Ph.D. thesis topics 2026/2027 – 1st call

DSP Ochrana vodních ekosystémů / Protection of aquatic ecosystems

Zátiší 728/II, 389 01 Vodňany, Česká republika T/ +420 387 774 736 E/ lkacerova@frov.jcu.cz www.frov.jcu.cz

Výzkumný ústav rybářský a hydrobiologický / Research Institute of fish Culture and Hydrobiology

Vodňany

Zátiší 728/II, 389 01 Vodňany, Česká republika T/ +420 387 774 736 E/ lkacerova@frov.jcu.cz www.frov.jcu.cz

Supervisor: Assoc. Prof. Martin Bláha

Contact

E-mail: blaha@frov.jcu.cz
Tel.: +420 389 034 611; +420 773 111 446

Fishpond ecosystems in an era of global changes

Rybniční ekosystém v éře globálních změn

DSP: Ochrana vodních ekosystémů / Protection of Aquatic Ecosystems

Annotation

Fishponds are one of the key landscape elements. They influence material flows, water quality, and ecological stability in the cultural landscape. Besides the primary aquaculture purpose, fishponds play an undisputable role in ecosystem services. They are capable of accumulating and transforming nutrients, retaining sediment, mitigating extremes in the hydrological regime, and supporting biodiversity. The importance of fishponds as regulatory ecosystems is becoming increasingly relevant in light of the growing frequency of climate extremes, landscape homogenization, and ongoing water eutrophication.

Despite their importance, fishponds are often perceived either purely as production systems or, conversely, as degraded water bodies requiring strict nutrient limitation. This dichotomy complicates their management. Fishpond functioning is determined not only by external drivers such as climate and catchment nutrient inputs, but also by internal processes linked to fish stocking, feeding, water manipulation, and sediment dynamics.

The PhD project will focus on fishponds, with a particular emphasis on nutrient cycling, food web structure, and the responses of biodiversity. Recent evidence suggests that Central European fishponds exhibit pronounced seasonal and spatial shifts in nitrogen and phosphorus limitation, which strongly influence phytoplankton biomass, water quality, and ecosystem predictability. These stoichiometric imbalances are further intensified by climate change and legacy nutrient loads, challenging traditional management practices.

The main hypothesis

- Climate-driven changes in temperature, hydrology, and nutrient availability alter the seasonal balance of nitrogen and phosphorus in fishponds, leading to increased variability in primary production, food-web structure, and ecosystem stability.
- The resilience of fishpond ecosystems to global change is strongly mediated by management and pond-specific characteristics.
- Wisely managed ponds can maintain ecological stability and ecosystem services despite increasing climatic and nutrient pressures.

Aim(s) of the Ph.D. thesis

- Describe the functioning fishpond ecosystem under a changing climate.
- Understanding seasonal and interannual changes in ecosystem functioning and their consequences for fish production stability and ecosystem predictability.

- To develop site-specific and based on history management recommendations for fishponds and to translate ecological and production insights into practical management guidance.

Possible approaches to reach the aims / to verify the hypotheses

- Analysis of available long-term data on fishpond environmental parameters and production.
- Comparative assessment of fishpond ecosystems across environmental gradients, focusing on how differing climatic, hydrological, and nutrient conditions modify ecosystem functioning under similar management frameworks.
- Targeted field and mesocosm experiments designed to test ecosystem sensitivity, thresholds, and resilience of fishponds to external pressures such as warming, altered nutrient availability, and hydrological stress.

References

Adámek Z, Kajgrová L, Regenda J, Roy K (2023) Carp pond aquaculture – concordance of production and nature. Aquac Eur 48:6–15

Francová K, Šumberová K, Janauer GA, Adámek Z (2019) Effects of f ish farming on macrophytes in temperate carp ponds. Aquacult Int 27:413–436

Kajgrová, L., Pecha, O., Roy, K., Dvořák, J., Let, M., Potužák, J. et al. (2024) Pond cascades as a tool for ecological aquaculture allowing natural zooplankton succession, nutrient retention, and multiple stocking–harvesting cycles. Aquacultural Engineering, 104, 102374.

Kajgrová, L., Kolar, V., Roy, K., Adámek, Z., Blabolil, P., Kopp, R., Mráz, J., Musil, P., Pecha, O., Pechar, L., Potužák, J. & Vrba, J. (2024) A stoichiometric insight into the seasonal imbalance of phosphorus and nitrogen in central European fishponds. Environmental Sciences Europe, 36(1), 139.

