbáček this thriving institution concentrated on basic limnological research of larger stagnant waters in Czechia and beyond. Hrbáček’s core group came from the Faculty of Natural Sciences of Prague University but for political reasons it had to seek safer affiliation in the Academy. The year 1959 was also the first full year of limnological monitoring in the Slapy Reservoir, which continues in regular three weeks’ intervals to the present. In 1960 the first Annual Report of the Laboratory was issued and since it has been printed every year as the summary of the most important events in the life of institution, the newest discoveries and as a general informational brochure on the mission of the institute. Fifty-eight volumes have been printed over 58 years so far. With the developments of modern electronic media providing instantaneous news and full texts of articles, the importance of Annual reports as newsletter of institute events declined while the need of the representative information medium continues. Consequently the management of our institute decided to abandon strict year based periodicity on Annual reports and to switch to the title “Research report”, which gives the outline of the Institute’s mission, its position within the research community and its potential for future work. Year specific materials (projects, results, publications) can be inserted into the reports according to current needs.

The main mission of the Institute of Hydrobiology of the Biology Centre of Czech Academy of Sciences remains the same. We concentrate on basic understandings of the most important processes in larger lenitic waterbodies. We study mainly lakes and reservoirs with the approach from “hydrophysics to fish”. To do this, the Institute consists of three departments named in a bottom-up direction:

- Department of Hydrochemistry and Ecosystem Modelling (HEM)
- Department of Aquatic Microbial Ecology (AME)
- Department of Fish and Zooplankton Ecology (DFZE)

Structures and missions of the departments are described further. Besides the three departments the institute shares the director, secretariat, IT services and maintenance. In many other services (finances, personnel, project management, legal support, catering, library, building and advanced maintenance etc.) the Institute is supported by the mother institution, the Biology Center CAS, especially its Technical and Administrative Service.

As an institution of fundamental research, the Institute is here to answer any
question which may rise from the management of lakes and reservoirs. Therefore, we address both theoretical and practical questions important for scientists and managers. This combination of tasks is often very challenging, but it is in line with the mission of the Czech Academy of Sciences (Excellent research in public interest) and keeps our scientists connected with real world problems such as eutrophication and water quality, acidification and catchment processes, climate change and water regime species fluctuations, landscape recultivation and others. A large part of Institute activity is dedicated to traditional long term research in public interest) and keeps of the Czech Academy of Sciences (Excel-

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model sites like Slapy and Rímov Reservoirs
and the lakes in Bohemian Forest (Šumava).

Huge datasets exist for these model sys-
tem sites like Slapy and Rímov Reservoirs
and lakes originating from open cast brown
coal quarries (mostly lakes Milada, Most
and Medard) where the interesting suc-
cession of the ecosystem has been man-
aged from the very start, and 2. Aquacul-
ture fishponds that are heavily exploited
for the fish production, creating very spe-
cific conditions for all parts of food web.

The tradition of the Institute since Dr.
Hrbaček’s time focused on accurate quan-
tification of the main ecological players and
thorough understanding of the processes.
Thorough understanding may sound like an
obvious requirement of any scientific ef-
fort but unfortunately it is not always so.
Nowadays the scientists are under tremen-
dous pressure to reach outstanding suc-
cess quickly and cheaply. This pressure often
works against thoroughly understanding
waterbodies. It favours simplification and
publishing unripe conclusions, jumping to
new hot topics without sufficiently resolv-
ing the old ones and drives the attention
from science to marketing. Many scientists
tend to abandon well-studied traditional
habitats as if no more discoveries can be ex-
pected and seek scientific sensations in less
studied systems. This environment makes
me always wonder: Do we know enough
about our “traditional systems” to be able
to predict their behaviour in future? Do we
have to abandon them when low hanging
fruits were already picked? Believe me or
not, I must confess that very often we do
not know enough. The fascinating diversi-
ty of ecosystem responses is really hard to
predict even in well known systems. Who-
ever had the task to predict what will hap-
pen in the lake in future knows this feel-
ing. Yes, there is nothing wrong to say we
do not fully understand, a lot of things suf-
ciently and thorough, long term thorough
study of model systems is a very effective
way to work towards this end. Of course,
there are a number of other ways and in-
evitably we have to use them as well. But if
you like the notion of a really thorough un-
derstanding of the processes in lakes, res-
ervoirs and other larger waterbodies, then
the Institute of Hydrobiology BC CAS is
the right partner for cooperation for you.
Departments

