2022–2023

BIENNIAL
REPORT

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01

Introduction

Who are we?

We are an enthusiastic team of people passionate about science in the fields of fisheries and protection of the water environment as well as biodiversity.

The Faculty of Fisheries and Protection of Waters is the smallest and at the same time youngest part of the University of South Bohemia in České Budějovice, which on the other hand constitutes no obstacles to it being one of the leading faculties regarding the contribution of scientific and practical outputs, great-quality instrumentation and other infrastructure, and a corresponding large number of professional scientific and academic staff.

What are we?

We are the most comprehensive institution in the field of fisheries and protection of waters in Central Europe with explorational and applied research, having the rights for associate professorship and professorship procedures, providing Bachelor's, Master's, and Ph.D. studies. The faculty has experimental facilities for studying and researching aquaculture, fish and crayfish culture, hydrobiology, toxicology, fish diseases, reproduction, and genetics, as well as a unique fisheries library.

Why are we here?

We are a research faculty bringing cut- ting-edge research knowledge directly to students and industry professionals. We aim to educate fishermen with a positive relationship to the environment and conservationists with a pragmatic approach to production fisheries. We have been pursuing a strategy for sustainable development of the so-called "Green FFPW". We would like to be a European leader in the fields of fisheries research and protection of the freshwater environment.

The faculty made it through the difficult years

Reverberations of the covid epidemic, the war in Ukraine, the energy crisis – problems that have not spared universities in recent years, either. In the following interview, Prof. Pavel Kozák gives an overview of how these factors have influenced the functioning of the Faculty of Fisheries and Protection of Waters and him in particular, having been the dean of the faculty from 2017, and the rector of the University of South Bohemia since April 2024

The recent years have been affected by a series of turbulent events. How has the faculty coped with them and how have You, being its dean, addressed them?

When I started my first term of office as dean in 2017, I was convinced that I would only hold the position for four years with suitable candidates gradually emerging to replace me. With the advent of covid and other developments, everything changed, so we agreed it would not be advisable to change the management at such a critical time and expose the faculty to destabilizing influences. These were challenging times, but the faculty made it through, emerging in a good shape.

Do you consider this the main achievement of your second term of office as dean?

Yes, as the faculty is now stable and in excellent financial condition, making progress in terms of research. I must give credit to the team of colleagues I am surrounded by, none of whom I could have managed without. As far as personnel is concerned, the faculty consists of a team of qualified people. However, there is still a shortage of key staff, which has now become apparent due to the departure of several important people to the Rector's Office.

Your predecessor in the position of dean was Prof. Otomar Linhart, who was at the birth of the faculty and is often considered its "founding father". To what extent did you want to build upon his legacy and in what respect did you want to differ from his approach on the other hand?

I particularly took up his emphasis on the importance of the faculty's financial stability. During my predecessor's time rapid construction took place, with a number of departments and laboratories being established. It was my task to stabilize the new infrastructure and work on the refinement of the academic environment, putting emphasis on the personnel side. At the same time, we did not give up on expanding the faculty's facilities, having managed to build a few new things.

How has the profile of the faculty changed in recent years with regard to the programmes of study offered?

When I assumed the office of dean, the field of Protection of Waters was rather a wish than a real and sought-after programme of study. Gradually, its quality and attractiveness increased, and when we compare the fields of Fishery and Protection of Wa-

ters today, it is roughly 50/50. This enables us to offer a wider range of career opportunities to prospective students. The field of Protection of Waters is future-oriented, not least due to the climate change, which makes the topic of water, its use and biodiversity protection of aquatic organisms very relevant. In spite of this, we still have some shortcomings in the area of education, especially in addressing foreign students for our Master's degree programme. We refused to take the route of cooperating with commercial agencies that would find us potential students for a lot of money. Instead, we would like to approach them directly by targeting specific institutions, perhaps through our colleagues abroad, just as we reach out to Czech students by visiting schools in person and recruiting them. I also put a lot of emphasis on marketing. In this respect, the faculty has improved significantly in recent years, on the other hand, the competition has also increased.

In some comparing rankings, the faculty turns out to be strong in scientific research activities. Do you keep track of various ranking lists and subsequently assess them?

That's right. The faculty emerged as "top" in various rankings, though it should be remembered that we were previously compared with agricultural and forestry faculties, where the competition is lower in terms of scientific results. I became a member of the Association of Deans of Faculties of Science and we started to compare ourselves more with them as well. And that's where it gets much more difficult. Nonetheless, I must say that we are equal partners to them. When we talk about science at our faculty, we should mention the CENAKVA research infrastructure. Thanks to it in particular, we can be competitive also within Europe.

Some may perceive a certain contradiction in the name of Faculty of Fisheries and Protection of Waters, as it reflects the irreconcilable divide between environmentalists who emphasize preservation of nature, and production fishermen and farmers who look at sustainability more from the economic point of view. How do you regard this contradiction?

What some call a contradiction, I see as a strength of our faculty. Indeed, it is true that the two opposing camps you mentioned sometimes have great difficulty in reaching an agreement and balancing their interests. However, this will not work without mutual communication. Personally, I consider nature conservation to be very important, yet it cannot ignore the view of people who actually farm in the countryside depending on it economically. My educational motto is to educate fishermen with a positive relationship to the environment and conservationists with a pragmatic relationship to production farming.

As of 1st April, you became the new rector of the University of South Bohemia, which is a great achievement for the faculty itself. Prof. Tomáš Policar took over the dean's "sceptre" from you. What would you like to wish him, or what would you warn him against?

I am glad that Tomáš Policar has become the new dean as he is a respectable and honest person. I am aware that he has a slightly different view on some things than me, but that is natural. He has his own vision, and he is taking the position of dean because he chose to do so. I would recommend that he surrounds himself with good colleagues. There are bound to be situations where you'd rather run away from your job. At such moments, I always stopped and said to myself that I had been the one to make that choice. Every new position offers something - new experience that takes you a step further.

02

Faculty Life

Faculty Ball

On 10th February 2023, the III. Representative Ball of the Faculty of Fisheries and Protection of Waters took place following a two-year hiatus due to the covid pandemic (2021) and the multipurpose hall reconstruction in Vodňany (2022). Consequently, the Faculty of Fisheries and Protection of Waters could welcome visitors in a newly reconstructed representative space. Marek Dědík and Martina Viktorie Kopecká, participants of the popular TV show StarDance, came there to perform a dance, with the excellent band MP3 České Budějovice providing the perfect accompaniment. Moreover, everyone could try their luck in a plentiful raffle. ◀

FROVFEST

Every year at the beginning of September we look forward to the now traditional FROVFEST, which is a multi-genre music festival organized at the Blanice Sports Complex in Vodňany, focused slightly more on rock-tuned fans. The organizers give a chance to local bands to perform, albeit more well-known names such as Visací zámek (Padlock in English), Abraxas, AC/DC TRIBUTE and Motorband are also present. This event is supported by financial subsidies from the Region of South Bohemia and other sponsors, thus you can enjoy it free of charge. In 2022, the visitors could already enjoy the tenth anniversary of the festival. Each year, nearly a thousand spectators attend, and during the 11th festival we even set a record with two thousand people attending. In recent years, we have not been forgetting our little guests, making a programme of bouncy castles and painting of funny pictures on different parts of the body to satisfy them as well. We would hereby like to express our gratitude to the two main organizers, Petra Plachtová and Martin Kahanec, as the festival would not have been possible without them. ◀

Earth Day, World Water Day, Let's Clean the Czech Republic, Scientists' Night, ABC Challenge

World Water Day is annually held on 22nd March. The celebration of this day is also associated with the so-called FROVrun aka World Water Run. As a faculty, we took part in this global challenge for the third time, supporting not only healthy movement, but also highlighting the important information on the state of water on the planet. As a team, we tackle several hundred kilometres each year, being rightly proud of the involvement of not only our employees but also others from the general public.

Earth Day is celebrated on the exact same day, just a month later, and then there is the Let's Clean the Czech Republic event. This is when we set off to the Vodňany surroundings armed with bags and gloves, cleaning everything that doesn't belong in the countryside and the town, as the

name of the event suggests. It is on these days that our colleagues from the International Environmental and Educational Centre MEVPIS try to draw the attention to current pressing issues in an entertaining way, whether it is awareness of the issue of the "invasive" species that have already reached our area and the impact of their presence on the local fauna and flora, the desirability of wetlands in the environment, the problem of soil regeneration, or the organic waste management using earthworms (vermicomposting).

Open Days take place during the Vodňany Fishery Days in May as well as in the winter months. Needless to say, we make the premises of the Faculty of Fisheries and Protection of Waters accessible and show our fellow citizens what normally goes on behind closed doors. Especially this month (but not limited to), we can explore what it is like to cycle to work or even on a trip instead of driving there. In autumn, we provide visitors with an insight into the life and work in the field of science during the Scientists' Night. ◀

Lunch Seminars

Those who would find the above-mentioned events "not scientific enough" could also attend a series of Lunch Seminars in 2022 and 2023. Our scientific colleagues from different parts of the world presented their topics – Hadi Alavi from the University of Tehran, Iran; Bryan W. Brooks from Baylor University, Texas, who is the current Editor-in-Chief of the journal "Environmental Science & Technology Letters"; Marc Verdegem from Wageningen University & Research, Netherlands; Mats Tysklind from the University in Umeå, Sweden; Geert Wiegertjese and Ian Mayer from the University of Life Sciences, Norway; Prof. Katsutoshi Arai from Hokkaido University, Japan; and Rafael Henrique Nóbrega from São Paulo State University, Brazil. ◀

European politicians and officials visited the South Bohemian Research Centre CENAKVA

In relation to the Czech Presidency of the European Union Council in 2022, two important events took place presenting the South Bohemian Research Centre CENAKVA to the representatives managing the affairs of European fisheries, science and research.

To start with, on Thursday, 1st September 2022, the Faculty of Fisheries and Protection of Waters welcomed 80 Directors-General and Attachés for fisheries from the EU member states. The meeting sought to make them aware that freshwater aquaculture, whether traditional or using modern technology, can play an important role in producing quality foodstuffs as well as in protecting the environment.

Ms Charlina Vitcheva, DG MARE Director, who is responsible for the European policy on maritime and fishery affairs within the European Commission, particularly appreciated the interconnection of aquaculture research with the protection of aquatic ecosystems and the relevance of our research for applied research and fisheries practice. She was pleasantly surprised by the high level of basic and applied research as well as the modern facilities of the CENAKVA research centre.

The meeting of the European delegation was also attended by representatives of the Ministry of Agriculture of the Czech Republic and the Director of the Regional Chamber of Agriculture South Bohemia Hana Štastná, who along with the Rector of the University of South Bohemia Bohumil Jiroušek greeted the delegation.

Then on Saturday, 10th September, the Faculty of Fisheries and Protection of Waters in Vodňany was visited by representatives of national ministries as well as science and research departments. The delegation of about forty officials received a warm welcome from the dean of the faculty, Pavel Kozák, and the director of the CENAKVA research centre, Vladimír Žlábek, who acquainted them with the research activities and objectives of the infrastructure in the form of video demonstrations and presentations. Afterwards, the group visited the Genetic Fisheries Centre, where among other things they could see live crayfish and sturgeon and try their hand at working in the Laboratory of Germ Cells.

The visit to CENAKVA made a good impression on the delegation. Head of the European Research Area Unit at the Ministry of Education, Youth and Sports, Lucie Núñez Tayupantu, also expressed her positive views on the South Bohemian research centre, praising its focus on acquiring large European grants and commitment to a multidisciplinary approach to aquaculture. ◀

03

CENAKVA and Research

Science and research

The Faculty of Fisheries and Protection of Waters conducts its science and research primarily through its research laboratories. These laboratories are part of four thematic research programmes under the South Bohemian Research Center of Aquaculture and Biodiversity of Hydrocenoses (CENAKVA). Since 2010, CENAKVA has been intrinsically linked to the faculty, following the establishment of a modern facility equipped with advanced technology that continues to be upgraded. CENAKVA has come a long way since then and currently includes a total of 12 faculty laboratories and service units, as well as selected services of the Institute of Hydrobiology, Czech Academy of Sciences, all contributing to the centre's four research programmes. At present, the centre operates on the principle of open infrastructure for experimental activities and is on the roadmap of large infrastructures of the Czech Republic. CENAKVA's primary mission remains to understand changes in freshwater ecosystems and their societal relevance, particularly concerning biodiversity conservation, protection of the aquatic environment and water resources vital for human life and activity.

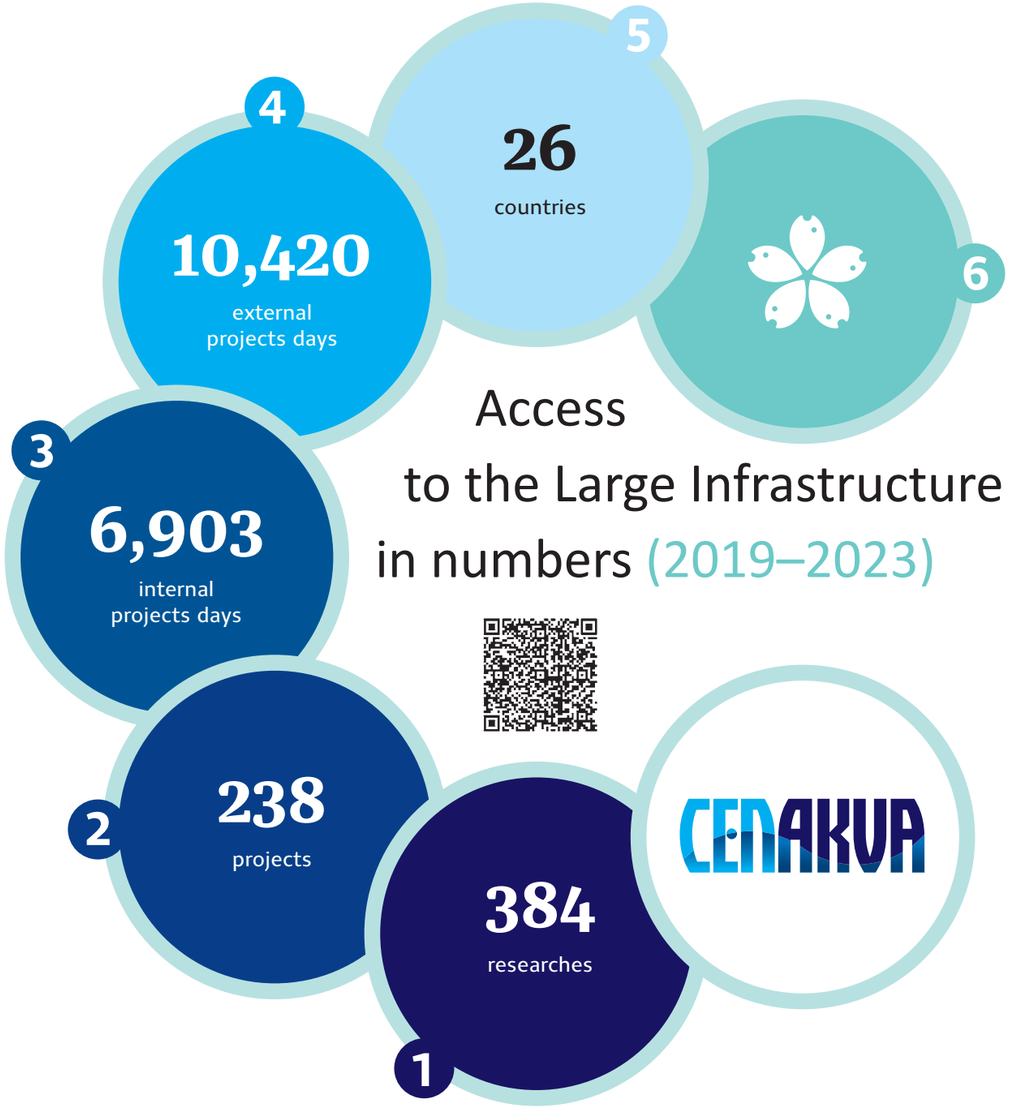
Shared services and data

The CENAKVA Large Research Infrastructure operates on the principle of open access for experimental activities. Researchers from around the world can utilize its unique experimental facilities, services, and expertise. Open access enables the conduct of experiments, and the application of the infrastructure's specialized knowledge. Access projects are evaluated in two stages, considering research quality, technical competence, and infrastructure availability. Successful projects are implemented with technical and scientific support from the infrastructure staff.