Orság, M., Meitner, J., Fischer, M., Svobodová, E., Kopp, R., Mareš, J., et al. (2023). Estimating heat stress effects on the sustainability of traditional freshwater pond fishery systems under climate change. Water, 15(8), 1523.

Pechar L, Přikryl I, Faina R (2002) Hydrobiological evaluation of Trebon f ishponds since the end of the nineteenth century. In: Květ J, Jeník J, Soukupová L (eds) Freshwater wetlands and their sustainable future: a case study of the Třeboň Basin Biosphere Reserve, Czech Republic, vol 28. UNESCO & The Parthenon, Paris, pp 31–62

Potužák J, Hůda J, Pechar L (2007) Changes in fish production effectivity in eutrophic fishponds–impact of zooplankton structure. Aquac Int 15:201–210

Scheffer M, van Nes EH (2007) Shallow lakes theory revisited: various alternative regimes driven by climate, nutrients, depth and lake size. In: Shallow Lakes in a Changing World: Proceedings of the 5th International Symposium on Shallow Lakes, held at Dalfsen, The Netherlands. Springer Netherlands, pp. 455–466

Varga, M., Berzi-Nagy, L., Csukas, B., & Gyalog, G. (2020) Long-term dynamic simulation of environmental impacts on ecosystem-based pond aquaculture. Environmental Modelling & Software, 134, 104755.

CENAKVA Research program

RP4 Freshwater ecosystems in the era of global change

Zátiší 728/II, 389 01 Vodňany, Česká republika T/ +420 387 774 736 E/ lkacerova@frov.jcu.cz www.frov.jcu.cz

Supervisor: Ganna Fedorova, Ph.D.

Contact

E-mail: gfedorova@frov.jcu.cz
Tel.: +420 775 360 674

Nature-inspired approaches for wastewater treatment and reuse

Přírodou inspirované přístupy k čištění a opětovnému použití odpadních vod

DSP: Ochrana vodních ekosystémů / Protection of aquatic ecosystems

Annotation

Every day we are using water and releasing many chemicals to wastewater. With the growing global concern over water scarcity and pollution, there is a critical need for innovative approaches to wastewater treatment that not only effectively remove contaminants but also recover valuable resources from wastewater streams.

Conventional wastewater treatment is not effective enough to remove pollutants from the wastewater, thus wastewater effluents are recognized as the main source of micropollutants in the aquatic environment. Presence of a wide range of emerging contaminants (such as pharmaceuticals, personal care products, perfluorinated compounds) in wastewater treatment plants effluents was reported.

Intensive research is going on to improve elimination of micropollutants from wastewater. So called green approaches, which promote sustainable and environmentally friendly methods for treating wastewater while also reducing the environmental impact of traditional wastewater treatment processes are gaining a lot of attention nowadays. Natural treatment methods include, for example, the use of stabilization ponds for wastewater treatment. This is a cheap and relatively effective way to reduce the content of nutrients and micropollutants in wastewater. Constructed wetlands are also used for wastewater treatment and have the potential to remove a wide range of micropollutants.

Treated wastewater represents a sustainable water source that could be used for fish farming. However, the reuse of treated wastewater poses certain safety risks. Until now, attention has been paid to the risk of microbial contamination or the accumulation of toxic metals in fish produced this way. However, less information is available on the possible contamination of fish with micropollutants.

The main hypothesis

- Additional wastewater treatment steps can improve quality of wastewater effluents
- Water plants can contribute to the elimination of micropollutants from wastewater
- Wastewater reuse for the fish production can be beneficial using the proper practise of fish handling

Aim(s) of the Ph.D. thesis

- To assess the effectiveness of stabilisation pond and constructed wetlands for the elimination of micropollutants from wastewater.
- To evaluate the bioaccumulation of micropollutants in water plants.
- To analyze the content of micropollutants in fish produced in the pond fed with treated wastewater. In case these substances will be detected, to monitor the duration of their purification after transferring the fish into clean water.

Possible approaches to reach the aims / to verify the hypotheses

- Collection of water, plant and fish samples; development and validation of extraction procedures.
- LC/MS analysis of micropollutants in collected samples.
- Data analysis, risk assessment.