Department of Hydrochemistry and Ecosystem Modelling

At the Department of Hydrochemistry and Ecosystem Modelling we investigate biogeochemical nutrient cycles and processes that influence the chemical composition and quality of surface waters. We focus especially on processes in lentic waters – mountain lakes, reservoirs, and ponds, but we also pay considerable attention to the hydrology and water chemistry of runoff from different types of catchments, and to selected processes in the soil environment that influence the transport of mineral and organic substances into surface waters. One part of our research is linked to long-term monitoring of model reservoirs, especially the Slapy and Římov Reservoirs in the Vltava River catchment; another important area of study involves alpine lakes in the Tatra Mountains and mountain lakes in the Bohemian Forest (Šumava). For a more detailed understanding of key processes we complement our monitoring activities with field and laboratory experiments and with the application of mathematical models. Two crucial areas of our research concern eutrophication and acidification of aquatic ecosystems.

Eutrophication is the enrichment of ecosystems by nutrients, leading to intensive growth of algae biomass, cyanobacteria and aquatic macrophytes, often accompanied by an unwelcome incidence of water blooms, anoxia of the water above the bottom, and decrease in water quality, etc. Our eutrophication research covers all important aspects of this issue: determination and management of sources of nutrient pollution in catchment areas, research on the transport of nutrients via river networks into reservoirs, and investigations of the conditions necessary for nutrients to actually trigger the production of biomass in a reservoir. To evaluate the importance of various natural and anthropogenic sources of nitrogen and phosphorus in individual catchments we use mathematical models of varying complexity, from simple empirical mass-balance equations to dynamic complex models based on detailed descriptions of hydrological, physico-chemical, and biochemical processes in the soil, in groundwater, and in the river network.

We recently joined the Global Lake Ecological Observatory Network (GLEON) which not only is an international community of scientists, educators, policy makers, and citizens, but also a worldwide network of instrumentations on lakes and reservoirs. The aim of our joining is to contribute to developing mathematical models that are valid not only for one specific water body but apply globally. Part of this network is the ISIMIC (Inter-Sectoral Impact Model Intercomparison Project). The project participants agreed on a set of scenarios that will be run using data and parameters of representative study sites in a set of models, to test the intercomparability of the models.
In our research on the recovery from acidification of mountain lake ecosystems and their catchment areas, we exploit the unique opportunity to understand reactions in different terrestrial and aquatic environments to atmospheric pollution, that was extreme in Central Europe during the 1970s and 1980s but that has since returned to levels from the first half of the 20th century in the last two decades. While the level of atmospheric pollution by sulphur and nitrogen compounds entering the catchments is currently very low, acidification levels in the soil and waters remain relatively high and ecosystem recovery is gradual. Forest die-back in lake catchments due to bark beetle infestation enables us to investigate the dynamics of interactions between plants and microbial communities in the soil. It also gives us the opportunity to study the effects of disturbed equilibria in the soil on the export of nutrients and organic compounds into surface runoff and their ensuing impacts on lake ecosystems. Acidified mountain catchments are also useful as model localities for research on the causes and effects of the long-term rise in the concentration of humic substances in the outflow from catchments. This phenomenon is observed in many temperate parts of the world and impacts both lake ecology and drinking water quality. Our current photochemistry studies of humic substances show interesting relationships between humic substances in the aquatic environment and the availability of nutrients and microbial production in the aquatic ecosystem.

Available infrastructure
Department of Hydrochemistry is equipped with the following instrumentation: automatic pH and titration unit (Radiometer TIM865), total and particulate organic carbon analyser (Shimadzu TOC-L with particulate organic module SSM 5000), organic carbon and total nitrogen analyser (Shimadzu TOC-L with TNM-L module), ion chromatography ( Dionex ICS-5000+), elements CHNSO analyser (Elementar varioMICRO cube), ICP-MS spectrometer (Agilent 8800 Triple Quadrupole), UV-vis spectrophotometer (Shimadzu UV-2700), spectrofluorometer (Horiba, Duetta), artificial solar light simulation chamber (SolSim), acoustic doppler velocimeter (Son Tec, FlowTracker).
Research at the Department of Aquatic Microbial Ecology is primarily focused on freshwater microscopic organisms. There are two main groups of aquatic microorganisms with considerably different functions. The first group, the autotrophs, consist of microscopic algae and cyanobacteria, which are jointly referred to as phytoplankton. They are responsible for generating new organic matter via photosynthesis. The second group, the heterotrophs, are the viruses, archaea, bacteria, fungi, and protozoa, which, on the contrary, take part in the decomposition of organic matter or grazing on other microbes.