OPEN DATA

OPEN ACCESS

14 UNITS



Consortia and partnerships

International Centre for Advanced Studies on River-Sea Systems

elixir

PARC Partnership for the Assessment of Risks from Chemicals

CEITEC

MUNI | RECETOX

AQUA EXCEL 3.0

EUROPEAN OPEN SCIENCE CLOUD

BIOCEV

CzechGlobe

EMBRC EUROPEAN MARINE BIOLOGICAL RESOURCE CENTRE

LTER-CZ Czech Long-term Ecosystem Research Network

ESFRI European Partnerships

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

Jihočeská univerzita v Českých Budějovicích
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Reproductive and genetic procedures for fish biodiversity and aquaculture conservation

RP1

RP1 Reproductive and genetic procedures for fish biodiversity and aquaculture conservation

Head of the program: Assoc. Prof. Martin Pšenička, psenicka@frov.jcu.cz

The visions and goals of the research program

A biodiversity conservation and development of a competitive freshwater aquaculture. A multi-disciplinary approach on a reproductive physiology and technology, molecular, cellular, quantitative and conservation genetics of individual species or higher taxa.

Also the development of reproductive technologies and germline stem cells bioengineering. The main goal is to establish an internationally acknowledged gene bank and improve competitiveness of European aquaculture with a significant share of the Czech Republic.

The results we have achieved

To maintain the biodiversity of fish we have also contributed to the discovery of a unique way of sturgeon sperm maturation, which opened more possibilities for sperm preservation and reproduction. Our team described the unique process of sturgeon fertilization by multiple sperm at once, the so-called polyspermy. The researchers developed a method of cloning sturgeon based on nuclear transfer from the fin cell to the egg and monitored the unique development of the sturgeon's digestive tube.

By revealing specific features in the genome of beluga and sterlet, we created a simple method of identifying pure species and hybrids, which works reliably and to determine the species origin of caviar. The current living gene bank of sturgeon fish already includes 11 species – beluga, Siberian sturgeon, Russian sturgeon, ship sturgeon, stellate sturgeon, Adriatic sturgeon, shortnose sturgeon, white sturgeon, Atlantic sturgeon, and American paddlefish. Since the recognition of the Amur mirror carp at the end of 2014, the Genetic Fisheries Center has produced more than 100 million F1 hybrids with this breed for Czech and Polish fish farming. This is a good example of the immediate transfer of R & D results into practice.

Unravelling the evolutionary mysteries of unusual creatures

Jan Štundl's passion for evolutionary biology has driven him to study lampreys and sturgeon at a top World university (California Institute of Technology). His research focuses on the role of neural crest cells in the development and evolution of vertebrates. In addition to his work at Caltech, he is also working under the auspices of the Laboratory of Germ Cells, led by Martin Psenicka, at the Faculty of Fisheries and Protection of Waters.

The prehistoric Cambrian sea was dominated by predators similar to today's spiny lobsters. One of the most formidable sea predators of that era was ***Anomalocaris***, an invertebrate that could reach up to two metres in length. It featured a pair of long frontal appendages used for catching prey. ***Anomalocaris*** likely fed on the ancestors of modern vertebrates, thus our ancestors as well, which at that time resembled soft, vulnerable filter feeders like today's amphioxus.

"In some cases, evolution can be compared to an arms race, prompting our ancestors to evolved traits that improved their position in the food chain," explains Jan Štundl.

In 2019, he received the prestigious Marie Skłodowska-Curie grant to support his postdoctoral fellowship at the renowned California Institute of Technology (CalTech, 47 Nobel Prizes to date) in Pasadena, USA.

The thirty-six-year-old biologist is fascinated by the intricate story of vertebrate evolution. Coming from the Jindřichův Hradec area, he has gained experience not only at the Faculty of Science of Charles University and Uppsala University in Sweden but also at the Faculty of Fisheries and Protection of Waters, where he became acquainted with sturgeon. "Studying sturgeons and their embryonic development, along with studies of other fish species, has provided us with important comparative material to understand various aspects of neural crest cell biology and their significance in vertebrate evolution," he explains.

The neural crest is an important stem cell population unique to vertebrates. It develops during neurulation, the process by which the central nervous system forms the brain and spinal cord. These cells subsequently migrate throughout the entire body of the embryo and play a crucial role in forming many important vertebrate structures.

How does this relate to the prehistoric story of our sea ancestors? Neural crest cells are responsible for the formation of jaws bearing teeth, pigment cells, various neurons, as well as dentoskeletal elements such as shark scales or sturgeon scutes. This suggests that neural crest cells were also involved in formation of the primitive “armor” of vertebrate ancestors, composed of bone and dentine, a tissue that is a key component of our teeth. This evolutionary advancement provided our ancestors with

protection against predators. Additionally, the development of the jaw apparatus and sensory organs in the "new head" allowed vertebrates to access a broader range of food sources and become predators themselves. ◀

Jawless lampreys

Apart from sturgeon, the sea lamprey (***Petromyzon marinus***) holds a special place in his interests. This rather unpleasant-looking ectoparasite, along with hagfish, is a jawless vertebrate. "It's another peculiar creature with significant evolutionary importance. For example, its body contains an endostyle, a feature unique to Chordates. Notably, larval lampreys are the only vertebrates with this organ. The endostyle, located in the pharynx, secretes mucus that aids in the movement of food into the digestive tract. Through evolution, this larval organ transforms into the thyroid gland in other vertebrates, with neural crest cells also contributing to this process," he explains.

Nevertheless, Štundl's primary research interest in lampreys and sturgeons lies in their remarkable regenerative abilities, which also involves the neural crest. "When a lamprey spinal cord is injured, it can regenerate and regain movement within a few hours. We've been studying similar processes in the sturgeon heart. By injuring the lower part of the heart chamber in anaesthetized juvenile sturgeons, we observe how the organ heals over days and weeks," he explains.

What makes this research unique is that it is not like work with model organisms such as mice or the zebrafish. "This type of work is always more challenging because you need to create the appropriate laboratory conditions. For sturgeon, cooperation with Martin Psenicka's laboratory in Vodňany and the sturgeon hatchery is crucial," he explains, highlighting why part of his research is conducted at the Faculty of Fisheries and Protection of Waters. There, he works with sturgeon embryos, using various methods of modern developmental biology, including injecting fluorescent dye which allows observation of how neural crest cells migrate through the developing body to distant locations, like the regions where bony fish scales form.

All his research topics are connected by his desire to understand the role of neural crest cells in the development and regeneration of various tissues. There is no better place in the world for

this than in Prof. Marianne E. Bronner's laboratory. "Marianne is a leading figure in modern neural crest cell research. She was essential in helping me obtain the Marie Skłodowska-Curie grant, and shares my multidisciplinary perspective on evolutionary and developmental biology topics," he says.

In science, he dislikes narrow specialization and the inability to see the broader context. He highlights, for instance, the importance of the humanities in complementing natural science fields. Regarding the differences in the position of science and scientists in the USA and Czech Republic, he observes, "There is much more funding in the science system overseas due to numerous private sponsors, giving researchers more opportunities to realize their ideas. The primary purpose of basic research is not to chase various indices and scientific statistics at any cost but to bring your findings to the community's awareness and thereby expand existing knowledge," says Štundl.

For him, science is a mission, driven by hard work and passion. It is also a puzzle to solve--a quest for identifying surprising connections and the anticipation of chance discoveries that advance his understanding of the depths of time and the mysteries of evolution. ◀

Jan Štundl, Ph.D.
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Quick to live, soon to die: Research into the turquoise killifish helps understand how extreme conditions impact the life of organisms

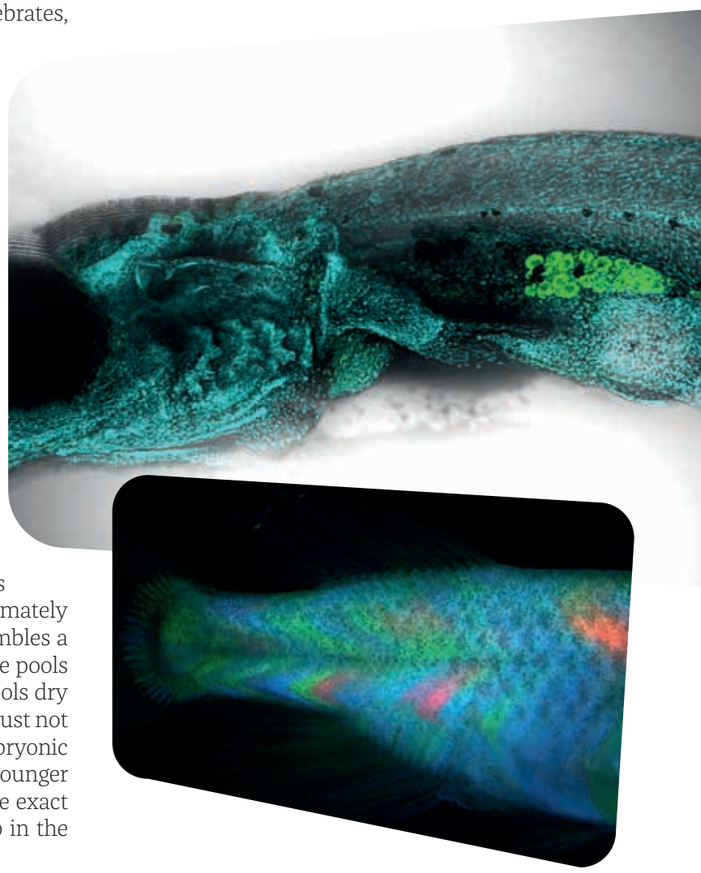
Roman Franěk from the Laboratory of Germ Cells has been researching a new model vertebrate species characterised by an extremely fast life cycle. He brought his interest in the colourful killifish from Vodňany to the prestigious Hebrew University of Jerusalem within his postdoctoral fellowship.

You have been engaged in studying killifish – fish with an extremely rapid life cycle. What makes these fish unique?

The turquoise killifish of the genus *Nothobranchius* is a freshwater fish belonging to the group of so-called annual killifish. They inhabit shallow, ephemeral pools in the African savannahs, surviving the dry season in the embryonic stage of development. Counting among the fastest maturing vertebrates, they only reach the age of three to four months. We had planned to study gametogenesis, i.e. the process of gamete formation, in connection with the turquoise killifish, and our collaboration with Prof. Martin Reichard from the Institute of Vertebrate Biology of the Czech Academy of Sciences in Brno brought us to these fish.

The title of the Czech Science Foundation project you are the principal investigator of starts with the sentence "Quick to mature, soon to die, but what about the germ cells?" What is the essence of your research?

Sexual differentiation in fish with a longer life cycle takes place after hatching from the egg. Taking in consideration that the turquoise killifish lives for such a short time, we wondered whether this development occurs earlier during embryogenesis, as the killifish reaches sexual maturity approximately two weeks after hatching. Its life cycle resembles a sprint, influenced by a short period when the pools it inhabits are filled with water. Since the pools dry up quickly in the local climate, the killifish must not waste time. We therefore investigated embryonic development progressing from older to younger developmental stages in order to identify the exact moment when the gonads begin to develop in the fish. This confirmed what we had assumed – that the process of sexual differentiation occurs already during embryonic development, i.e. earlier than in long-lived fish. It resembles the rapid rate at which the sexes differentiate in mammals. For instance, in mice it is as early as the third week after fertilization and in humans from approximately the beginning of the seventh week.



There are a lot of killifish. Some genera are not so short-lived. Is the development of their germ cells and gametes the same as that of the *Nothobranchius* genus killifish?

Admittedly, there are many species of killifish not only in Africa, but also in America and Sri Lanka. Besides the annual, short-lived species, we can also simplistically distinguish non-annual species, which are not restricted to ephemeral pools, having a longer lifespan. The semi-annual species constitute the transition phase. Our research also involves comparing different genera of killifish and finding out their similarities or differences. Owing to the wide diversity of killifish, we can characterize in detail to what extremes the inhospitable environment along with evolution can push fundamental processes preserved among vertebrates, such as gamete development.

The project also investigates the phenomenon of ageing. What did the research on killifish reveal to you?

The turquoise killifish is an ideal model organism for studying ageing. A laboratory mouse can live for two to three years, whereas the life span of the turquoise killifish is three to four months, which logically implies that we can reduce the research cycle ideally by up to ten times. It's a huge time saver. Our research focuses on the aging process of the gonads. We discovered that the killifish germ cell are functional essentially until they die, even when the phenotype of the fish is really affected by age.

So it can produce offspring even if it is "on its last legs". Is there a deeper correlation between the short life span of the fish and the rapid maturation of the gametes?

There are theories about a certain cost an organism must "pay" to become and remain fertile. One of my colleagues here at the Hebrew University carried out research with the *Caenorhabditis elegans*, a soil worm of the Nematoda phylum, and found that sterilized individuals live to a higher age. We did the same thing with killifish, though the result was different from the nematodes. Sterilization extended the life of males by almost 50 percent, whereas no effects were observed in females. This seems strange at first glance, as oocyte production is extremely energy intensive, so females should be the ones to save a lot of energy due to their sterility, yet this is not the case. On the other hand, the sterility of females resulted in improved regenerative abilities. When we removed a piece of their fins, they regenerated better than the non-sterile females. However, sterile killifish males did not experience any effect on regeneration, though they coped better with different types of stressful situations. This indicates a non-existence of a linear relationship between these processes, and if we remove the gonads, it does not necessarily result in an automatic improvement of the expected life functions. However, we are still investigating these relationships and processes within the project and have recently had an article on this topic published by the prestigious journal Nature Aging.

You brought this project with you from Vodňany to the Hebrew University of Jerusalem, where you are now on a two-year internship. Have you been involved in any other projects in Israel?