References

Fedorova, G., R. Grabic, K. Grabicova, J. Turek, T. Van Nguyen, T. Randak, B. W. Brooks and V. Zlabek (2022). "Water reuse for aquaculture: Comparative removal efficacy and aquatic hazard reduction of pharmaceuticals by a pond treatment system during a one year study." Journal of Hazardous Materials 421.

Mackuľak, T., M. Mosný, J. Škubák, R. Grabic and L. Birošová (2015). "Fate of psychoactive compounds in wastewater treatment plant and the possibility of their degradation using aquatic plants." Environ Toxicol Pharmacol 39(2): 969-973.

Zaibel, I., D. Zilberg, L. Groisman and S. Arnon (2016). "Impact of treated wastewater reuse and floods on water quality and fish health within a water reservoir in an arid climate." Science of the Total Environment 559: 268-281.

CENAKVA Research program

RP2 “New” pollutants in the environment and their effect on freshwater ecosystems

Zátiší 728/II, 389 01 Vodňany, Česká republika T/ +420 387 774 736 E/ lkacerova@frov.jcu.cz www.frov.jcu.cz

Supervisor: Hamid Niksirat Hashjin, Ph.D.

Contact

E-mail: niksirat@frov.jcu.cz
Tel.: +420 389 034 745

Sustainable Extraction of Chitosan from Invasive Crayfish

Udržitelná extrakce chitosanu z invazních raků

DSP: Ochrana vodních ekosystémů / Protection of aquatic ecosystems

Annotation

Invasive crayfish species, particularly Faxonius limosus, Procambarus clarkii, Procambarus virginalis and Pacifastacus leniusculus, pose a growing ecological threat to freshwater ecosystems in the Europe. Their rapid spread, high reproductive rate, and competitive dominance disrupt native crayfish populations, alter benthic habitats, and facilitate the transmission of crayfish plague. Current management approaches rely mainly on trapping and removal, yet the biomass collected is typically discarded or used only in low-value applications. This represents a missed opportunity for circular-economy innovation.

Chitin and its deacetylated derivative, chitosan, are valuable biopolymers used across biomedical, agricultural, environmental, and food-processing industries. Global demand for chitosan is increasing due to its biodegradability, biocompatibility, antimicrobial activity, and sorption properties. While commercial chitosan production typically relies on other crustacean shell waste such as shrimp, invasive crayfish represent an underutilised alternative raw material that could simultaneously support ecosystem management and reduce dependency on external imports.

However, little is known about the optimal extraction procedures, chemical properties, and industrial suitability of chitosan derived specifically from invasive crayfish removed from Central European freshwater bodies.

This PhD project addresses these gaps by developing and assessing sustainable chitosan-extraction methods from invasive crayfish. The research will contribute to both invasive-species mitigation and the generation of high-value bio-based materials.

The main hypothesis

- The quality of chitosan extracted from different invasive crayfish species is different.
- Invasive crayfish biomass from European freshwater systems represents a viable and high-quality raw material for the sustainable production of chitosan compared to imported chitosan.
- Environmentally optimised extraction protocols can produce chitosan with physicochemical properties comparable to or better than commercially available sources.
- Valorisation of invasive crayfish through biopolymer production supports circular-economy principles and enhances the cost-effectiveness of invasive-species management.

Aim(s) of the Ph.D. thesis

- To assess the availability, composition, variability, and quality of invasive-crayfish biomass as a source of chitin and chitosan.

- To develop and optimise environmentally friendly extraction methods (chemical, enzymatic, or hybrid).
- To characterise and compare the physicochemical properties and application potential of extracted chitosan from different crayfish species.

Possible approaches to reach the aims / to verify the hypotheses

- Field collection and quantification of invasive crayfish from selected European localities; analysis of shell composition and yields.
- Laboratory optimisation of demineralisation, deproteinisation, and deacetylation steps using greener alternatives (e.g., reduced chemical intensity, enzymatic treatments).
- Characterisation of chitosan quality (degree of deacetylation, molecular weight, purity, FTIR spectroscopy, thermal analysis, solubility, and antimicrobial tests).
- Economic evaluation comparing invasive-crayfish-derived chitosan to conventional sources.
- Statistical analyses to understand variation across species, locations, and extraction parameters.