The department consists of several tightly collaborating working groups dealing with the ecology of aquatic bacteria, picocyanobacteria and protozoa, and the ecology of phytoplankton. With the advent of the "omics" era, a new group has been established to expand our understanding of microbial ecology and evolution using state-of-the-art molecular biology techniques and bioinformatics. For decades, freshwater lakes and reservoirs of the various trophic have been our main study sites, but recently we have expanded the spectrum of systems studied to include, hypertrophic shallow ponds or new lakes emerging in former brown-coal quarries that are being inundated.

In aquatic bacterial taxonomy, we aim to identify the most abundant bacterial taxa inhabiting freshwaters and pinpoint the reasons for their prevalence. We mainly concentrate on two groups, Proteobacteria and Actinobacteria, which are highly abundant and ubiquitous in freshwaters. It is noteworthy that only a minor fraction of freshwater bacteria is so far cultivable; we have achieved considerable success in isolating and cultivating aquatic bacteria using unique methods developed by our researchers. Genomic analyses of isolated strains and natural consortia (metagenomes) are increasingly used to get deeper insights into the metabolic capacity of all components of freshwater microbiota (pro- and eukaryotes and their viruses) and pinpoint their evolutionary history. Currently, we are expanding our international activities to have a broader biogeographical pattern of investigated habitats to answer where and why different bacteria occur.

Studying the functions of aquatic bacteria (the types of organic substances they decompose and utilise, their growth and survival strategies in lakes) and their relation to other organisms in the food web (particularly bacterivorous protozoa and small animals that feed on them and viruses that attack them) is a classical field within aquatic microbiology. We have made significant contributions to this field attempting at highest taxonomic resolution possible (species to subspecies level) to identify microdiversification patterns, and analysing key lineages of bacteria and protozoa involved in the studied processes.

Our research on algae and cyanobacteria has provided valuable insights into their functions and interactions with other organisms in their environment.
ecology, ecophysiology and taxonomy. We host a unique collection of several hundred strains of cyanobacteria and algae isolated from various types of freshwaters. Our contribution to the modern taxonomy of cyanobacteria based on a combination of classical (microscopy) and current molecular methods has been recognized internationally. We perform genome mining in selected cyanobacterial strains to identify new bioactive secondary metabolites with application potential and to elucidate their biosynthetic background. Recently, we have further focused on the detection of new and little known cyanobacterial toxins in aquatic habitats to reveal potential threats to ecosystems (such as wild animal mortalities after ingestion of toxic cyanobacteria) and public health.

Time series analysis of long-term environmental data allowed us to elucidate important general trends and interactive effects of land-use, management practices, and the ongoing climate change on community ecology and reservoir limnology and determine impacts of weather extremes (i.e. droughts and extreme rainfalls) on reservoir functioning. We also focus on the investigation of phytoplankton spatial heterogeneity, resource competition and the relationship between the physiological traits of individual taxa and their occurrence and temporal dynamics in an aquatic ecosystem. We have developed and implemented modern single-cell as well as community characterising fluorescent techniques depicting physiological responses of phytoplankton to the changing environment that furnish important clues for deciphering processes beyond the spatiotemporal heterogeneity and long-term changes of aquatic systems. These techniques have been used for microscopic examination and taxonomic detection of individual microbial cells and allowed for both qualitative and quantitative evaluation of, e.g. production of certain substances, growth rates, cell damage or vitality, and studying microbial interaction; specifically those between phytoplankton and bacteria, fungi and flagellates.