Yes, I have been engaged in research related to the hormones produced by the pituitary gland in the brain of humans and other vertebrates. Three of the most important hormones are involved in the regulation of growth, reproduction, and aging. However, studying the pituitary gland hormones in living animals is technically challenging and lengthy. My colleagues at the Hebrew University, whose project I joined, studied the functioning of these hormones in the turquoise killifish. The experiments revealed that mutant turquoise killifish lacking one of these three hormones involved in growth regulation, reproduction, and aging were actually smaller, reached adulthood later, and were completely infertile. We demonstrated that these three hormones play a similar role in fish as in other vertebrates. Certainly, these findings are not groundbreaking, but they do confirm that the functions of individual genes are very similar across organisms. What was unique about this study was that we developed a method to make a fish without the correct sequence for hormone production recreate the missing hormone by inserting a short DNA sequence into the dorsal muscle. Using this approach muscle cells were able to produce hormones which are naturally produced only in pituitary. In result, we were able to restart somatic growth and recover fertility to certain levels. Owing to the new experimental platform that the team subsequently created, the findings from this research could be of practical use in the future, e.g. for optimizing the way farmed fish grow and reproduce and for regulating hormone levels in human patients with hormonal imbalances.

Israel is considered a major technological and scientific power. What were the reasons for your decision to choose Hebrew University in particular?

After earning my Ph.D. degree in 2019, I knew I wanted to go abroad and find a top-quality institute that aligned with my research interests. Additionally, I wanted a location reasonably close to the Czech Republic, where my wife lives, and preferably somewhere with a mild climate, as I am not fond of cold places.

How does the level of research at the Hebrew University compare to that at the University of South Bohemia and other scientific institutions you have experienced?

Without diminishing the quality of the University of South Bohemia, which holds a respectable position within the Czech Republic, the Hebrew University is a globally prestigious research institution. In our department alone, nearly every group leader has published papers in top-tier journals such as Science, Nature, or Cell. Additionally, several researchers on our floor are leading prestigious ERC grants. Level of cooperation is very intense here with greater permeability between topics and laboratories, with a strong emphasis on interdisciplinarity. At this institute, everyone is engaged in genetics and developmental biology and it does not matter whether you use fish, mice, fruit fly or worm as your research model. Geneticists have everything they need at their fingertips, all under one roof. Need to sequence a DNA sample? Just go down one floor, and you'll have the results emailed to you by the next morning. Want to use a special microscope? Visit the lab dedicated solely to microscopy, where you can choose from a wide range of advanced equipment.

And what is campus life like?

The campus is situated in the government district of Givat Ram, offering scenic views of the Knesset and housing several ministries. It's fenced and guarded 24/7, with even taxi services restricted. Spanning a vast, picturesque park, the campus occasionally sees jackals and porcupines in the evening roaming the area alongside the students. Personally, I find myself rarely leaving the campus.

I assume it is also related to the security situation in Israel at the moment. How does it feel to suddenly find yourself in a state of war?

On the day of the brutal attack on 7th October, I was thankfully in the Czech Republic. Some discouraged me from returning to Israel, but I knew I couldn't abandon over a year of intensive work in the lab. Experiencing several rocket attacks here, where you have about a minute to reach shelter, is an unpleasant feeling. Almost all of my colleagues have family members in the army, currently engaged in Gaza and along the northern border, causing them understandable worry for their safety. However, Israelis have a different mentality from us; they're accustomed to such situations. When the conflict erupted, a significant number of Israelis immediately and voluntarily returned from abroad to enlist. What helps me cope is my workload. Immersed in research in the lab, I find myself consumed by my work, leaving little time to dwell on the war and its proximity. My goal is to complete my work here and return to Vodňany in the summer of 2024, where I hope to apply my experience from the Hebrew University to the fullest. ◀

Roman Franěk, Ph.D.
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Scientists innovated carp culture to take more effective advantage of selection programmes

In the Czech Republic, common carp typically farmed in ponds do not reach sexual maturity until around their fifth year, which is later than most other economically important animal and fish species. This late sexual maturation complicates the breeding process. The goal of a project funded by the National Agency for Agricultural Research and led by Assoc. Prof. Martin Kocour was to innovate carp culture to fully leverage the potential of selection programmes. In selective breeding, it is advantageous to have the shortest possible generation interval, as this accelerates the improvement of targeted traits in the desired direction. Therefore, a shorter generation interval enhances the efficiency of the selection programme.

In contrast to warm-blooded livestock species, the length of the generation interval in fish can be significantly influenced by environmental factors, particularly water temperature. In tropical regions, carp can reach sexual maturity as early as the end of their first year, demonstrating the impact of water temperature on maturation timing. Researchers from the Laboratory of Molecular, Cellular and Quantitative Genetics kept selected individuals until sexual maturity in controlled conditions of a recirculating aquaculture system at temperatures exceeding 20 °C. By modifying the selection programme, they managed to reduce the generation interval of the carp to three years.

The next phase of the project focused on comparing the production potential of selected fish in ponds, which are natural habitats highly influenced by external conditions. The genetically improved stocks, represented by a cross-bred with amur mirror carp, were compared with standard carp stocks. In cooperation with the Klatovy Fish Farm, it was demonstrated that the cross-bred stocks increased carp production by 30 to 50% per a unit of pond area. This increase was achieved without needing to replace the supplementary feeding of fish with cereals, which yields the best economic results.

The research also examined the extent to which increased carp production and type of supplementary feeding affect water quality in ponds. Based on measurements of chemical parameters in the inflows and outflows of the ponds, the researchers concluded that an increase in carp production per unit of pond area does not degrade water quality. Similarly, it was found that supplementary feeding of fish with cereals does not negatively affect water quality compared to pelleted feed KP1, provided that a relative feeding coefficient of 2.0 is maintained. The project results demonstrated that fish farmers can increase the carp production, and thus the profitability of their fish farms, through carp stocks coming from selective breeding programmes without affecting the water quality. ◀

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Intracytoplasmic sperm injection – a new method of assisted reproduction in sturgeon

Intracytoplasmic sperm injection (ICSI) is a widely used method of assisted reproduction in mammals. However, it is not well established in non-mammalian species. In fish, ICSI has been successfully optimized in only a few model species. This study marks the first use of ICSI in critically endangered sturgeon. We optimized various ICSI types using different sturgeon species, including beluga, sterlet, Siberian and Russian sturgeon. We then evaluated fertilization success and paternity of the resulting embryos and larvae. Using single, freshly collected, non-activated sperm, all combinations of crosses produced normal-shaped, food-accepting fish after ISCI. Molecular analysis confirmed the genome integration of both parents in most individuals. These results indicate that ICSI technology can be utilized as an assisted reproduction technology to preserve valuable paternal genomes in sturgeon. ◀

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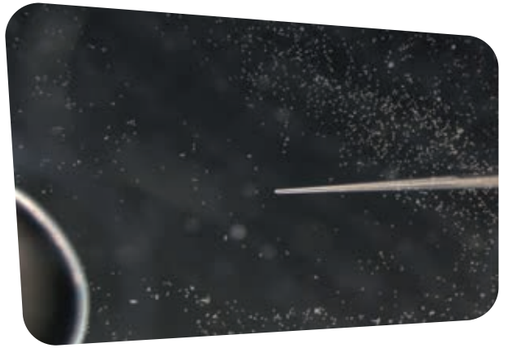
Fatira, E., Havelka, M., Saito, T., Landeira, J., Rodina, M., Gela, D., Pšenička, M., 2022. Intracytoplasmic sperm injection in sturgeon species: A promising reproductive technology of selected genitors. Frontiers in Veterinary Science 9:1054345. doi.org/10.3389/fvets.2022.1054345



Preserve and protect: The faculty cryobank has been in service for a quarter of a century

Cryopreservation is a method of long-term preservation of cells or whole tissues at very low temperatures, typically achieved using liquid nitrogen at -196 °C. Hence the term 'freezing' is sometimes used. The first successful cryopreservation of fish was conducted in 1953 by Mr. Blaxter, who preserved herring sperm. A cryobank is a facility where deep-frozen samples are stored in special containers, in liquid nitrogen or its vapour, until needed.

The Faculty of Fisheries and Protection of Waters also has its own cryobank, dedicated to preserving genetic material for fisheries research and breeding purposes.

"Our cryobank is divided into two parts. The first part contains batches of fish semen within the National Programme for the Conservation and Utilisation of Genetic Resources of Animals Important for Food and Agriculture, while the second part is operational, containing samples used for scientific experiments," says Marek Rodina, curator of the faculty cryobank.

The part focused on economically important species include the original Czech breeds of carp

(Třeboň scale carp, South Bohemian mirror carp, etc.), tench (of Vodňany, Tábor, Velké Meziříčí, etc.), rainbow, and brown trout. It also contains pure species of sterlet, beluga, maraena whitefish, and northern whitefish. This part of the cryobank is secured against unforeseen events, such as floods or fire, by the existence of a duplicate in the central genebank of the Czech-Moravian Breeders' Society at Hradišťku in Central Bohemia.

Freezing fish gametes and embryos still has its limitations. Unlike human or bovine cells, only sperm cells are suitable for this method in fish, while eggs and embryos have not yet been successfully frozen. "Fish eggs, for example, are so-called polylecithal, meaning they contain more yolk and are much larger than mammalian eggs. Cryoprotectants, substances used in the freezing process to protect the cells, do not penetrate the eggs very well," explains Marek Rodina.

Besides fish spermatozoa, the cryobank in Vodňany contains various cell lines for testing on cell cultures as well as germ cells, which serve the needs of scientists. The first samples that found their way into the faculty's Dewar vessels – special insulating containers with liquid nitrogen – date back to 1997. What Marek Rodina values most is the collection of sturgeon sperm samples, which the faculty frequently works with.

In addition to supporting breeding and scientific research, another reason for long-term sample storage is the protection of endangered species such as the crucian carp. This can help maintain the genetic variability of the species, although this method also has its pitfalls. "Each fish species has its own specific characteristics, along with a different amount of sperm and varying methods of spermatozoa activation. It is also important to have a sufficient number of samples from different males and to be cautious about mixing populations. That is why having a clear, precise description of each sample is crucial when organising a cryobank," explains the curator. ◀

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NeoGiANT

NeoGiANT is a project dedicated to developing innovative solutions based on the natural antimicrobial and antioxidant properties of pomace extracts. The project unites eight institutions from various parts of the world, including the Faculty of Fisheries and Protection of Waters USB, and is coordinated by the University of Santiago de Compostela in Spain. It is funded by the European Union's Horizon 2020 research and innovation programme.

Since the project's inception in October 2021, significant progress has been made towards reducing reliance on antibiotics in animal breeding. By utilizing polyphenols extracted from the biomass of white grape pomace at low cost, the project partners aim to produce high-value natural antimicrobial and antioxidant products. NeoGiANT's product range includes animal feed, treatment solutions, and semen storage solutions, addressing the demand for affordable natural functional products from alternative sources.

NeoGiANT's approach particularly emphasizes sustainability on multiple levels: environmental (utilizing agro-food by-products and green technologies), economic (low-cost and waste-free production processes), and social (supporting the development of local wine producers). ◀

Scientists to survey the genetic variability of the Bohemian Forest trout

Scientists from the Faculty of Fisheries and Protection of Waters joined a project to monitor the brown trout populations in the Bohemian Forest (Šumava) between 2023 and 2026. "The work of hydrobiologists, parasitologists and molecular geneticists will result in identifying various characteristics of these populations, such as the number and size of individuals, knowledge about the condition of the fish, and the occurrence of their parasites, especially myxozoa," says the project's principal investigator, Dr. Petr Blabolil from the Biology Centre, Czech Academy of Sciences (BC CAS). The international Interreg Bavaria-Czech Republic project, entitled "Living jewels under the water surface of Šumava", aims to shed light on the genetic variation of the Bohemian Forest trout and identify their native populations best adapted to local conditions. Researchers from the Laboratory of Molecular, Cellular and Quantitative Genetics at the Faculty of Fisheries and Protection of Waters are responsible for answering questions about the genetic structure of the populations.

"In total, the laboratory is going to process samples from one hundred and twenty sites on the Czech side and forty sites on the Bavarian side, which is a really high number," clarifies Prof. Martin Flajšhans, head of the laboratory in Vodňany. Numerous non-native trout populations have been introduced into the open waters of Bohemia and Moravia due to the transfer of fish and fertilised eggs between hatcheries in different catchments, along with the import of fish from abroad, and the transport and stocking of fish in non-native locations in different catchments. This has caused a significant reduction in interpopulation genetic variability. "The results of the project should also lead to some reconsiderations of fisheries management, with proper local populations being recommended for stocking into the waters of the Bohemian Forest," explains Prof. Flajšhans.

The project involves scientists from the Czech and Bavarian sides – besides representatives from the FFPW USB there are also scientists from the Faculty of Science, USB. The project management is carried out by experts from the Institutes of Hydrobiology and Parasitology, BC CAS. Additional partners include the Nationalpark Bayerischer Wald, the Bohemian Forest National Park, and Bezirk Niederbayern. This collaborative effort aims to establish a coordinated approach to the protection of the brown trout and the Bohemian Forest waters. Apart from continuous scientific work, it will feature a range of lectures and educational activities tailored for the wider community. ◀

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Bavorsko – Česko

Award for Martin Prchal

At the “Země Živitelka” trade fair, one of the traditional highlights was the presentation of awards for extraordinary research and experimental development achievements for the year 2023. Our colleague Martin Prchal, Ph.D., received an honourable mention for his peer-reviewed article, "Simplified Method for Genetic Slaughter Yields Improvement in Common Carp." The award was presented by the Minister of Agriculture, M.Sc. Marek Výborný, and the chairman of the Czech Academy of Agricultural Sciences, Jan Nedělník, Ph.D. The study focused on using ultrasound tomography in the selection program for common carp to enhance its slaughter yields. ◀