References

Kotovska G, Khrystenko D, Patoka J, Kouba A (2016). East European crayfish stocks at risk: arrival of non-indigenous crayfish species. Knowledge & Management of Aquatic Ecosystems. 417:37. https://doi.org/10.1051/kmae/2016024

Rinaudo, M. (2006). Chitin and chitosan: Properties and applications. Progress in Polymer Science, 31(7), 603-632. https://doi.org/10.1016/j.progpolymsci.2006.06.001

Tolaimate, A., Desbrieres, J., Rhazi, M., & Alagui, A. (2003). Contribution to the preparation of chitins and chitosans with controlled physico-chemical properties. Polymer, 44(26), 7939-7952. https://doi.org/10.1016/j.polymer.2003.10.025

Kadak, A. E., Küçükgülmez, A., & Çelik, M. (2023). Preparation and Characterization of Crayfish (Astacus leptodactylus) Chitosan with Different Deacetylation Degrees. Iranian Journal of Biotechnology, 21(2), e3253. https://doi.org/10.30498/ijb.2023.323958.3253.

CENAKVA Research program

RP4 Freshwater ecosystems in the era of global change

Zátiší 728/II, 389 01 Vodňany, Česká republika T/ +420 387 774 736 E/ lkacerova@frov.jcu.cz www.frov.jcu.cz

Supervisor: Dr. hab. Josef Velíšek

Contact

E-mail: velisek@frov.jcu.cz
Tel.: +420 725 787 931

Is a new generation of herbicides a safer alternative for aquatic organisms as well?

Je nová generace herbicidů bezpečnější alternativou i pro vodní organizmy?

DSP: Ochrana vodních ekosystémů / Protection of aquatic ecosystems

Annotation

The growing production of energy crops in Europe (mainly maize and rapeseed), which has replaced traditional crops such as grain, has significantly changed patterns of pesticide use over the past few decades. The herbicide acetochlor, with annual consumption exceeding 200 tonnes, was widely applied in maize cultivation as a substitute for atrazine (a triazine herbicide banned in 2005). Acetochlor is one of the most frequently detected herbicides in aquatic environments worldwide (Olowoyo and Mugivhisa, 2019; Konecna et al., 2023; CHMI, 2024). Together with its isomer alachlor, it has been classified as a probable human carcinogen. In addition, acetochlor acts as a thyroid disruptor, accelerates metamorphosis in amphibians, and affects fish ontogeny (Li et al., 2009). Due to its documented adverse effects, acetochlor was banned in the Czech Republic in 2014. Following this ban, it was largely replaced by the herbicides dimethachlor, chloridazon, metazachlor, and metolachlor. Residual amounts of these substances and their metabolites have been detected in both ground and surface waters long after application (Konecna et al., 2023).

Indeed, there is a clear gap in knowledge regarding the toxicity of the new generation of herbicides and their metabolites, which are commonly found in aquatic environments. It is therefore essential to investigate the chronic effects of these herbicides and their major metabolites at environmentally relevant concentrations in aquatic animals. However, it can be hypothesised that these herbicides and their primary metabolites may pose a potential risk to aquatic organisms.

The main hypothesis

- Some older herbicides and their metabolites, which are frequently detected in aquatic environments, have been shown to have a negative impact on aquatic organisms. It therefore raises the question: Are the new herbicides safer for aquatic organisms than the older ones?

Aim(s) of the Ph.D. thesis

- The aim of this study is to evaluate the effects of newly introduced herbicides and their metabolites on the physiological responses of exposed aquatic organisms (fish, crayfish, and mussels) and to assess their potential use as suitable bioindicators.

Possible approaches to reach the aims / to verify the hypotheses

- Model aquatic organisms (fish, crayfish, and mussels) will be exposed to new herbicides and their metabolites at environmentally relevant concentrations in a long-term experiment. The effects on behaviour, ontogeny development, growth, physiology, and histopathology will be assessed.

References

CHMI (Czech Hydrometeorological Institute), 2024. On-line water duality database. Available from: http://hydro.chmi.cz/.

Konecna, J., Zajicek, A., Sanka, M., Halesova, T., Kaplicka, M., Novakova, E., 2023. Pesticides in Small Agricultural Catchments in the Czech Republic, Journal of Ecological Engineering 24 (3): 99-112.