Available infrastructure
At the Department of Aquatic Microbial Ecology, well-equipped microbiological laboratories are available allowing basic and advanced microbial analyses, such as isolation and cultivation of microbial strains, cell enumeration and biomass measurement of microbes (bacteria, protozoa, phytoplankton), CARD-FISH staining of bacteria and heterotrophic flagellates, qualitative and quantitative fluorescence techniques and general molecular biology (DNA/RNA isolation, PCR, qPCR). We also have specific equipment and know-how for designing highly sophisticated manipulative experiments to address new questions emerging from the simultaneous applications of molecular and classical microbial ecology approaches.

Main instruments:
A fully automated fluorescence microscope with image analysis (Zeiss Axio Imager.Z2 with AxioCam 506, ZEN 2.5 software) for high-throughput evaluation of CARD-FISH stained microbial samples, a fluorescence microscope Nikon-90i, Image analysis system NIS Elements 5.1, microscopes Olympus IMT2 and BX51 with DP70 camera, inverted microscopes (Olympus IX71), a micromanipulator (Narishige MMO-202ND), and a microinjector (Narishige IM-9A). A CytoFLEX flow-cytometer (Beckman Coulter) with fully automated plate loader for high-throughput quantification of microbes.
Our research is focused on the highest trophic levels in freshwater ecosystems, zooplankton and fish. The department is divided into six research groups investigating different aspects of fish and zooplankton ecology using diverse methodological approaches and advancements.

The "Ecology of early life stages of fishes" group is focused on diurnal vertical and horizontal migrations of juvenile cyprinid, perchid and coregonid fishes in reservoirs and lakes, and on ecological causes and the consequences of these migrations. It studies the effect of ecosystem management and nutrient load on the main characteristics of fry communities in selected water bodies (species composition, abundance, distribution, growth rate etc.).

The "Spatio-temporal ecology of fish" group focuses its research on spatio-temporal distribution of fish in artificial and natural waterbodies. Its main emphasis is the diurnal and seasonal changes of fish distribution, the effect of abiotic and biotic factors, and individual as well as intra- and interspecific variability. The research of spatio-temporal distribution is linked with other aspects of fish ecology (trophic interactions, population genetics and fish physiology) and the isolation and experimental equipment: Four walk-in climate-controlled chambers for cultivation with controlled light and temperature, crossed-gradient table, various setups for experimental work under in situ conditions.

Culture collection of isolated microorganisms:
Picocyanobacteria: Cyanobium, Synechococcus, Aphanothece, Chroococcus
Cyanobacteria: several hundreds of non-axenic cyanobacterial cultures (Dolichospermum, Sphaerospemium, Aphanizomenon, Anabaenopsis, Cuspidothrix, Anabaena, Chroococcus, Nostoc, Nodularia, Trichormus, Leptolyngbya) isolated from both benthic and planktic habitats in various systems, e.g. pools, ponds, post-mining lakes, reservoirs.
Algae: Rhodomonas, Pediastrum, Scenedesmus, Chlamydomonas
Protozoa: Bodo, Tetrahymena, Ochromonas, Poterioochromonas, Codonella, Cyclidium, Codosiga, Endosiphon

Main field equipment for sampling and water column profiling:
Friedinger samplers, plankton nets, light sensors and LICOR LI-1400 datalogger with the underwater sensor Li 193 SA, multiparametric submersible probes (FluoroProbe, bbe-Moldaenke; YSI EXO 2).

For sequencing data processing:
MinION and MinIT (Oxford Nanopore) for generating ultra-long sequencing reads, a 128-core Unix server (768 Gb RAM), two 64-core Unix servers (512 Gb RAM) and a 100 TB NAS storage are available with all relevant software installed for analyses of (meta)genomic data.

Daphnia galeata (water flea), a common member of freshwater zooplankton. Photo by Petr Znachor.
applied to broader ecological concepts explaining fish ecology and functioning in freshwater ecosystems.

The "Trophic ecology of fish" group studies the structure and functioning of fish communities, food web dynamics and trophic interactions in natural and managed aquatic ecosystems. To answer its research questions, it combines both classical and novel methodological approaches (field observations, manipulative experiments, gut content analysis, stable isotope analysis etc.). The overall goal of its research is to better define and understand mechanisms governing the functioning of fish communities. Current works explore: (i) the functional role of herbivorous fish in lake ecosystems; (ii) the diet and feeding ecology of wels catfish, the largest European freshwater predator, in its native and introduced areas; (iii) the importance of different energy pathways and carbon fluxes in food webs of novel ecosystems such as post-mining lakes and dam reservoirs; and (iv) the isotope composition of fish scales and its utility as an indicator of anthropogenic environmental changes.