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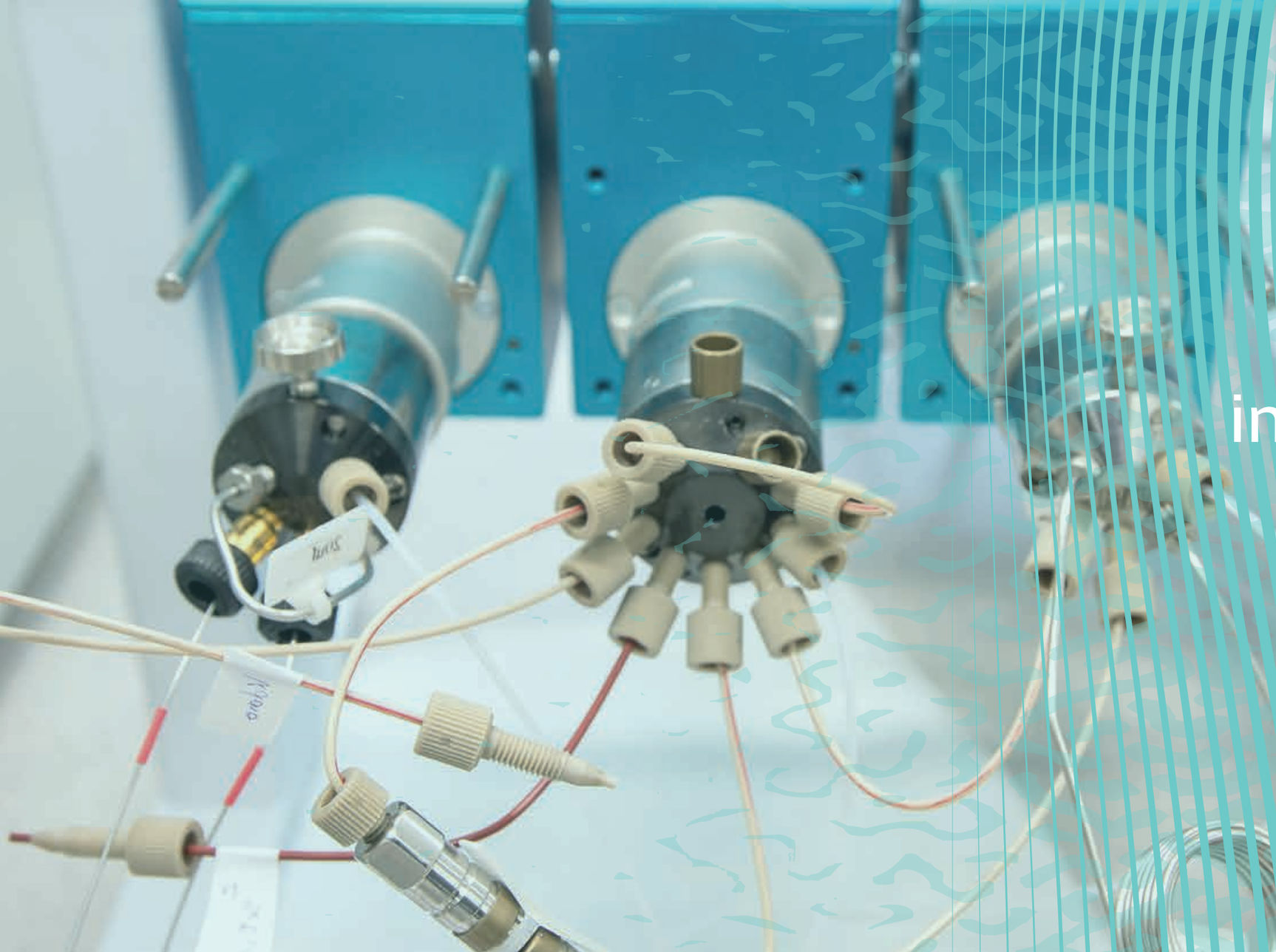
Our fishermen weighed the largest freshwater fish

In March 2023, after a period of three years, the staff of the Genetic Fisheries Centre, Research Institute of Fish Culture and Hydrobiology in Vodňany, harvested and subsequently weighed our largest individuals of the beluga broodstock (*Huso huso*).

Sturgeons are an ancient group within the Chondrostei superorder, having remained largely unchanged for over 200 million years. Their main and distinctive features include a unique body shape covered with rows of scutes, a snout, and a mouth located on the underside of the head. Unfortunately, wild populations of these majestic fish have been in significant decline worldwide for many decades. Consequently, one of the main focuses of our hatchery staff is to make every effort to preserve and protect the genetic resources of our native Chondrostean fish species.

Our gene pool collection of Acipenseriformes, currently encompassing an impressive eleven species, is unique and represents the most species-diverse sturgeon breeding in Central Europe. ◀



CENAKVA | South Bohemian Research Center of Aquaculture and Biodiversity of Hydrocenoses

"New" pollutants in the environment and their impact on freshwater ecosystems

RP2

RP2 "New" pollutants in the environment and their impact on freshwater ecosystems

Head of the program: Assoc. Prof. Hana Kocour Kroupová, kroupova@frov.jcu.cz

The visions and goals of the research program

The presence of pollutants in aquatic environments significantly affects the health of aquatic organisms, including their natural reproduction and behaviour. The array of chemicals produced and used by humans is continually expanding. Key sources of surface and groundwater contamination include industrial activities (e.g., bisphenols, UV filters, perfluorinated substances), agriculture (pesticides), and even "treated" municipal wastewater. Many substances or their degradation products cannot be fully removed by standard wastewater treatment technologies, leading to their persistent entry into surface waters with treated wastewater. These substances, often referred to as micropollutants of the aquatic environment, stem from the use of medicines, drugs, daily care products (such as cosmetics, cleaning products, and disinfectants), and many other items.

Increasing scientific evidence highlights the negative impact of micropollutants on both wildlife and humans. However, very little is currently known about the impacts of this type of contamination on entire ecosystems and trophic chains.

The aim of this programme is to conduct comprehensive research on the fate of these "new" pollutants in aquatic and soil ecosystems and to critically assess their impact on exposed organisms and their communities. This new and previously unavailable information is crucial for economically viable strategic planning in wastewater treatment, drinking water treatment, and landscape management.

The results we have achieved

The research team is actively and regularly involved in the implementation of the national surface water quality monitoring programme coordinated by the Czech Institute of Hydrometeorology. We also cooperate intensively with the state companies in charge of our river catchments, as well as companies operating wastewater treatment and drinking water treatment plants, focusing on micropollutant monitoring. In collaboration with our Norwegian (COWI) and Swedish (ExposMeter AB) partners, we have repeatedly succeeded in international tenders aimed at identifying new pollutants in various environmental matrices. Since 2013, we have also been involved in an international project aimed at detecting illegal drugs in wastewater entering treatment plants.

Additionally, members of our research team have achieved significant success in both basic and applied research projects.

Danube River monitoring revealed hazardous substances

In 2019, the largest ever monitoring of chemical pollution in the Danube River began, focusing on the analysis of 747 substances, identifying 21 as hazardous. The research findings were summarized in a 2023 paper by Pavel Šauer and collective, conducted by an international team of researchers from various institutions in the Czech Republic and Germany.

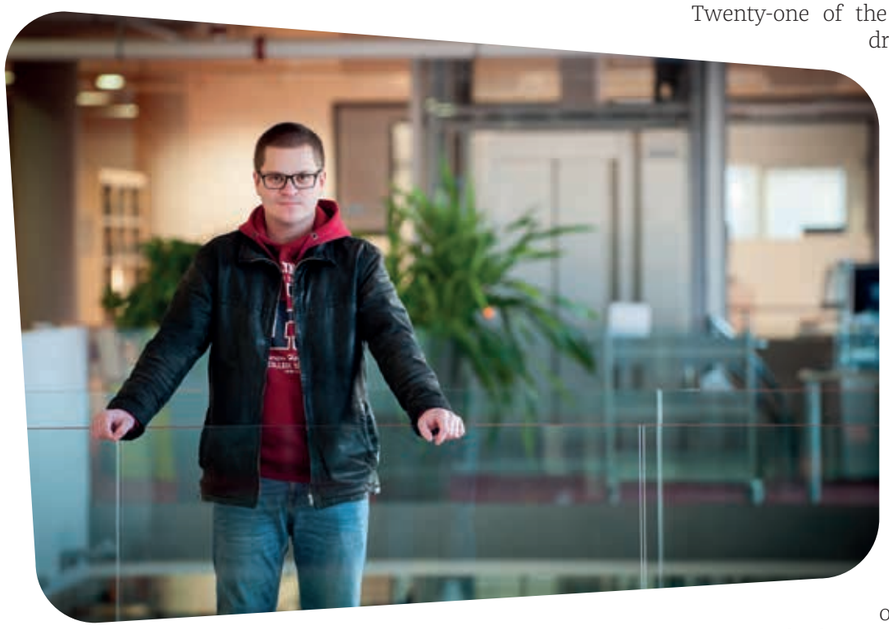
Why is it important to monitor the water quality of this nearly 3,000-kilometre-long river?

The Danube flows through ten European countries, including four capitals, serves as a source of drinking water for more than 20 million people, and its water quality is essential for many regional activities. However, the river also passes through large urban agglomerations and, due to intensive industrial and agricultural activities and wastewater discharges in its catchment area, it receives significant amounts of anthropogenic contaminants, both directly and indirectly.

The campaign entitled "Joint Danube Survey", in the framework of which you carried out the research, is the fourth in a row and takes place every six years. In what way was yours different?

Our survey was unparalleled in its innovative use of long-term passive sampling methods, as well as the duration of the sampling period, the volume of water sampled, and the number of substances monitored. While the previous campaign, which was the largest to date, monitored 270 compounds, our survey analysed 747 compounds. We used two types of passive samplers to detect both hydrophilic and hydrophobic substances. Additionally, the sampling process lasted 100 days, allowing us to detect even extremely low concentrations of pollutants in the water, as opposed to the previous research.

Alongside the conventional risk quotients, we used a completely new model to estimate risk, which considered the contribution of each substance to the overall toxicity of the mixture in the sample. Subsequently, seven different *in vitro* bioassays were carried out to assess the risk of the measured concentrations of biological effects caused by the different substances on the aquatic ecosystem.



What substances did you focus on?

We focused on a wide range of environmental pollutants, which we categorized into three main groups in the study: pharmaceuticals and personal care products, industrial substances, and pesticides. Within each of these groups, we defined a number of subgroups. Just to give you an idea, these included antibiotics, psychoactive substances, steroids, UV filters, sweeteners, repellents, dyes, perfluorinated substances, polychlorinated biphenyls, insecticides, fungicides, and many others.

And what were your conclusions?

Twenty-one of the more than four hundred substances detected in the Danube were found to exceed derived or established environmental quality standards. These substances had concentrations that surpassed the risk quotient, in some cases by more than ten times. They have various effects, with some acting on hormone receptors, others on the central nervous system, and others on the thyroid gland. Additionally, the bioassays revealed exceedances of environmental quality standards at some sites for two types of effects. To some extent, the substances causing these exceedances were identified and need to be monitored in the future. The information resulting from our research can serve as a basis for taking effective measures. The methodology of long-term passive sampling can be applied in future research, potentially leading to the introduction of new technologies for wastewater treatment or the reduction of substances and materials containing these pollutants.

At which locations did the sampling take place and how large a volume of water did you analyze?

Sampling took place at nine sites, mostly situated downstream of major cities such as Passau, Bratislava, Vienna, Budapest, and Belgrade. These locations span from Germany to the Danube's estuary at the Black Sea in Romania. The volume of water sampled by the passive samplers was substantial, indeed. For the samplers designed to collect hydrophobic substances, thousands of litres of water were sampled over the 100 days. For the hydrophilic samplers, we estimated that approximately 73 litres were sampled, which is significantly more than in previous studies.

To what extent does the type of pollution vary according to the locations where the research was carried out? Are there any socio-economic phenomena that can be inferred from this?

Admittedly, industrial substances dominate across all locations, but in Bulgaria and Romania, we observed higher pollution levels caused by intensive agriculture, particularly with an increased presence of herbicides in the pesticide group. This is understandable as the Danube flows through fertile lowlands in these regions. Conversely, in the upper and beginning of the middle Danube, we observed a higher concentration of biocides in the pesticide group. Near major cities, industrial pollution prevails, accompanied by high concentrations of various pharmaceuticals and personal care products. However, these patterns can vary, influenced by many factors, such as dilution rates.

Who did you collaborate with on the research?

Besides our faculty, colleagues from the RECETOX centre at Masaryk University in Brno played a vital role in the monitoring, as they conducted most of the fieldwork and assisted in testing a significant portion of the samples through chemical analysis and biological tests. Furthermore, we collaborated with German scientists from the Helmholtz Centre for Environmental Research (UFZ) in Leipzig. During the research, I completed a year-long internship there, conducting biological tests, while my colleagues performed another portion of the chemical analyses. As far as chemical risk assessment is concerned, we worked closely with a colleague from the German National Environment Agency (UBA) in Dessau-Roßlau. Additionally, another part of the chemical analysis was conducted at our faculty. It was a great honour to work alongside top experts in the field of environmental chemistry and toxicology.

Are the results of your research relevant for the next, upcoming campaign?

Absolutely, our goal was to develop a methodology that can be utilized in future campaigns and applied to other watercourses as well. This will enable us to compare how the water pollution situation in the Danube changes over time regarding the substances and effects monitored. ◀

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Do hormonally active substances present in water affect humans and fish similarly or differently?

In recent decades, new knowledge and evidence have been collected about the negative effects of some substances of anthropogenic origin that enter the environment. These are mainly hormonally active substances that can interfere with the endocrine system of wild animals and humans. These substances have come to be collectively referred to as endocrine disruptors.

In the aquatic environment, most attention has so far been paid to substances with estrogenic effects, which have been shown to be involved in the increased occurrence of hermaphrodite fish, or can even cause feminization of males. Relatively recently, it has been shown that some substances interact with progesterone receptors and can thus exhibit progestogenic or anti-progestogenic activity. Progesterone receptors mediate the action of natural progestins (gestagens) in the bodies of all vertebrates. Natural progestins, such as progesterone, play an essential role especially in reproduction, but they also have other physiological functions. If substances with progestogenic or anti-progestogenic activity enter the aquatic environment, it can be assumed that they will adversely affect the development or fertility of fish that live in the affected localities. Progestogenic and anti-progestogenic activities have already been detected in wastewater and surface water in Europe, including the Czech Republic. These activities have mainly been detected using ***in vitro*** bioassays with the human progesterone receptor. However, there are quite large differences between the structure of human and fish progesterone receptors. Therefore, we sought to determine to what extent data on progestogenic and anti-progestogenic activities, obtained using ***in vitro*** bioassays with the human progesterone receptor, are relevant to fish.

For these purposes, we took samples of wastewaters and receiving surface waters. In these samples, we then measured the (anti-)progestogenic activity in parallel using an ***in vitro*** bioassay with the human progesterone receptor and a bioassay with the zebrafish progesterone receptor (which is a model fish species). The analyses showed that the progesterone receptors of humans and zebrafish are activated or blocked differently by environmental samples. And it is a question whether the blocking or, on the contrary, the activation of the fish progesterone receptor is caused by other substances present in the waters than those to which the human progesterone receptor responds. In any case, our tests have shown that the results obtained using ***in vitro*** bioassays with the human progesterone receptor cannot be used to estimate the potential risk of the occurrence of (anti-)progestogenic activity in the aquatic environment for fish. ◀

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Kocour Kroupová, H., Grimaldi, M., Šauer, P., Bořík, A., Zálohová, K., Balaguer, P., 2023. Environmental water extracts differentially activate zebrafish and human nuclear progesterone receptors. Science of the Total Environment 859: 160232. doi.org/10.1016/j.scitotenv.2022.160232

From the war to a lab

A Ukrainian scientist, Alina Sadchenko, fled to the south of Bohemia to escape the war. After a harrowing journey, she landed at the Laboratory of Environmental Chemistry and Biochemistry, where she has been researching the fate of selected micropollutants in the soil.

That morning, they were awakened by muffled explosions, and when they looked out the window, they saw fires. It was 24th February 2022, and a war had just broken out in Ukraine. Quickly, they packed the essentials, grabbed their tomcat, and headed out of Kharkiv with the whole family. However, after a few hours spent in a traffic jam, they decided to return and spent a week sleeping in the cellar. Soon after, Alina Sadchenko made the decision to leave Ukraine with her mother and two young children. Their journey as war refugees eventually brought them to the south of the Czech Republic, where after some time Alina began working at the Faculty of Fisheries and Protection of Waters.