Li, W., Zha, J., Li, Z., Wang, Z., 2009. Effects of exposure to acetochlor on the expression of thyroid hormone related genes in larval and adult rare minnow. Aquatic Toxicology 94: 87–93.

Olowoyo, J., Mugivhisa, L., 2019. Evidence of uptake of different pollutants in plants harvested from soil treated and fertilized with organic materials as source of soil nutrients from developing countries. Chemical and Biological Technologies in Agriculture 6: 1–11.

CENAKVA Research program

RP2 “New” pollutants in the environment and their effect on freshwater ecosystems

Zátiší 728/II, 389 01 Vodňany, Česká republika T/ +420 387 774 736 E/ lkacerova@frov.jcu.cz www.frov.jcu.cz

Supervisor: Assoc. Prof. Antonín Kouba

Contact

E-mail: akouba@frov.jcu.cz
Tel.: +420 607 622 137

Macrobrachium nipponense: a new threat to European freshwater ecosystems

Macrobrachium nipponense: nová hrozba pro evropské sladkovodní ekosystémy

DSP: Ochrana vodních ekosystémů / Protection of aquatic ecosystems

Annotation

Freshwater ecosystems are increasingly affected by biological invasions, resulting in significant ecological and socio-economic consequences. One emerging non-native species spreading across Europe is the Oriental prawn Macrobrachium nipponense. It is therefore essential to monitor its distribution and investigate its potential impacts on native taxa. This thesis aims to monitor sites where this species has recently been detected, as well as other locations considered critical to its potential future spread. Genetic methods will be employed to elucidate the introduction pathways of non-native populations. Potential impacts on native taxa, ranging from competition for resources to predation and disease transmission, will be assessed using a multi-methodological approach that includes laboratory experiments, genetic markers, and stable isotope analysis of the invaded communities. Species distribution models will be used to predict both current and future areas of potential establishment.

The main hypothesis

The Oriental river prawn is an emerging invasive species in European freshwater ecosystems. Its recent spread is likely facilitated by multiple introduction pathways, and its establishment may exert measurable ecological impacts on native biota through trophic interactions, competition, and potential disease transmission. These impacts, when combined with suitable environmental conditions and ongoing climate change, are expected to promote the species' further spread and invasiveness across Central and Western Europe.
This hypothesis is supported by the following observations and considerations:

- Oriental river prawn has established populations in both thermally altered and naturally temperate waters in Central Europe. Its life-history traits, such as high fecundity, the ability to reproduce in freshwater, and thermal tolerance, are consistent with those of other successful invasive species.
- Preliminary evidence suggests introductions may occur via the pet trade, as seen with non-native crayfish, or through unintentional means such as ballast water discharge. Population genetic analyses will be used to determine whether spatially disjunct populations have independent origins.
- As a generalist omnivore, the Oriental river prawn may impact both native and non-native species through predation and resource competition. These potential interactions will be investigated experimentally.
- The species may act as a vector for pathogens such as Aphanomyces astaci, thereby contributing to indirect negative effects on native crayfish populations.

The hypothesis will be tested using a multidisciplinary approach combining field monitoring, laboratory experiments, stable isotope analysis, genetic tools, and species distribution modelling to ensure a comprehensive and robust assessment.

Aim(s) of the Ph.D. thesis

- This project will monitor the spread of a novel non-native species in Europe, assessing its introduction pathway, several potential impacts on other taxa, role in the invaded trophic web, as well as its potential distribution, and invasiveness and impact risks.

Possible approaches to reach the aims / to verify the hypotheses

- Several complementary and integrated approaches can be employed, aligned with the objectives outlined above. These include field monitoring (using trapping, hand searching, eDNA sampling, and associated genetic analyses), trophic ecology, behavioural and functional response experiments, species distribution modelling, and impact and invasiveness risk assessment.

References

Bláha, M., Schrottenbaum, A., Weiperth, A., Hammerschmied, U., Graf, W., Csányi, B., ... & Kouba, A. (2025). Macrobrachium nipponense (De Haan, 1849) continues to spread in the Danube: first records in Germany and Hungary. Knowledge & Management of Aquatic Ecosystems, 426: 9.

Oficialdegui, F. J., Bláha, M., Prati, S., Lipták, B., Weiperth, A., Bányai, Z. M., ... & Kouba, A. (2025). Contrasting patterns of genetic variability in pet-traded red swamp crayfish Procambarus clarkii and its feral populations. Freshwater Biology, 70: e70008.