Investigations of the "Behavioral ecology of fish" group focuses on protandry behaviour in asp and individual fish strategies that maximize reproductive success. Further research topics include impacts of climate change and predation on spawning fish and egg survival in a model asp/bleak system. Special emphasis is on the influence flow regimes from hydroelectric power plants on fish behaviour and egg mortality with potential threat to riverine biodiversity and productivity.

The "Fish populations dynamics" group aims at developing ecological models to scrutinize the role played by the biotic (primary and secondary production and competition) and abiotic (water quality parameters and temperature) factors on fish survival rate, growth, reproduction and ultimately on the populati-
The Institute of Hydrobiology operates two field stations at our long term monitoring sites.

The Slapy Reservoir Station is located at the bank of the Slapy Reservoir near the village Nebřich. Long term monitoring data from this location spans more than 60 years with regular sampling at three weeks intervals. It documented several important socioeconomical changes in the region of South Bohemia during the 20th and 21st centuries and represents one of the longest uninterrupted time series of limnological data.

The Římov Reservoir Station is located near the dam of the Římov Reservoir. It serves as the hub for intensive investigation of our principal research subject, which has been a reference site for many limnological studies in Central Europe. Long term limnological monitoring of the Římov Reservoir has been done regularly at three weeks intervals since its completion in 1979. Besides the regular monitoring, several intensive field experiments are carried out here every year.
Director's preface

Institute of Hydrobiology

Pictured by Zuzana Sajdlová.
In 2018 Mitsubishi Motors company, namely its dealer AUTOPROFI ČESKÉ BUDĚJOVICE supported the work of our Institute by giving us a very beneficial deal in purchasing universal off-road vehicle L 200. As you see from the field work in the Jordán Reservoir (Tábor, Czechia), it is an indispensable tool for transporting the research fleet and equipment to the field work. The first year of demanding tests revealed high quality of this vehicle in multitude of use.
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Awards

Lukáš Vejřík was awarded the Prize of the Dean of the Faculty of Science, University of South Bohemia in České Budějovice for his outstanding Ph.D. thesis.

Marek Šmejkal received Josef Hlávka Award for the Best scientific publication for 2018. Lukáš Vejřík won the second place in Photogenic Science competition.

Marek Šmejkal receives Josef Hlávka Award. Photo courtesy Josef Hlávka Foundation.

Spring pool in the Ocala National Forest, Florida, U.S.A. Photo by Lukáš Vejřík
Projects

INTERNATIONAL PROJECTS

EU Horizon 2020

Co-creating a decision support framework to ensure sustainable fish production in Europe under climate change (ClimeFish)

Project No.: 677039

Principal Investigator: Prof. Michaela Aschan, University of Tromso, Norway

Co-principal Investigator: Jan Kubečka

Duration: 2016–2020

Scientist from 16 countries collaborate to help ensure that the increase in seafood production comes in areas, and for species, where there is a potential for sustainable growth, given the expected climate changes. The ClimeFish project will provide a support framework for decision makers, to contribute to robust employment and sustainable development of rural and coastal communities. In the Czech aspect of the project we will rethink how recreational fisheries impact fish production in a changing environment.

Why: Real climatic changes are happening now and they are threatening sustainable growth in aquaculture and fisheries worldwide. The world population is growing, and demand for food is increasing. Forecasts indicate an overall decline in food production due to climate change. ClimeFish addresses the necessity of changes, both when it comes to utilizing opportunities and mitigating risks under climate change. ClimeFish will help ensure that the increase in seafood production comes in areas and for species where there is a potential for sustainable growth.

In the Czech aspect of the project we will rethink how recreational fisheries impact fish production in a changing environment.

What: ClimeFish project will provide a support framework for decision makers, to contribute to robust employment and sustainable development of rural and coastal communities. The output of the project will be the ClimeFish Decision Support Framework (DSF), which contains guidelines, databases and the ClimeFish Decision Support System (DSS). The results of the project will be used for optimization of fishery in the Lipno Reservoir and other water bodies.