"When we set off by train and then by bus to the west, we didn't know where we would find a place to stay. However, during the journey, a friend who was pursuing her Ph.D. at the faculty called me with an advice to come to Vodňany," Alina recounts the dramatic circumstances of her escape. She found accommodation at the faculty, and after two months, the biophysics graduate secured a job as a laboratory technician in the Laboratory of Environmental Chemistry and Biochemistry. Subsequently, in her role as a researcher, she participated in a project to track the fate of selected micropollutants found in treated water and sludge from wastewater treatment plants in the soil. As part of the project, funded by the National Agency for Agricultural Research, the scientists assessed the fate of drugs present in wastewater in different types of soils. Some soils were enriched with sewage sludge, while others were irrigated with wastewater. The researchers also examined how these substances from the exposed soils were absorbed by the plants growing on them. Alina's responsibilities included extracting samples and analysing the pollutants and their metabolites.

"The beginnings were difficult, as I had to learn a lot of things. For instance, I didn't know how to use the machines I work with here," says Alina. "But mainly, I didn't speak Czech, I didn't ride a bike and I didn't drink beer," she adds with humour. However, despite these challenges, her background in studies in Kharkiv, a university town before the war, equipped her with a Ph.D. in natural sciences and a strong foundation in environmental issues. Currently, she is working on a subsequent project under the supervision of Assoc. Prof. Roman Grabic, which focuses on organic pollution of drinking and irrigation water sources. Additionally, she is interested in exploring the possibilities of improving wastewater treatment technologies.

The subject of pollution and water or soil contamination is also highly relevant in Ukraine. As a result of the war aggression, the environment is contaminated with mines and other military equipment. Furthermore, Alina mentions the blowing up of the Kachovka dam in the Kherson region and the subsequent ecological disaster caused by the flooding of approximately 600 square kilometres. "Due to the total destruction of frontline towns such as Mariinka, Avdiivka, Bakhmut, and others, as well as missile attacks, huge amounts of various chemicals, petroleum products, heavy metals and other substances related to the warfare are entering the environment across the country," Alina explains. Eastern Ukraine is a vast industrial area with metallurgy, engineering, and chemical industries, a significant part of which has been destroyed. "The Azovstal iron and steel works, coke-chemical plant in Avdiivka and many others are in ruins. From the very beginning of the war until now, warehouses with different types of chemicals, such as pharmaceuticals and pesticides, have been burning all over Ukraine, and this is compounded by the destruction of a large number of water treatment plants. All of this places a huge burden on the environment, which cannot currently be addressed due to safety concerns or these places are occupied, " Alina points out. Moreover, large areas of Ukraine remain mined, and demining efforts will take many decades. People cannot go there to bathe in rivers or the sea or to walk in the woods. There are cases where the Russians plant explosive devices in even the least expected objects, such as toys or packets of sweets.

Alina hopes for peace to prevail in Ukraine as soon as possible so that the country's reconstruction can begin. While she finds fulfilment in her work in the laboratory, she also grapples with the absence of her father and especially her husband, who had to remain in Ukraine. He worked there and assists the army as a volunteer. But now he is in the army and fighting for Ukraine. "We have seen each other once since the war, which was in the spring of 2023 when we visited Kharkiv. Otherwise, we communicate online," Alina explains.

She feels grateful to her colleagues at the Laboratory of Environmental Chemistry and Biochemistry and the need to repay them for their support with her work. Simultaneously, she strives to be a positive example for her children, who attend primary school and kindergarten in Vodňany. She has learnt to ride a bike and speaks fluent Czech, although she had to get used to some of the language's pitfalls. "For example, the phrase 'fresh bread' in Ukrainian means bread as hard as a stone. Or the word ‘smells’ in our language means the opposite," laughs Alina and concludes, "Anyway, working at the faculty and the support of my colleagues is one of the best things that happened to me during those difficult years. I would like to thank everyone: my colleagues from the faculty and the laboratory, the dean, and the director of the research institute, but also the Czech government and all the people who support us." ◀

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Bilateral meeting between Norway-Czech Republic

The Laboratory of Environmental Chemistry and Biochemistry (LECB) organized a bilateral meeting between Norwegian and Czech partners at the beginning of May 2022. Representatives of COWI AS and Aquateam COWI on the Norwegian side and the LECB staff together with partners in the field of water monitoring and treatment – Povodí Vltavy, State Enterprise; Povodí Labe, State Enterprise; CHMI; and ENVI-PUR Ltd. – attended the workshop on the Czech side The workshop dealt mainly with issues related to reducing the negative impact of human activities on water quality and the possibilities of mutual cooperation in monitoring and water treatment. During the workshop, participants presented several papers, followed by discussions on the topic. The workshop was dedicated to water monitoring and new micropollutants in the aquatic environment, soil, and sludge. Newly emerging micropollutants and ways to prioritize them were also discussed. ◀

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New devices from Nové Hrady

Outside the area of environmental pollutants, we are active in the field of microscopy and technology as well.

The faculty team from the Institue of Complex Systems (Kirill Lonhus, Dalibor Štys, Renata Štysová Rychtáriková, Maksim Karpov and Ivan Larin) used their unique knowledge in microscopy, physical chemistry, camera data processing, artificial intelligence and Bayesian statistics to design a solution and build s function samples of the different systems:

An intelligent microscopic inspection system for direct measurement of particles in industrial liquids for ASTOS Machinery a.s. Aš, or an intelligent real-time microscopic inspection system for OSRAM Česká republika s.r.o., production site Bruntál.

These and other results can be seen in person at the International Engineering Fair in Brno, which our scientists regularly attend and present their research. ◀

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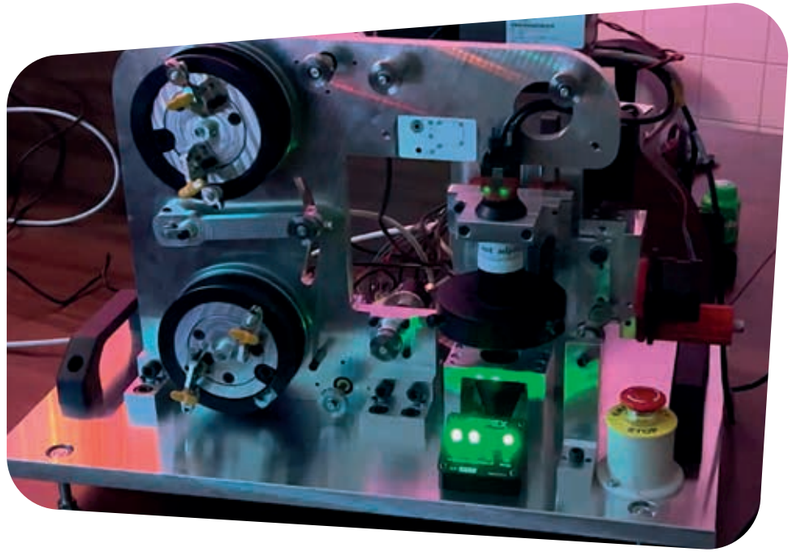

Award for Ganna Fedorova

On 15th March 2023, the meeting of the Scientific Board of the University of South Bohemia took place, where our colleague Ganna Fedorova, Ph.D., received the Award of the Rector of the University of South Bohemia in České Budějovice for the prestigious scientific publication of the year 2022. She earned the award for her publication titled "Water Reuse for Aquaculture: Comparative Removal Efficacy and Aquatic Hazard Reduction of Pharmaceuticals by a Pond Treatment System during a one Year Study" published in the prestigious Journal of Hazardous Materials. The publication explores the possibility of reusing wastewater in aquaculture. ◀

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Award for Prof. Zdeňka Svobodová

The traditional Natura Viva exhibition for hunters, fishermen, beekeepers, and gardeners opened on 25th May 2023 in Lysá nad Labem. During the opening ceremony, Prof. Zdeňka Svobodová was honoured for her lifelong contribution to Czech fisheries. The award was presented by Prof. Tomáš Randák, the director of the Research Institute of Fish Culture and Hydrobiology in Vodňany, where Prof. Svobodová was a key contributor for many years. ◀

CENAKVA | South Bohemian Research Center of Aquaculture and Biodiversity of Hydrocenoses

Sustainable aquaculture with a responsible water and nutrient management

RP3

RP3 Sustainable aquaculture with a responsible water and nutrient management

Head of the program: Assoc. Prof. Jan Mráz, jmraz@frov.jcu.cz

The visions and goals of the research program

The vision of the research programme is the aquaculture as the future solution for maximum production of quality foodstuffs for people with minimum consumption of water and energy, minimum production of waste matters, minimum 'food miles' and minimum competition for resources with consumption regarding people and farm animals. The next objective is that the aquaculture industry, which is dependent on the supply of fish from oceans and pollutes aquatic resources, would become an industry independent on sea fishery with a negative balance of waste production.

The objective is to develop technologies enabling the maximum use of nutrients, wastes, including municipal waste of vegetable and animal origin, and energy for production of fish and plants with minimum released waste products and greenhouse gases into the environment. The key outputs of the RP will be mutually connected technologies for the production of fish, plants and other organisms with treatment and use of waste therefore enabling maximum use of nutrients directly on an aquaculture or aquaponic farm with minimum released waste products into the environment. The target results are those having a significant impact for the entire society, mainly for ensuring enough high-quality foodstuffs, minimization of the production of greenhouse gases, use of waste, reduction in food miles and thus a decrease in fossil fuels, decrease in water consumption and production of waste, decrease in water eutrophication and reducing dependence of aquaculture on fishery.

The results we have achieved

The research team thanks to their applied research and broad national and international cooperation regularly contributes to technical and technological innovations and optimizations of intensive breeding of valuable fish species such as pikeperch (*Sander lucioperca*), perch (*Perca fluviatilis*), burbot (*Lota lota*) and other species. Recently, a special airlift system has been applied in fish culture practice to streamline water flow and sediment deposition in culture tanks. Furthermore, there was a description of the artificial induction of the production of triploid pikeperch and the optimization of the initial exogenous nutrition in pikeperch larvae using rotifers *Brachionus plicatilis*, that increases survival of reared fish by 30–40%. The research team was engaged in research of serious viral diseases of cyprinid species, which in recent years has contributed to increased carp mortality in ponds in spring and autumn. The team has developed a patented carp breeding technology with increased omega-3 fatty acids (Omega3carp) and tested its positive effects in the treatment of cardiovascular diseases. Omega3carp has been available for several years on the Christmas market. We are planning to build aquaponics research centres for the further development of sustainable aquaculture and other water and nutrient-efficient technologies.

Balanced carp nutrition tackles pond eutrophication

Meeting the nutritional requirements of fish while improving the ecological conditions in pond ecosystems – this is the essence of the concept of balanced fish nutrition, presented hereinafter by one of its authors, Lenka Kajgrová, a Ph.D. student from the Laboratory of Nutrition.

You have been involved in the feeding management of fish in fishponds. Along with your colleagues Jan Mráz, Koushik Roy, and limnologist Jaroslav Vrba, you have proposed a balanced feeding method that leads to a more efficient use of resources in the pond ecosystem. What does this entail?

At present, the European fishponds are under semi-intensive management. The production of fish, especially common carp, relies on natural food and supplementary feeding, with cereals being the most common. The foundations of this method were laid at the end of the 19th century by the hydrobiologist Josef Šusta. We are now revising this system and examining the issue from the perspective of the bioenergetic flows within the ponds. We strive to balance nutrition for fish so that during certain phases of the growing season, the fish receive precisely what they need for optimal growth without excessively burdening the water environment with unused nutrients.

So, what is (not) the ideal carp diet like?

Early in the growing season, carp predominantly consume natural food rich in protein and phosphorus. Conversely, carp lack energy and burn much of the ingested protein as an energy source, excreting excess nitrogen along with surplus phosphorus, contributing to eutrophication. In the latter half of the season, natural food sources typically diminish, and farmers supplement carp diet intensively, usually with cereals. Here, proteins tend to be deficient, while there's an excess of energy and phytate. Additionally, due to the reduced growth rate of the fish and indigestibility of phytate phosphorus, surplus phosphorus is excreted. Both scenarios indicate the need to balance optimal nutrient ratios for the fish in each phase of the growing season. This approach will support the development of natural food and enhance resource use efficiency while minimizing the discharge of other substances that degrade water quality.

However, such a state of imbalance is unlikely to last the whole season.

Roughly from the early to mid-summer, a period of sufficient natural food and concurrent supplemental feeding with cereals occurs. It's the phase when the diet is relatively balanced until strong fish grazing pressure depletes the large-filter feeding zooplankton from the ecosystem. This imbalance then resumes – unlike spring, there's an energy surplus, indigestible phosphorus, and insufficient essential amino acids that carp cannot synthesize.

Do fish contribute to poor water quality by excreting excessive amounts of phosphorus?

Our pond ecosystems were historically limited by phosphorus levels. Today, phosphorus levels in water are excessive, resulting in algal blooms and cyanobacteria overgrowth. Our research recently revealed limitation shifts from phosphorus to nitrogen during the growing season. The community present in the fishpond – from fish and zooplankton to microbes – depletes oxygen from the water, leading to oxygen deficits. At this point, microbes start denitrifying, removing nitrogen from the ecosystem while phosphorus remains, ideal for cyanobacterial growth.

Why? How are cyanobacteria better than algae?

Unlike algae, cyanobacteria can utilize atmospheric molecular nitrogen. They have enough phosphorus for growth and can obtain nitrogen on their own. Moreover, cyanobacteria are safe from zooplankton and herbivorous fish due to their indigestible coverings.

Not without reason are cyanobacteria the pioneers of life on Earth. But let's get back to fish nutrition. What changes should be made to improve the situation?

We hope that our concept of balanced fish nutrition in ponds will reduce the eutrophication potential of feeding practices. Fish need to be supplied with energy at the beginning of the growing season. We are trying to incorporate the principles of circularity, zero waste, and the promotion of local products into our concept. Old bakery products obtained from local supermarkets or waste from muesli production have proven to be ideal forms of feed rich in energy. The same principle can be applied at the end of the season when there's a shortage of protein in the form of zooplankton in the ecosystem. During our research, we tested locally produced peas, rapeseed, sunflower press cakes, and brewing by-products as protein sources. The right combination of all these elements ensures that the fish do not excrete substances that contribute to the deterioration of water quality.

Does this also have any effect on the quality of the fish meat?

Of course. Fish that rely heavily on cereals have fattier meat. The longer the fish is on a natural and balanced diet, the better the meat quality.

I sometimes come across the opinion that it is possible to improve water quality and biodiversity in ponds by reducing fish stocking. What is your perspective on this?

I believe that the widespread adoption of extensive fish farming may not be the optimal solution. While I agree that more emphasis needs to be placed on the importance of ecosystem services, this can be effectively achieved by diversifying the fish stock. Relying not only on carp but also utilizing a more diverse species composition of fish has potential. Invasive species can pose a considerable threat. If you reduce fish numbers in a pond, you risk that vacant niches may be occupied by invasive species such as the topmouth gudgeon. This visual predator of zooplankton can quickly disrupt the entire ecosystem and subsequently parasite directly on carp once it depletes its primary food source.

It's one thing to come up with an idea, but it's another to get the new idea off the ground. How is your innovative concept received by fishermen?