Lipták, B., Prati, S., Oficialdegui, F. J., Apfelová, M., Pekárová, S., Kautman, J., ... & Kouba, A. (2024). First populations of invasive red swamp crayfish flourish in Slovakia. BioInvasions Record, 13: 825-841.

Mojžišová, M., Weiperth, A., Gebauer, R., Laffitte, M., Patoka, J., Grandjean, F., Kouba, A., Petrusek, A. (2024). Diversity and distribution of Aphanomyces astaci in a European hotspot of ornamental crayfish introductions. Journal of Invertebrate Pathology, 202: 108040.

Kouba, A., Oficialdegui, F. J., Cuthbert, R. N., Kourantidou, M., South, J., Tricarico, E., ... & Haubrock, P. J. (2022). Identifying economic costs and knowledge gaps of invasive aquatic crustaceans. Science of the Total Environment, 813: 152325.

Haubrock, P. J., Oficialdegui, F. J., Zeng, Y., Patoka, J., Yeo, D. C., & Kouba, A. (2021). The redclaw crayfish: A prominent aquaculture species with invasive potential in tropical and subtropical biodiversity hotspots. Reviews in Aquaculture, 13: 1488-1530.

CENAKVA Research program

RP4 Freshwater ecosystems in the era of global change

Zátiší 728/II, 389 01 Vodňany, Česká republika T/ +420 387 774 736 E/ lkacerova@frov.jcu.cz www.frov.jcu.cz

Supervisor: Prof. Tomáš Randák

Contact

E-mail: trandak@frov.jcu.cz
Tel.: +420 721 855 763

Occurrence of PFAS in the aquatic environment and their impact on the hygienic quality of wild fish

Výskyt PFAS ve vodním prostředí a jejich vliv na hygienickou kvalitu volně žijících ryb

DSP: Ochrana vodních ekosystémů / Protection of aquatic ecosystems

Annotation

Perfluorinated and polyfluorinated alkyl substances (PFAS) include thousands of synthetic chemicals that are highly stable and accumulate in the environment and in the bodies of organisms. Due to their properties, PFAS are used in various industrial processes, in households, and as components of pesticides. Because these compounds are resistant, they enter the environment with treated municipal or industrial wastewater. Due to their stability and also proven toxic effects, some PFAS have been included in the updated list of persistent organic pollutants of the Stockholm Convention (Stockholm Convention, 2024). In 2022, Commission Regulation (EU) 2022/2388 came into force, subsequently being incorporated into Commission Regulation (EU) 2023/915, which establishes maximum levels of specific contaminants in food. This regulation sets limit concentrations for four individual PFAS and their sum. These are perfulorooctanesulfonic acid (PFOS), perfluoroocatanoic acid (PFOA), perfluorononanoic acid (PFNA), and perfulorohexanesulfonic acid (PFHxS). The value of the tolerable weekly intake (TWI) of the sum of limited PFAS for humans is set in Commission Regulation (EU) 2022/2388 at a level of 4.4 ng kg-1 of body weight. Humans primarily intake PFAS through food and water. In this regard, the consumption of fish, especially wild fish, is also problematic.

The main hypothesis

- PFAS concentrations in the muscle of market fish cultured in major production ponds will usually be below the hygienic limit. In fishing grounds, exceeding the hygienic limit values will be frequent in older individuals and in fish living in locations located in the lower reaches of major rivers.
- The level of PFOS contamination in the aquatic environment is increasing.
- Significant sources of PFAS contamination in the Lipno Reservoir include tributaries affected by wastewater, preparations used to treat sports equipment, ports, and shipping activities.
- PFAS concentrations in the bodies of aquatic organisms will increase with increasing level of their position in the food chain. The spectrum of contaminants will vary between individual species.

Aim(s) of the Ph.D. thesis

- To assess the load of selected sites of the aquatic environment in the Czech Republic with PFAS in terms of the presence of these substances in the muscle of various species of wild fish
- Based on the obtained results, specify sites, species, or size categories of fish that may pose a risk to fish consumers in terms of PFAS load levels.

- Based on the database results of analyses of juvenile fish, which are used as a bioindicator within the national monitoring program of aquatic environment contamination, to assess the development of PFOS contamination levels at regularly monitored sites within the Czech Republic.
- To identify the main sources of pollution of the Lipno Reservoir - a key recreational area of South Bohemia - by PFAS and analyse the distribution of these compounds in various components of the aquatic environment and in the food chain.