How: ClimeFish will develop forecasts for production scenarios that will serve as input to socio-economic analysis and identify risks and opportunities regarding climate changes. Strategies to mitigate risk and utilize opportunities will be identified in co-creation with stakeholders, and will serve to strengthen the scientific advice and to improve long term production planning and policymaking. The project addresses three production sectors: marine aquaculture, marine fisheries and lake and pond production in a total of 16 case studies, involving more than 25 species. For Czech fisheries, the main target species are wells, Silurus glanis, pikeperch, Sander lucioperca and carp, Cyprinus carpio.

NATIONAL PROJECTS

Ministry of Education, Youth and Sport of the Czech Republic, the support provided from EU funds

Biomanipulation as a tool for the improvement of reserve reservoir water quality

Project No.: CZ.02.1.01/0.0/0.0/16_025/0007417

Principal Investigator: Jan Kubečka, Tomáš Jáza

Duration: 2018–2022

Water is the most important global resource so strong emphasis is placed on sustaining its high quality. Due to climatic changes, water resources are exposed to various extremes and only healthy ecosystems with good ecological potential are able to withstand these changes. Surveys show that most reservoirs in the Czech Republic are in an unsatisfactory state and the situation will have to be improved in the near future. Evaluation of the ecological potential clearly shows that the cause of this negative state is eutrophication, stemming from increased loads of phosphorus and nitrogen into water bodies. A successful biomanipulation or the achievement of better water quality through targeted changes in the food chain, requires interventions in the watersheds which lead to decreased nutrient loading into reservoirs as well as development of bulk reduction fishing. The aim of the project is a unique wholelake experiment with the monitoring of all of the important parts of the reservoir food chain before, during, and after a targeted manipulation. The project will evaluate the effect of reducing the stock of undesirable fish species and the proliferation of predatory fish species on specific trophic levels, and, ultimately on the improvement of water column transparency and water quality in selected reservoirs. The majority of the biomass of planktivorous fish will be removed from three model reservoirs differing in nutrient load (trophic). At the same time, predatory fish will be introduced. Detailed monitoring of the entire reservoir ecosystem from fish, zooplankton, phytoplankton, macrophytes, and bacteria to nutrients and reservoir metabolism will help uncover the effects of such vigorous manipulation. The economic rentability of these biomanipulations will also be evaluated, with the aim to put into numbers the difference between the costs and the savings due to the improvement of ecological potential (Water Framework Directive). Other savings can include easier treatment of raw water.
in waterworks processing or an increase in the recreation potential. According to the Water Framework Directive, all European Union member states are expected to reach an at least good ecological state of water bodies by the year 2027. Biomanipulation represents one of the important tools to fulfill this ambitious goal. To put into numbers the difference between the costs and the savings due to the improvement of ecological potential (Water Framework Directive). Other savings can include easier treatment of raw water in waterworks processing or an increase in the recreation potential. According to the Water Framework Directive, all European Union member states are expected to reach at least good ecological state of water bodies by the year 2027. Biomanipulation represents one of the important tools to fulfill this ambitious goal.

Technology Agency of the Czech Republic
Floating green islands, a perspective alternative for improvement of ecological potential and support of littoral habitats in water reservoirs
Project No.: TH02030633
Principal Investigator: Jan Kubečka, Josef Hejzlar
Duration: 2017–2020

The aim of this project is to develop floating islands technology for application in reservoirs (construction design, substrate, composition of plants and field tests of mechanics and ecosystem benefits). The target of the project is the littoral habitat, which is normally the richest habitat of natural lakes. In most of our reservoirs it is ecologically degraded due to water level fluctuations. Aquatic macrophytes are destroyed here by drying and freezing or due to shading by low transparency. Project outputs will enhance the ecological potential of reservoirs by supporting species diversity of aquatic organisms, the structure of the fish stock, nesting of waterfowl, nutrient reduction, water quality and aesthetic value.

Development of technical measure for protection of natural riverine fish stock against massive migration of undesirable fis species from Lipno reservoir as encouragement of population of brown trout and freshwater pearl mussel Margaritifera margaritifera
Project No.: TH02030709
Principal Investigator: Milan Muška, Jan Kubečka
Duration: 2017–2020

The aim of the project is to develop a mobile migration barrier above the Lipno reservoir. The barrier must not influence either the river flow or transport of debris, but must effectively prevent reservoir fish from migrating into upper Vltava river catchment. Effective operation of the barrier assures the undisturbed development of the indigenous salmonid assemblage in upper Vltava river and at the same time improves the essential requirements for reproduction of critically endangered Pearl mussels. The location of the barrier should also allow us to find suitable spawning habitats for desirable fish species from the reservoir. The technology developed will be applicable to many similar places where the regulation of fish migration is necessary and building weirs is not possible.