We have completed two years of experiments in Vodňany, so we are in the early stages of the result implementation. Currently, we are evaluating the project's outcomes and assessing the profitability of our concept and its impacts on the ecosystem. However, we do not keep to ourselves the idea of balanced fish nutrition in fishponds. We attend conferences and present our results both nationally and internationally. The response has been positive so far.

What do you think would facilitate better cooperation and more effective implementation of innovations in fishpond management?

This is a challenging question. I still observe significant gaps between key stakeholders – state institutions, fish farmers, and academia. Mutual communication often falters. It seems to be that even though many necessary changes are being talked about, the system is evolving at a slow pace. This slow progress can be attributed partly to the low demand and consumption of freshwater fish in the Czech Republic. Addressing such issues might require a strategic focus on marketing and branding – for instance, carp from cleaner, more sustainable production could be marketed as "bio-carp" or "organic carp". Adding an extra dimension to farming, associated with ecology, circularity, and support for local products, could make a difference.

Does your concept of balanced nutrition have a chance to break through?

Absolutely. In general, our collaboration primarily focuses on smaller-scale farmers who are more open and willing to adopt innovations. For instance, we have established close partnerships with the fish farm in Tábor. However, eventually, no one could resist change. It's important to realize that Josef Šusta developed his concept in nutrient-poor ponds. There were far fewer nutrients and pollutants in the landscape, and the agriculture sector was not nearly as intensive. Current ponds face many challanges. Our concept of balanced nutrition aims to address some of these issues. ◀

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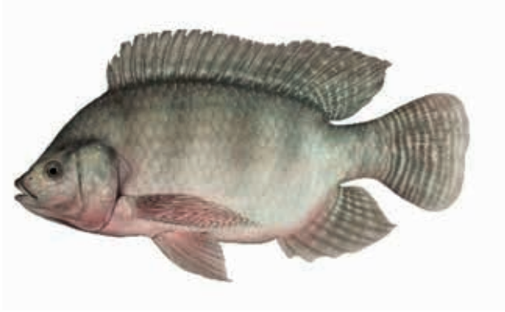
Recycle and re-use of nutrients

A tool for optimizing feed for aquaculture. It allows for achieving optimal recipes to meet the nutritional requirements of fish based on digestible nutrients, the lowest cost, and finding alternatives with the lowest production of waste materials. A double-edged sword that can be used to reduce pollution from fish farms or to reduce the need for fertilizers for plants in integrated systems. Members of the Laboratory of Nutrition have recently contributed to this field by compiling an inventory for circular nutrients management and promoting bioeconomy in future aquaponics.

For example, aquaponics is a hallmark of a circular food production model. Like agriculture or hydroponic, plant nutrient fertilization in aquaponics often relies on artificial fertilizers. These fertilizers have an environmental footprint and weaken aquaponics' circular, sustainable hallmark. To truly live up to its circular image, aquaponics must gradually decrease its dependency on supplemental inorganic plant fertilizers.

Based on the so-called TilaFeed-Model, feed for future aquaponics may be more precisely formulated with the principle that nutrients are not only a resource for fish, but excreted nutrients from fish (feed) also fertilize the microbes and plants. The inventory is expected to serve as a valuable tool to improve 'nutrient planning' in aquaponic systems, combining knowledge of ***in-vivo*** (fish) nutrient partitioning and ***in-vivo*** to ***in-situ*** nutrient flow (from feed to fish to microbes to plants in an aquaponic system). The inventory is freely available. ◀



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Roy, K., Kajgrová, L., Mráz, J., 2022. TILAFeed: A bio-based inventory for circular nutrients management and achieving bioeconomy in future aquaponics. New Biotechnology 70: 9–18. doi.org/10.1016/j.nbt.2022.04.002

Aquaponics has helped develop sustainable approaches to pest and disease management in plants

Aquaculture has been identified as the fastest-growing food production sector globally, with further growth expected. However, this optimistic outlook applies mainly to global aquaculture, while the EU sector is stagnating despite repeated interventions. The growth of EU aquaculture is hindered by the lack of suitable sites, limited water availability, and, finally, strict environmental regulations and bureaucracy. Therefore, innovative food systems, improving resource efficiency and minimizing the ecological footprint through a circular bioeconomy approach have been implemented in recent decades. A typical example of circular food production is aquaponics, which combines intensive aquaculture and hydroponic plant production, where waste from fish farming serves as a nutrient source for plants. Integral to aquaponic systems is a native microbial consortium transforming nutrients to make them available to plants. This microbial consortium is susceptible to changes in water quality and the presence of pollutants, such as pesticides applied to protect plants from pests and diseases. Therefore, pest and disease management in aquaponics requires specific approaches based on so-called integrated pest management (IPM). IPM combines a variety of disease and pest control methods that aim to minimize pest activities below the point where they cause economic damage. These methods include preventive measures, selection of suitable crops and cultivars, biological control, mechanical interventions, physical barriers, and limited use of chemical methods. The selection and combination of these control methods depends on several factors, such as the pest or disease species, the infestation's severity, and the economic threshold.

To correctly implement IPM in aquaponics, it is necessary, among other things, to understand the systems' design and complexity. There are two basic types of aquaponic systems. In single-loop aqua-

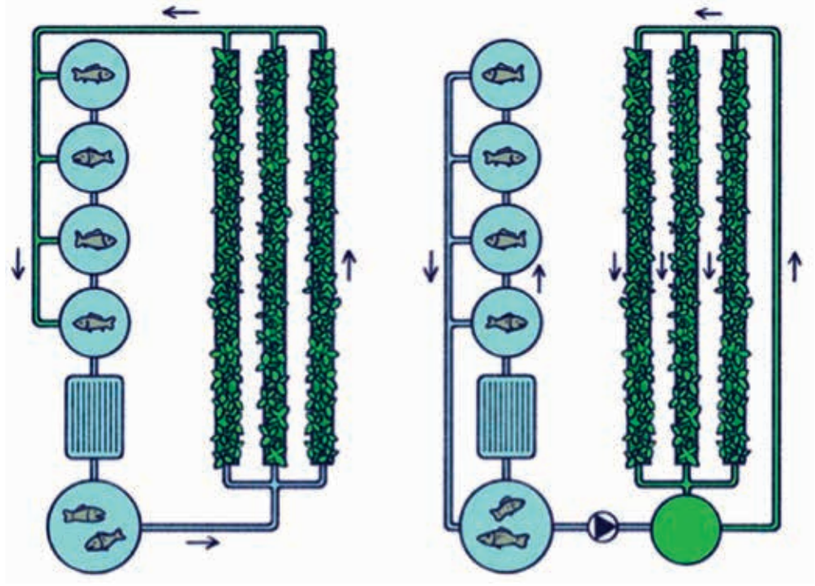
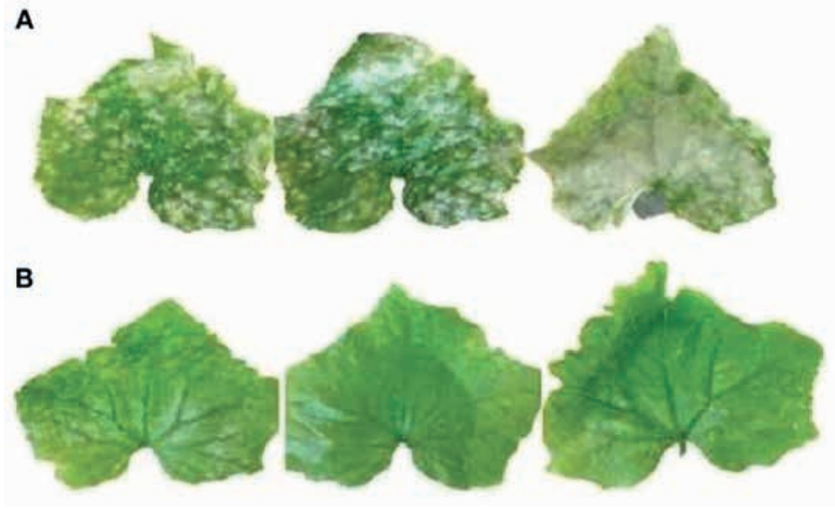


Diagram of a single-loop (left) and two-loop (right) aquaponic system.



Biocontrol effectivity against powdery mildew: (A) leaves treated with the control solution, and (B) leaves treated with ***L. attenuatum*** *after 20 days.*

ponic systems, purified water is returned to the fish tank. In two or more loop systems, the aquaculture and hydroponic units are decoupled so that water with nutrients is dosed to the hydroponic unit through a one-way valve according to the needs of the plants. If set up correctly, the plants use all the water. The two-loop design has several advantages, including increasing the system's production intensity by allowing optimal conditions to be maintained separately for fish, bacteria, and plants, and the ability to apply pesticides that would disrupt the microbial consortium in a single-loop system.

Scientists led by Assoc. Prof. Jan Mráz meta-analyzed published data and confirmed that prophylactic measures, proper hygiene practices, physical barriers, and environmental conditions (e.g. manipulation of temperature or relative air humidity) do not negatively affect aquaponic systems and can thus be a safe part of IPM. Conversely, chemical methods are very complicated for both system designs. Furthermore, the authors emphasized that insecticides and herbicides are fully replaceable by appropriately selected and timely applied commercial biological control and prophylactic measures. However, fungicides and nematicides are still relevant in aquaponics due to the low efficiency of alternative IPM methods. Based on these findings, scientists decided to research powdery mildew of cucumbers (***Podosphaera xanthii***), a global disease that causes significant economic losses in fields and greenhouses. Thus, researchers focused on finding biocontrol agents against cucumber powdery mildew and found that entomopathogenic and mycoparasitic fungi showed remarkable results in controlling and suppressing the diseases. Air drift or runoff of biocontrol isolates into the aquaponic system during foliar application is irrelevant, as their survival in aquaponic water is negligible. In the latest study, scientists demonstrated effective control of cucumber powdery mildew using ozone nanobubbles. This method has several advantages over conventionally applied ozone, including longer stability, contact time, and economic savings. Colleagues from the Faculty of Fisheries and Protection of Waters have thus developed several methods to effectively fight against powdery mildew of cucumbers in greenhouse conditions, which can be implemented in commercial systems and should thus reduce the consumption of fungicides. ◀

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Folorunso, E.A., Gebauer, R., Bohatá, A., Velíšek, J., Třešňáková, N., Dvořák, P., Tomčala., A., Kuebutornye, F.K.A, Mráz, J., 2024. Runoff of foliar-applied natural fungicides in aquaponics: Implications for fish and nitrification. Environmental Toxicology and Pharmacology 105: 104341. doi.org/10.1016/j.etap.2023.104341

Super-sustainable aquaponics: Nutrient manipulation using circular fish diets

Members of the Laboratory of Nutrition, together with German colleagues from the Leibniz-IGB, recently contributed to the development of the super-sustainable aquaponics by compiling three fish diets in which they replaced expensive and unsustainable fish protein with circular alternatives, including insect meal, feather meal and blood meal. Besides being circular, these meals have a markedly different nutrient composition compared to fish meal and can thus provide the missing nutrients for plants in aquaponics. This has also been demo-started experimentally, where effluent from fed fish (African catfish and herbivorous piranha) showed a better nutrient profile for plants, while fish growth was not affected. Based on this pilot experiment, the researchers will continue to develop aquaponic diets for fish further. ◀

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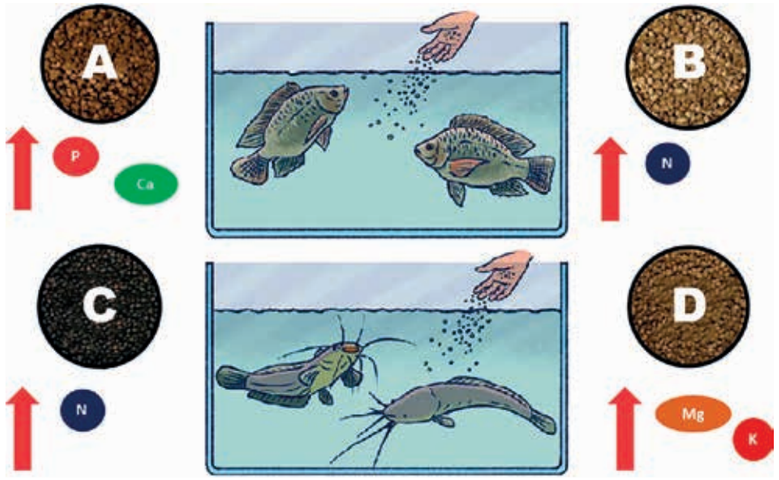

A: Fish meal FM
B: Hydrolyzed feather meal HFM
C: Poultry blood meal PBM
D: Black soldier fly meal BSFM

Gebauer, R., Brügmann, A., Folorunso, E.A., Goldhammer, T., Gebauer, T., Schöning, V., Bittmann, S., Knopf, K., Mráz, J., Kloas, W., 2023. Species-and diet-specific aquaculture wastewater nutrient profile: Implications for aquaponics and development of sustainable aquaponics diet. Aquaculture 568: 739307. doi.org/10.1016/j.aquaculture.2023.739307.

The sun is helping out

The first photovoltaic system was installed by the Faculty of Fisheries and Protection of Waters for its aquaponic hall in České Budějovice back in 2018. Since then, we have been working to install photovoltaic systems in other suitable locations. Collectively, these PV systems have generated approximately 98 MW of electricity. At the current electricity price of CZK 4.08 per kWh, this translates to a saving of about CZK 400 thousand per year. ◀

Bold-shy perch: The link between boldness, stress tolerance and immunity

The Eurasian perch is considered a suitable candidate for the diversification of European intensive aquaculture. Its high market value, combined with increasing consumer demand, makes this species commercially important in European countries, where over 900 tons are produced annually. Nowadays, Eurasian perch production relies heavily on intensive farming systems, i.e. recirculating aquaculture systems. Although rearing in these systems allows the improvement of desirable traits, such as higher growth rate, greater survival, and adequate swim bladder inflation, the production of Eurasian perch still fails to meet market demands. One bottleneck is its high sensitivity to distress conditions in captivity, which reduces immune resistance while increasing sensitivity to pathogens. It has been hypothesised that sensitivity to stress, and its impact on immunity, is related to fish personality. Therefore, selecting individuals with more profitable personalities for future selective breeding programs could help overcome these bottlenecks.