Possible approaches to reach the aims / to verify the hypotheses

- Sampling of fish from selected locations in the Czech Republic. Preparation of samples for analysis, analysis of samples using liquid chromatography with mass spectrometry (LC/MS).
- Historical data analyses on PFOS contamination of juvenile fish in long-term monitored locations of the Czech Republic.
- Sampling of various matrices (biota, passive samplers) of the aquatic environment of the Lipno Reservoir, and analysis of samples using LC/MS.
- Statistical analysis of data, preparation of scientific publications

References

Buchtíková, S., Šimková, A., Rohlenová, K., Flajšhans, M., Lojek, A., Lilius, E.M., Hyršl, P., 2011. The seasonal changes in innate immunity of the common carp (Cyprinus carpio). Aquaculture 318: 169-175. doi:10.1016/j.aquaculture.2011.05.013

Kocour, M., Gela, D., Rodina, M., & Linhart, O., 2005. Testing of performance in common carp Cyprinus carpio L. under pond husbandry conditions I: top-crossing with Northern mirror carp. Aquaculture Research 36(12): 1207–1215. doi:10.1111/j.1365-2109.2005.01340.x

Omori, R., Adams, B., 2011. Disrupting seasonality to control disease outbreaks: The case of koi herpes virus. Journal of Theoretical Biology 271: 159-165. doi:10.1016/j.jtbi.2010.12.004

Prchal, M., Bugeon, J., Vandeputte, M., Kause, A., Vergnet, A. Zhao, J. Gela, D., Genestout, L. Bestin, A., Haffray, P., Kocour, M., 2018. Potential for genetic improvement of the main slaughter yields in common carp with in vivo morphological predictors. Front. Genet. 9:283. doi: 10.3389/fgene.2018.00283

CENAKVA Research program

RP2 “New” pollutants in the environment and their effect on freshwater ecosystems

Zátiší 728/II, 389 01 Vodňany, Česká republika T/ +420 387 774 736 E/ lkacerova@frov.jcu.cz www.frov.jcu.cz

Supervisor: Assoc. Prof. Miloš Buřič

Contact

E-mail: buric@frov.jcu.cz
Tel.: +420 724 204 706

Invasive freshwater crayfish and their influence on other freshwater taxa

Invazní druhy raků a jejich vliv na ostatní vodní organismy

Annotation

European freshwater ecosystems are facing high rates of colonisation by invasive animal species. These species are animals that are introduced, either deliberately or accidentally, to areas outside their natural range. Once established in new environments, they spread uncontrollably and cause substantial ecological and economic problems. The effects of biological invasions are exacerbated by anthropogenic changes to habitats, pollution and the effects of climate change, due to the high adaptability and resistance of these species. No country is immune to the colonisation of alien animal species. This PhD thesis focuses primarily on a highly successful group of invasive species in European waters: North American freshwater crayfish. Six of these species are included on the list of invasive species of European concern, and their handling and transport is therefore limited. Unfortunately, it is almost impossible to manage their populations once they are established. They can spread and impact valuable endangered species, such as bivalves, native crayfish and fish. The proposed work will employ experimental and observational approaches in laboratory and field studies to evaluate the impact on different aquatic organisms in terms of behaviour in lotic and lentic conditions, and in terms of competition and predator–prey interactions, with an assessment of the influence of environmental factors such as temperature, habitat complexity and water flow. The results of this PhD thesis will extend our knowledge of the basic life processes of invasive organisms and their impact on protected or important aquatic species.

The main hypothesis

- The effects of invasive crayfish on other biota will differ depending on the complexity of the habitat and the conditions of the water flow.
- Invasive crayfish can affect even thick-shelled organisms, such as different species of bivalves and gastropods, by preying on them directly.
- Salmonid fish stocks management could be affected by the presence of invasive crayfish in certain areas.
- To evaluate regulation approaches and their effectivity for invasive crayfish removal in different habitats.

Aim(s) of the Ph.D. thesis

- To evaluate the potential risks posed by invasive crayfish, which are not immediately apparent.
- To determine the factors that influence the negative effects of invasive crayfish in particular ecosystems/habitats, either positively or negatively.
- To collect data for future prioritization of localities with invasive species for selection promising methods but mainly to determine if the effort is meaningful in compared localities.
- To publish the results of the experimental and field work.