CZECH SCIENCE FOUNDATION PROJECTS

Inside the leaf microbiome: bacterial and fungal endophytes in the context of ecosystem development
Project No.: 17-104935
Principal Investigator: Dagmara Sirová
Duration: 2017–2019

Microorganisms colonizing the interior of plant leaves are recognized to have enormous impact on all aspects of their host’s existence - from health to evolutionary diversification. Their specific function in plant ecology, however, is still largely unexplored. We will test the hypothesis that plant foliar endophytes, consisting of interacting fungi and bacteria, are extending the functional plasticity of their hosts and enhance their ability to adjust to changing environmental conditions during ecosystem development. We will employ in-situ screening of the endosphere in a taxonomically diverse selection of plants, along a gradient of vegetation succession. As our study system, we have chosen the unreclaimed areas of colliery spoil heaps formed by open cast coal mining in western part of Bohemia. We believe that unraveling the complex interactions of foliar endophytes with and within their plant hosts to generate unique biological and ecological entities will lead to our greater understanding of important aspects of biology and ecology, not only in our model plants, but in general. The project goal is to explore the dynamics within microbial communities colonizing the interior of above-ground plant tissues, their role in plant adaptation to ecosystem changes, and their contribution to extending functional plasticity of plants, especially with regards to nitrogen acquisition.
Role of changes in environmental chemistry on lake ecosystems at the Younger Dryas onset

Project No.: 17-059355
Principal Investigator: Jiří Kopáček, Přírodovědecká fakulta, Univerzita Karlova v Praze
Co-principal Investigator: Evžen Stuchlík
Duration: 2017–2019

Younger Dryas (YD) is well documented cold period. It began 12900 years ago and lasted 1200 years. The causes of this change are still not sufficiently understood. According to recent new evidence multiple proxies support a major transient event. The evidence includes findings of micro-particles containing iridium, microspherules, and nano-diamonds in a carbon rich black YD layer. A transient episode initiated a sequence of catastrophic events including floods and fires that contributed to emissions of a dust containing toxic compounds that were a part of the global paleo-atmospheric pollution and the contaminated paleo-ecology of undisturbed sites on continental scale (including America and Euroasia).

The aims of the project are to: Characterize Younger Dryas Boundary proxies in sediments from 4 central European lakes; Characterize Laacher See tephras proxies from 4 central European lakes; and Identify the effect of catastrophic events on Central European lake ecosystems at the YD onset.

Phosphorus dynamics in unmanaged terrestrial ecosystems: Links with nitrogen and carbon cycling.

Project No.: 52295
Principal Investigator: Jiří Kapáček
Co-principal Investigator: Jihočeská univerzita v Českých Budějovicích, P.F.F.
Duration: 2017–2019

Unmanaged central European ecosystems (the Bohemian Forest and Tatra Mountains) exhibit the world’s greatest recovery from atmospheric acidification. Resulting changes in biogeochemical processes and P, N and C cycles in soils are further affected by rapid changes in climate and vegetation, which lead to undesired losses of these nutrients from terrestrial to aquatic ecosystems. The extent and rate of nutrient losses and water pollution differ between catchments, reflecting soil and bedrock composition, and vegetation health. In continuation of our long-term research in these areas, we propose a set of integrated laboratory and field experiments to study the effects of changing precipitation chemistry, climate, and vegetation on (1) the soil microbial community at sites differing in P sources and availability, (2) P cycle in soils and its links with C and N cycles, especially the effects of P availability on N-saturation of catchments and the role of organic C in P leaching, (3) the weathering rate and P liberation from bedrock and soils, and (4) pollution of receiving waters with this key nutrient.