To test this hypothesis, members of the Laboratory of Controlled Reproduction and Intensive Fish Culture, along with German colleagues from the Research Institute for Farm Animal Biology, utilized Eurasian perch in a series of tests (open-field and novel-object test) to identify particularly shy and bold personalities based on video analyses. A cohort of shy and bold perch were exposed to stocking density stress and stimulation with *Aeromonas* sp. Using a panel of classical molecular and transcriptional analyses, it was then determined whether personality correlates with resistance to stress and pathogens. The project's outcomes might constitute a beneficial cohort of Eurasian perch well-suited for selective breeding programs, ultimately counteracting the production losses in current perch farming. ◀

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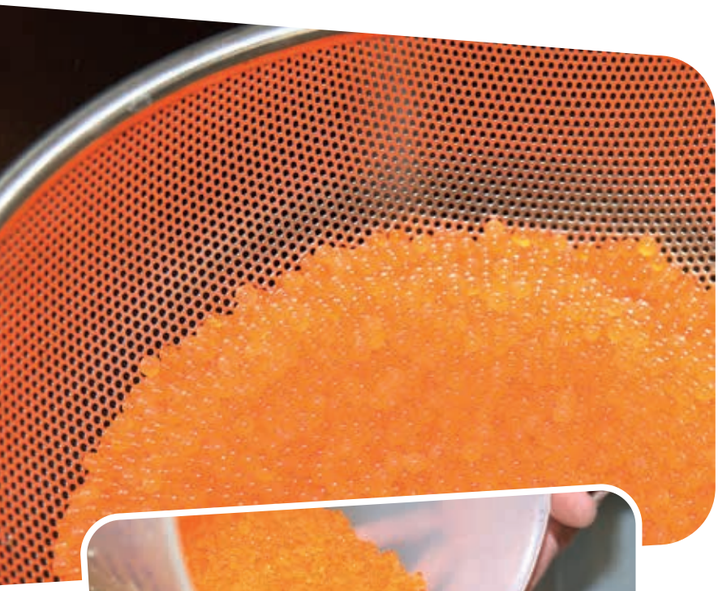
Processing technology for salmonid eggs



Members of the Processing Unit and Shop with Fish and Aquaculture Products have successfully tested and put into practice a modified technology for the production of salmonid caviar. This technology is notable mainly for the absence of preservatives, except for table salt, which is present at around 4% in the final product. As a result, it falls into the category of 'malossol' caviar. The minimum shelf life is stated as 6 months at 4 °C. The main advantage of this technology is the elimination of preservatives such as the frequently used sorbic acid (E200) and sodium tetraborate (E285, Borax). Thanks to the new process, consumers can enjoy the real taste of caviar without any aftertaste. ◀

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Jana Anna Kateřina Zátková Award for the popularization of science

On Tuesday, 3rd October 2023, the ceremonial opening of the new academic year took place at the University of South Bohemia in České Budějovice. On this occasion, Prof. Bohumil Jiroušek, the Rector of the University of South Bohemia, handed over awards for excellent pedagogical results and popularization of science for the first time. Assoc. Prof. Jan Mráz received the Jana Anna Kateřina Zátková Award on behalf the aquaponic team from the Laboratory of Nutrition for their efforts in popularizing science. ◀

CENAKVA | South Bohemian Research Center of Aquaculture and Biodiversity of Hydrocenoses

Freshwater ecosystems in the era of global change

RP4

RP4 Freshwater ecosystems in the era of global change

Head of the program: Assoc. Prof. Miloš Buřič, buric@frov.jcu.cz

The visions and goals of the research program

Freshwaters are an essential source of water for drinking water treatment, industry, agriculture, aquaculture, as well as having important ecological and socio-economic significance. Environmental changes are substantially affecting this resource, which results in cascading effects in the functioning of freshwater ecosystems, and furthermore, they have a negative impact on both the water use and the quality of human life. Therefore, society needs information on the state and future of aquatic ecosystems, their protection, and the possibilities of their sustainable use.

Hence, the key objectives include understanding current and predicted processes affecting freshwater ecosystems and assessing their ecological and socio-economic importance. Our aims are to develop and apply biomonitoring methods to assess water quality and test appropriate model organisms, to use physiological, developmental, ecological and behavioural responses of aquatic organisms for experimental studies (from species to communities). Consequently we offer results of our research for application in water management, food science, aquaculture and in the protection of the aquatic environment.

The main areas of basic and applied research include biological invasions and freshwater biodiversity, the monitoring and evaluation of environmental changes in freshwater, and the development and use of new technologies in aquaculture and water quality monitoring.

The results we have achieved

The results of the team are related to the basic biology of studied animals, their physiology, behavioural responses of each species and species interactions, as well as more complex ecological relations between predators and prey, or the position of key stone species in food chains.

We found that invasive species of crayfish and other organisms are able to adapt to adverse environmental conditions such as droughts and extreme temperatures, which is crucial in view of recent major changes in the aquatic environment such as climate change and anthropogenic environmental damage.

These features are often coupled with high reproductive potential and varied pathways of spread. Achieved results create space for further applications of biomonitoring systems using fish, crayfish and other organisms as biosensors. For early detection of contamination or disease, we use motion detection, behavioural and cardiac activity analysis. Some of the systems are already commercially exploited and we plan their extension among users in water supply, food and aquaculture industries.

Hydrothermal spring waters: A haven for unwanted aquarium organisms

Hungary's hydrothermal spring waters provide an ideal environment for the survival of thermophilic non-native species from around the world. A research team from the Laboratory of Freshwater Ecosystems, including Assoc. Prof. Martin Bláha, has been monitoring the local waters for several years in collaboration with Hungarian colleagues. In addition to finding exotic fish and shrimp species, they have also discovered previously undescribed species of crayfish from New Guinea in these thermal sites.

What species of crayfish have you encountered during your several years of monitoring?

We have focused on sites around major cities such as Budapest and Miskolc. Regarding crayfish, we identified over ten introduced non-native species. In addition to the red swamp crayfish and marbled crayfish, which are North American invasive species in Europe, and the Australasian red claw crayfish (genus *Cherax*), native to Australia and New Guinea, we surprisingly discovered several other exotic species of the genus *Cherax*. These crayfish are native to the island of New Guinea. Specifically, we found *Cherax boesemani*, *C. snowden* and four species not yet scientifically described.

What other non-native organisms did you find at the sites?

In addition to the introduced crayfish species, the hydrothermal springs are a hotspot for other non-native organisms. We found a remarkably diverse mix, making it feel as though we were in the tropics rather than Europe. Among the notable discoveries were freshwater shrimp, including a large population of *Neocaridina denticulata*, commonly found in aquarium shops. Additionally, we identified four other shrimp species, three of which were recorded in the wild in Europe for the first time. Fish were another abundant group, particularly

in the thermal lake Hévíz. With lake temperatures reaching 33 to 36 degrees Celsius, the temperature gradient in the outflows creates ideal survival conditions for various species. We commonly found cichlids, *Amatitlania*, guppies, and *Poecilia* thriving in these conditions.

Who places these non-native species in the lake and for what reasons?

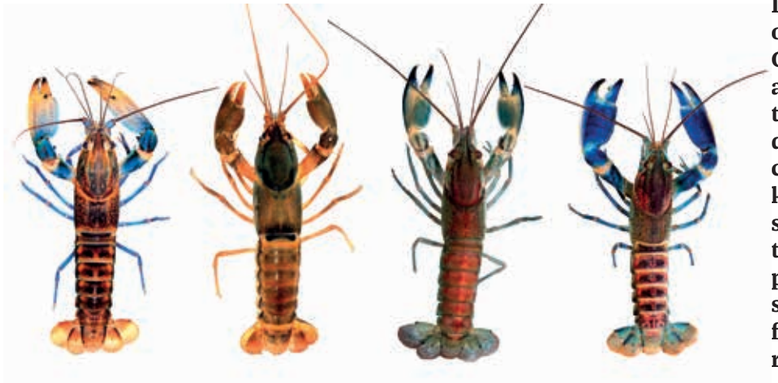
Mostly, it is amateur aquarists who introduce these non-native species into the lake. They may do so when they become overwhelmed by their pets or fear penalties associated with possessing undesirable species listed by the EU. These species originate from the developed aquarium and terrarium animal trade, and their introduction is often due to irresponsible behaviour by aquarists. At the same time, hydrothermal springs serve as attractive locations for breeders because they act as natural, cost-effective incubators. Breeders introduce non-native species into these springs, where the species multiply. Subsequently, aquarists capture and sell them.

You have described several species previously unknown to science. How is it possible that researchers are often unaware of species that are readily available for purchase by the general public?

Indonesia, particularly New Guinea, is a hotspot for the diversity of crayfish in the genus *Cherax*. These crayfish are characterized by their vibrant colours, making them highly attractive for aquarium keeping. While capture for aquarium purposes is mostly legal, and importers possess all required certificates, the high morphological variability of local crayfish leads to some previously undescribed species being mislabelled as known species. Consequently, there is a risk that endangered and rare species may inadvertently become the subject of export. One of the aims of our research is to prevent such confusion.

Have aquarium crustacean distributors been supportive of your endeavours?

Yes, we have established collaborations with them. In instances where we encounter a crayfish in their database that we suspect to be a previously undescribed species, we either purchase it from them or they reach out to us directly to facilitate species identification.



In 2017, you embarked on an expedition to New Guinea, during which you and your colleague Jiří Patoka made a significant discovery – the Yumugima crayfish, marking the first known cave crayfish in the southern hemisphere. With these crayfish species now present in Hungary, is it still worthwhile to conduct further expeditions to such remote locales?

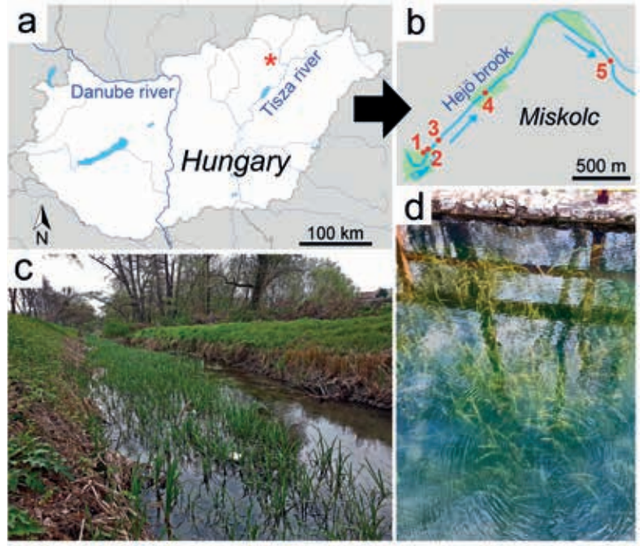
To a certain extent, yes (laughs). In terms of monitoring species diversity in Indonesia, the necessity to explore exotic locales may have diminished, given that exotic species have found their way to Europe independently. However, it's important to note that only species from the accessible regions of New Guinea, typically frequented by hunters, have been discovered thus far. What lies concealed in the less accessible parts of this intriguing island remains ripe for exploration and discovery.

Are similarly exotic species also found in the Czech Republic?

Thus far, their presence has been confined to aquarium shops. Fortunately, the Czech Republic lacks natural hydrothermal springs in abundance. However, in addition to invasive North American species such as the signal crayfish and the spiny-cheek crayfish, we also find the more thermophilic marbled crayfish. Particularly in select locations in Prague, where the likelihood of someone releasing an unwanted pet is higher, these crayfish capitalize on the warmer urban climate. Climate change has generally facilitated the survival rate of these species. Until recently, it was unexpected for them to survive the winter season in our country. Unlike Indonesian and Australian species of the genus *Cherax*, the marbled crayfish, native to southern North America, serves as a carrier of the crayfish plague.

It can be anticipated that with rising temperatures, the risk of invasive species being introduced into Europe will escalate. How can this problem be addressed?

Besides European legislation, which relies on a list of invasive species and takes appropriate steps, proactive measures primarily involve awareness campaigns. This includes educating not only breeders and resellers of exotic species but the general public as well. Once a potentially invasive species gains entry into the wild and establishes new populations, it becomes exceedingly challenging to eradicate. In many cases, eradication efforts are futile. Thus, prevention through education remains the most effective approach. ◀



Map showing the locality in Miskolctapolca (a suburb of Miskolc, Hungary) indicated by a red asterisk (a); positions of the five sampling points indicated by red dots and numbers (b); Hejő brook (c); thermal Békás pond, well-vegetated with non-native ornamental plants e.g. ***Vallisneria*** *sp. (d).*

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Invasive species cost us thousands of millions of dollars

Invasive reptiles and amphibians globally incur substantial economic costs that can be approximated, as outlined and published in a study led by Ismael Soto Almena and his team from the Faculty of Fisheries and Protection of Waters.

Its mating calls are so loud that it deters potential homebuyers in the Hawaiian Islands, adversely affecting property values. The common coquí is an invasive species that causes great economic damage. The global economic impact of these occurrences, alongside those of other reptiles and amphibians, has been systematically analysed in a study first-authored by Ismael Soto Almena of the Faculty of Fisheries and Protection of Waters. The 27-year-old Ph.D. student from Spain and his colleagues focused on the period spanning 1986 to 2020, arriving at a figure of 17 thousand million US dollars. "Beyond the quantifiable economic losses, the detrimental effects on biodiversity and human health are equally significant, often presenting immeasurable challenges," says Soto.

The example of the common coquí, whose male can croak at up to a hundred decibels, illustrates one of the rather unique challenges posed by invasive species. More commonly, however, the economic costs involve the expenditure by government agencies and local institutions to eradicate these species from the environment, as well as losses due to crop destruction. Additionally, non-native species often transmit parasites or contagious diseases that pose risks not only to native wildlife but also to livestock and humans.

The species causing the most financial damage is the non-venomous brown tree snake. Native to Australia and Indonesia, it has spread to several Pacific islands, including Guam, likely arriving on an American warship, where it has caused the most damage. "Lacking natural predators in this new environment, the brown tree snake's population grew exponentially, leading to the decimation of local bird, lizard, and other vertebrate populations," Soto explains. "In addition to frequent bites, residents of Guam face daily power outages as these snakes climb high-voltage power poles or enter transformers, causing short circuits," he says.

Marking its territory by bellowing

In terms of financial cost, the American bullfrog ranks second. It is invasive in large areas of North and South America, China, and southern and western Europe, causing approximately $6 thousand million in damage. Growing up to 25 centimetres long, it was named for the bellowing call males use to mark their territory. The remaining nineteen invasive reptile and amphibian species, for which some economic damage has been reported, collectively account for less than $600 million in costs.

"But it is certain that the $17 thousand million represents only the tip of the iceberg," Soto points out. For their study, the researchers sourced their data exclusively from the international InvaCost database, which constitutes the most comprehensive platform to date for information on the economic costs of invasive plant and animal species. However, our knowledge in this area remains incomplete. "This is indicated by the fact that up to 94 percent of non-native invasive species surprisingly showed recorded economic damage. Geographically, there have been no reports of economic damage caused by amphibians from the African continent to date," he says. This absence of data does not imply that invasive amphibian species are absent in Africa; rather, it indicates a lack of relevant information about them.

The primary objective of the study was not merely to quantify the damage caused by invasive species but to raise awareness among the general public and policymakers. "Non-native species present a significant ecological problem, yet the issue does not receive adequate attention. Reporting that an invasive species has displaced a native frog or bird often fails to elicit a strong response. Howev-

er, highlighting the economic cost associated with these invasions tends to capture more interest," Soto explains.

Awareness and prevention are by far the most cost-effective methods. Developing national lists of imported and traded species, better screening for potentially harmful species, and regulating them can save thousands of millions. Once an invasive species establishes and spreads in a location, it is often too late, and the subsequent measures tend to be significantly more expensive.