Possible approaches to reach the aims / to verify the hypotheses

- Manipulative experiments in laboratory conditions using the static conditions but also conditions simulating different water flow regimes.
- Field observations using video-cameras at the places with co-occurrence of invasive and protected/important species.
- Field activities connected with the crayfish species regulation.

References

Gherardi F, Aquiloni L, Diéguez-Uribeondo J, Tricarico E (2011) Managing invasive crayfish: is there a hope? Aquatic Sciences 73: 185-200.

Holdich DM (2002) Biology of freshwater crayfish. Blackwell Science (Oxford): 1-702.

Holdich DM, Reynolds JD, Souty-Grosset C, Sibley PJ (2009) A review of the ever increasing threat to European crayfish from non-indigenous crayfish species. Knowledge and Management of Aquatic Ecosystems: 11: 394-395.

IPBES (2023) Thematic assessment report on invasive alien species and their control of the intergovernmental science-policy platform on biodiversity and ecosystem services. Roy HE, Pauchard A, Stoett P, Renard Truong T (eds.). IPBES secretariat, Bonn, Germany.

Kouba A, Oficialdegui FJ, Cuthbert RN, Kourantidou M, South J, Tricarico E, Gozlan RE, Courchamp F, Haubrock PJ (2022) Identifying economic costs and knowledge gaps of invasive aquatic crustaceans. Science of Total Environment 813: 152325.

Kouba A, Petrusek A, Kozák P (2014) Continental-wide distribution of crayfish species in Europe: update and maps. Knowledge and Management of Aquatic Ecosystems 413: 05.

Krieg R, King A, Zenker A (2021) Barriers against invasive crayfish species in natural waters and fish passes - Practical experience. Global Ecology and Conservation 25: e01421.

Peay S, Johnsen SI, Bean CW, Dunn AM, Sandodden R, Edsman L (2019) Biocide Treatment of Invasive Signal Crayfish: Successes, Failures and Lessons Learned. Diversity 11: 29.

Pergl J, Sádlo J, Petrusek A, Lastuvka Z, Musil J, Perglová I, Sanda R, Sefrová H, Síma J, Vohralík V, Pysek P (2016) Black, Grey and Watch Lists of alien species in the Czech Republic based on environmental impacts and management strategy. NeoBiota 28: 1-37.

Prior KM, Adams DC, Klepzig KD, Hulcr J (2018) When does invasive species removal lead to ecological recovery? Implications for management success. Biological Invasions 20: 267-283.

Pyšek P, Blackburn TM, García-Berthou E, Perglová I, Rabitsch W (2017) Displacement and local extinction of native and endemic species. In: Villá M, Hulme PE (Eds) Impact of biological invasions on ecosystem services. Springer Nature: 157-175.

Regulation (EU) No 1143/2014 of the European Parliament and of the Council of 22 October 2014 on the prevention and management of the introduction and spread of invasive alien species.

Ricciardi A, Hoopes MF, Marchetti MP, Lockwood JL (2013) Progress toward understanding the ecological impacts of nonnative species. Ecological Monographs 83: 263-282.

Zátiší 728/II, 389 01 Vodňany, Česká republika T/ +420 387 774 736 E/ lkacerova@frov.jcu.cz www.frov.jcu.cz

Sol D, Weis JS (2019) Highlights and Insights from" Biological Invasions and Animal Behaviour". Aquatic invasions 14: 551-565.

Stebbing P, Longshaw M, Scott A (2014) Review of methods for the management of non-indigenous crayfish, with particular reference to Great Britain. Ethology Ecology & Evolution 26: 204-231.

Taylor CA, DiStefano RJ, Larson ER, Stoeckel J (2019) Towards a cohesive strategy for the conservation of the United States' diverse and highly endemic crayfish fauna. Hydrobiologia 846: 39-58.

Funding

Interreg project BY-CZ: REWMA - REsilient Waters: Managing Aquatic invasions for sustainable ecosystems

CENAKVA Research program

RP4 Freshwater ecosystems in the era of global change

Zátiší 728/II, 389 01 Vodňany, Česká republika T/ +420 387 774 736 E/ lkacerova@frov.jcu.cz www.frov.jcu.cz