Fishponds as models for exploring plankton diversity and dynamics of hypertrophic shallow lakes

Project No.: 93105
Principal Investigator: Jaroslav Vrba, Přírodovědecká fakulta, Jihočeská Univerzita v Českých Budějovicích
Co-principal Investigator: Jiří Nedoma
Duration: 2017-2019

The aim of the project is to explore plankton diversity and dynamics, key players and their functional traits, and to estimate primary production, respiration, nutrient mobilisation, and production efficiency in the hypertrophic fishponds to test and refine general ecological hypotheses. Fishponds are semi-natural, human-controlled, shallow ecosystems used for fish production. Different management results in different ecological states that predestine the fishponds as unique model systems. Nutrient loads and fish overstock have led to fishpond hypertrophy, however, interactions in the plankton communities under such extreme conditions remain unexplored. We lack data on primary production, community respiration, diversity and functions of heterotrophic microbial food webs in eutrophic freshwater, as well as information about the effects of fish on their food web structure. We hypothesise that hypertrophic conditions result in net ecosystem heterotrophy, an increase in heterotrophic microbial biomass and nutrient mobilisation, and a decrease in net ecosystem productivity and cost effectiveness. Under the conditions of high (auto- and heterotrophic) microbial biomass, intensive photosynthesis and respiration processes cause ecosystem imbalances and low resource use efficiency that results in higher plankton (mainly microbial) diversity due to niche diversification.

Unveiling life strategies of uncultivated viruses in freshwater environments using metagenomics

Project No.: 48285
Principal Investigator: Rohit Ghai
Duration: 2017–2019

Viruses are the most abundant biological entities on the planet, at least one order of magnitude more numerous than their host microbes in aquatic environments. Despite their abundance, studying viruses via cultured isolates remains challenging owing to the complexities in obtaining axenic cultures for the abundant microbial groups. The situation is even more acute for freshwater habitats where the availability of such pure cultures of the dominant phyla is still rather limited. We propose a long-term metagenomics based approach in two well-studied freshwater habitats to enable a first glimpse
of the important double-stranded DNA bacteriophages in freshwaters. We will link these uncultured phages to their host both using existing sequence based approaches and also develop novel methods. In particular we will focus on life strategies of free-living viruses developed in the process of coexistence with the host microbes. Moreover, important insights into factors affecting seasonal dynamics of phage and host populations and global biogeography of freshwater phages are expected.

PROJECTS SUPPORTED BY THE CZECH ACADEMY OF SCIENCES

Unveiling flagellate and bacterial community dynamics and trophic interactions in two deep freshwater ecosystems by a unique methodological combination
Project No.: JSPS-17-17
Principal Investigator: Karel Šimek
Duration: 2017–2018

Consultancies

2017–2018 Assessment of European catfish behavior and biomanipulation effects in the Římov Reservoir (M. Říha)
2017–2018 Assessment of European catfish abundance in the Žlutice Reservoir (L. Vejřík)
2017–2018 Asp spawning stock assessment in the Švihov Reservoir (M. Šmejkal)
2017–2018 Study of the limnological components of the ecosystem of Medard Lake (J. Peterka, P. Znachor)
2017–2019 Complex fish stock assessment of Most Lake (J. Peterka)
2017–2020 Complex fish stock assessment of Balaton Lake (M. Muška, M. Tušer)
2018–2019 Study of the limnological components of the ecosystem of Medard Lake (J. Peterka, P. Znachor)
2018–2019 Asp spawning stock assessment in the Švihov Reservoir (M. Šmejkal)
2018–2019 Assessment of European catfish abundance and diet in the Římov Reservoir (L. Vejřík)
2018–2019 Monitoring of European catfish population in the Klčava Reservoir (L. Vejřík)
2018–2019 Fish stock monitoring of Lipno Reservoir (J. Kubečka)
2018–2019 Fish stock assessment of Jordan Reservoir (J. Peterka, M. Čech)
2018 Fish stock removal from Bolevecky Pond (T. Jůza)
Students’ theses finished in 2018

Ph.D.
Lukáš Vejřík – Biology of predatory fishes in dam reservoirs and lakes (Faculty of Science, University of South Bohemia, České Budějovice, supervised by M. Čech)
Vesna Grujčič – Differential freshwater flagellate community response to bacterial prey with a focus on planktonic Betaproteobacteria (Faculty of Science, University of South Bohemia, České Budějovice, supervised by K. Šimek)

Publications
(* authors from other institutions)

A: Papers in International Periodicals

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B: Proceedings or Monographs

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