Undesirable non-native species are not limited to reptiles and amphibians; they span across the plant and animal kingdoms and even include viruses. The next phase of international research involving Ismael Soto Almena focused, for example, on invasive species of gastropods, crustaceans, and feral domestic and farm animals. His work, however, is far from complete. Once again, he will engage in meticulous work, not in the field, but in front of a computer screen – searching databases, creating graphs, and developing statistical models. This is the type of research in which the scientist, who is splitting his doctoral studies between Vodňany and Frankfurt am Main, Germany, excels. ◀

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The mystery of the narrow-clawed crayfish: From Europe to Siberia

A team of scientists from several European institutions, led by Assoc. Prof. Martin Bláha from the Laboratory of Freshwater Ecosystems, has illuminated the genetic diversity of the narrow-clawed crayfish, revealing three evolutionarily distinct lineages.

The narrow-clawed crayfish, belonging to the European species of crayfish and native to the basins of the Azov, Black, and Caspian Seas, exhibits significant morphological variability and encompasses numerous described species and subspecies. To elucidate the genetic relationships among these taxa, scientists undertook a comprehensive analysis. "Our research was based on an extensive collection of samples gathered over more than a decade. This allowed us to chart 65 populations across fourteen countries," explains Martin Bláha.

The study's findings indicated a significant discrepancy between mitochondrial and nuclear markers, suggesting the existence of a single species but revealing three evolutionarily long-separated mitochondrial lineages." The first lineage is primarily found in central and southern Europe, the second in eastern Europe and Asia, and the third in Turkey. The distribution range of the narrow-clawed crayfish is vast, and examining a map with our researched locations raises intriguing questions. How did it reach such remote areas?" remarks Martin Bláha.

These areas, located in Siberia and the northernmost parts of European Russia, are linked to the demand for freshwater crayfish meat. In some regions, crayfish remain a significant commercial commodity and are introduced beyond their natural range to meet this demand. Not all narrow-clawed crayfish are destined for restaurant plates; some can be seen in nearby rivers or backwaters. "This also explains the frequent occurrences of Asian and Turkish lineage crayfish outside their native ranges. These crayfish, most often originating from Armenia's Lake Sevan or Turkish lakes, are transported in large quantities to European countries," he points out.

What is the situation with the occurrence of the narrow-clawed crayfish in the Czech Republic? Although this species is non-native in most parts of our territory, it is classified as an endangered species for conservation purposes. It is most commonly found in isolated localities such as ponds or quarries, for example in the Příbram region. Like other European crayfish species, the narrow-clawed crayfish is highly sensitive to the crayfish plague. This infectious disease, transmitted by invasive North American crayfish species, has significantly impacted the distribution of narrow-clawed crayfish lineages in Europe. Many local populations were decimated by the crayfish plague, leading to the

use of individuals from less affected areas to rebuild populations. "Interestingly, there are locations, such as some Turkish lakes, where narrow-clawed crayfish populations have shown some resistance to the crayfish plague. One possible explanation is that the high mineral concentration in these lakes' waters may reduce the mobility of the parasite's zoospores, limiting its effective spread. In any case, we know of more resistant populations that survive with the disease, which is a positive finding," suggests Martin Bláha.

The results of the published study are likely to challenge the previously accepted nomenclature of the narrow-clawed crayfish species complex, which was based on morphology with eight described species and two subspecies. Although the authors do not rule out the possibility of a previously undiscovered population within the vast range of the narrow-clawed crayfish having a completely different genetic footprint, the probability of this is very low. ◀

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Fish paparazzi

Utilizing modern technology to explore the world of fish, Petr Císař from the Faculty of Fisheries and Protection of Waters is developing systems capable of identifying specific individuals within a school of thousands of fish. These systems can also detect signs of illness in the fish.

The skin pattern of a fish is as unique as a human fingerprint, and the spots on an agile salmon's body hold more information than meets the eye. Petr Císař, Director of the Institute of Complex Systems and a member of the Laboratory of Signal and Image Processing, specializes in utilizing modern technologies for aquaculture and research monitoring. Based in Nové Hrady, he develops systems that provide unprecedented insights into the lives of fish. Unlike traditional paparazzi, his interest lies not in sensational details but in scientific understanding. One of his flagship projects involves identifying fish from images, a non-invasive method particularly useful in intensive aquaculture, i.e. in farms with high stocking densities. "For example, this method can be applied to cage farming of salmon in the open sea or land-based fish farms," explains Císař. "Our aim is to replace invasive tagging methods that require attaching various types of tags to the fish."

These methods not only promote gentler handling of fish but also enhance the efficiency of aquaculture, saving farm owners both time and money on complex fish handling procedures. Instead of having to repeatedly capture, tag, and return each fish to the breeding tank, cameras placed in the tank can identify individual fish based on their skin patterns. This approach significantly individualizes fish culture. "Initially, we experimented with a system that utilized iris recognition. However, it proved to be technically more demanding, requiring more cameras with higher resolution in the tank or cage, and in addition, the iris changes as the fish develops," says Císař. Skin pattern recognition has demonstrated greater effectiveness, even for fish without distinctive body patterns. "We have found that identification works reliably for common carp and the relatively indistinct European seabass. A unique pattern of scales or lateral lines is sufficient to identify an individual," he adds.

Diseases are reflected in skin patterns

Why is it necessary to identify individual fish? By utilizing a database of fish appearances, we can not only identify specific individuals but also gather information about their weight gain, welfare, and current health conditions. "We can easily detect morphological changes in fish, such as various deformities or disease symptoms, as many of these specifically manifest on the skin. Currently, we are conducting projects in Denmark and Italy to monitor Red Mark Syndrome (RMS) in rainbow trout, identifiable by red spots on the skin. Although RMS does not significantly restrict the fish, it reduces the marketability for the owner," explains Císař. These systems can also aid in combating sea lice, parasites that infest Atlantic salmon. These parasites not only affect commercial breeding farms but also have detrimental impacts on wild salmon populations in nearby areas. Efforts are underway to develop technology that uses laser beams to remove these parasites directly from the fish's skin.

As intensive fish culture is only beginning to rise in the Czech Republic, similar technologies are predominantly utilized in aquaculture superpowers like Norway and Denmark." However, there is also increasing interest in some systems within our country. It is crucial that these technologies are cost-effective and user-friendly, preferably in the form of a mobile phone application," points out Císař. A fisherman can simply place his phone in a holder next to the tank, and the mobile app will capture images of each fish he pulls out, read data from scales and measuring tapes, and assess weight gain, welfare, and any deformities.

Another application of identification systems, outside the realm of fish breeding, can be observed at the fish ladder on the Otava River in Písek. Numerous obstructions along watercourses have hindered fish migration, prompting water managers to construct fish passes. However, doubts persist regarding the functionality of many of them. Petr Císař and his colleagues have developed a camera system capable of detecting fish traversing fishways. In addition to tallying the number of fish, the system identifies species based on their silhouettes." Approximately 100 fish traverse the Písek fish ladder per night, but much depends on the frequency of maintenance to clear various accumulations. Failure to do so could result in the fish pass becoming impassable. Our plan is to leave the system in the fish ladder for a year and then evaluate the effectiveness of this fishway."

In his ongoing quest to unveil the mysteries of fish life, Petr Císař remains relentless. Years of experience have taught him how to devise innovations with practical applications in the commercial sector. "It's a lengthy journey from prototype to implementation within a company, and scientific institutions here lack the knowledge to navigate this process efficiently. We understand the need for simplicity and affordability; sophisticated data from expensive cameras is unnecessary when readily available technology suffices," he comments, highlighting the current absence of spin-off companies tasked with transforming research patents into marketable products. ◀

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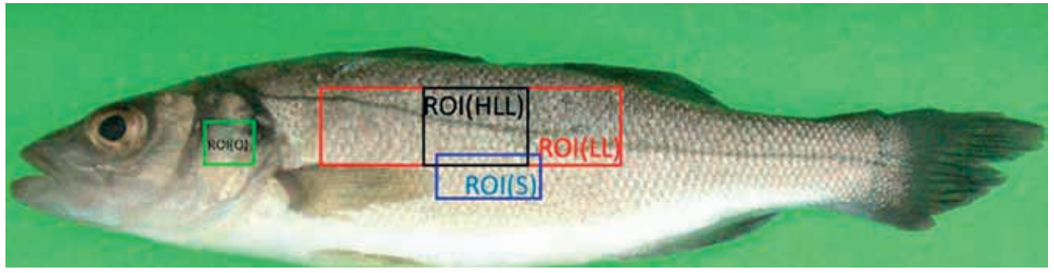

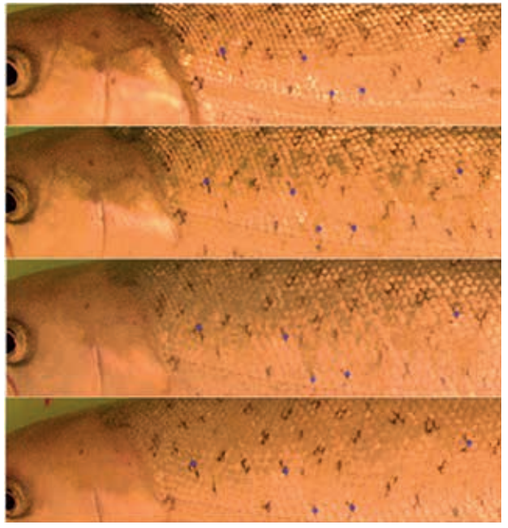

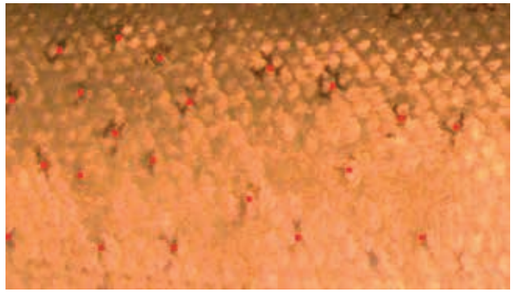

Invasive crayfish and native branchiobdellidans: the end of symbiosis?

Branchiobdellidans are small aquatic annelids that engage in symbiotic relationships on the exoskeletons of crayfish. In Europe, branchiobdellidans parasitizing crayfish gills are relatively rare. In the Czech Republic, most branchiobdellidan species often form mutualistic relationships with crayfish by removing overgrown microscopic organisms from their exoskeletons.

During observations of the invasive North American signal crayfish in the Czech Republic, it was noted that these crayfish were infrequently infested by native European branchiobdellidans. Our field experiment revealed that signal crayfish harboured 81 to 91% fewer branchiobdellidans compared to the native noble crayfish captured from the same locality. The incidence of egg cocoons attached to the crayfish exoskeletons was even lower. In areas where noble crayfish had been completely extirpated by signal crayfish, original branchiobdellidans were absent from the invasive crayfish species entirely.

Our laboratory experiments corroborated these findings, demonstrating significantly lower survival rates of native branchiobdellidans on signal crayfish compared to noble crayfish. Based on our findings, we concluded that the increased grooming behavior of signal crayfish contributes to this trend. However, it remains unclear why the invasive signal crayfish exhibit intolerance specifically towards European branchiobdellidans, while coexisting with certain North American branchiobdellidans.

Nevertheless, there is no doubt that the invasive signal crayfish not only threaten native crayfish species but also jeopardize their native symbiotic organisms. ◀

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Let, M., Ložek, F., Kouba, A., Buřič, M., Bláha, M., 2023. Signal crayfish as a threat for European ectosymbionts: overlooked biodiversity losses. Aquatic Sciences 85: 30. doi.org/10.1007/s00027-022-00932-w

23rd Symposium of the International Association of Astacology, Hluboká nad Vltavou

The year 2022 marked the 50th anniversary of the founding of the International Association of Astacology. We had the honour of organizing the 23rd Symposium of the International Association of Astacology for the first time in the Czech Republic, which took place from 20th June to 26th June 2022, in Aleš's South Bohemian Gallery and Hotel Štekl in Hluboká nad Vltavou.

The conference attracted 138 experts from around the world, with significant representation from North America, Australia, Scandinavia, Croatia, Spain, England, Germany, Austria, and other countries. The week-long event featured a comprehensive programmme of professional lectures complemented by a diverse array of accompanying activities. ◀

The regional issues of invasive non-native species in the Czech Republic and Germany

The regional issue of invasive non-native species in the Czech Republic and Germany was the focus of an international workshop held on 8th November 2023 at the Environmental Educational Center MEVPIS. The programme aimed to address critical aspects related to legislation, practical management, current evaluations, and future impacts of these species. Experts from Czech and German institutions were invited to discuss the respective situations in their countries.

The event was supported by the Embassy of the Federal Republic of Germany in the Czech Republic, the Ministry of the Environment, the Czech-German Climate Dialogue, and the Faculty of Fisheries and Protection of Waters. ◀

Living Rivers

The Faculty of Fisheries and Protection of Waters USB is a co-investigator in the integrated LIFE project "Implementation of the river basin management plan in selected river sub-basins in Slovakia – Living Rivers." This project, coordinated by the Water Management Research Institute (Slovakia), spans from 2023 to 2032. The project will contribute to the implementation of the 3rd Water Plan – Management Plan of the Danube River Basin Administrative Area in Slovakia by undertaking measures in the Danube, Hron, Ipeľ and Belá River basins.

The project supports the achievement of the ecological objectives of the Water Framework Directive and the Habitats Directive, aiming to ensure good ecological status/good ecological potential in 10 water bodies and to improve a total of 344 km of watercourses through hydromorphological measures, appropriate management of protected areas, restoration of floodplain forests and non-forest habitats. Additionally, the project will facilitate the removal of barriers to fish migration, supporting natural reproduction and the enhancement of native species populations through active habitat restoration measures. ◀

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Innovative management strategies for fishponds

Introducing a novel approach to fishpond management is the core objective of the RAGO project, which seeks to enhance the sustainability of selected ponds through the introduction of alternative fish stocks. Spearheaded by the partner organization ENKI, the project also involves the Faculty of Fisheries and Protection of Waters, University of South Bohemia.

As part of the project, ENKI, based in Třeboň, aims to evaluate alternative fish stocks in selected ponds and to observe their impact on pond biodiversity and water quality. Marek Baxa, a researcher at ENKI, elaborates, "Our objective is to safeguard valuable pond ecosystems and rejuvenate those already degraded. To achieve this, in collaboration with other project partners, we identified ten ponds to serve as experimental sites."

Could the management of ponds in a more natural manner help preserve fish species facing extinction in our environment? Moreover, is there economic viability for fishpond keepers in adopting alternative approaches?

A key collaborator in the project is the Faculty of Fisheries and Protection of Waters, tasked with the artificial spawning of selected fish species. "These species, including the crucian carp, common minnow, gudgeon, and sunbleak, are facing endangerment and declining numbers in our environment," explains Ján Regenda. He highlights the expertise of his colleague, Prof. Jan Kouřil, who achieved a remarkable feat last year with the unique artificial spawning of crucian carp, resulting in the production of half a million pieces of sac fry. These were primarily stocked into the monitored ponds. Additionally, species such as common roach, common rudd, predatory perch, and pikeperch are anticipated to contribute significantly to the investigated alternative stocking methods. An essential consideration is the economic viability of such management practices, a matter addressed by Ján Regenda. Is it financially feasible for fishpond keepers to partially substitute the carp stock with these declining species? "It's evident that breeding sunbleak or crucian carp isn't highly profitable. Thus, the project is presently targeting pond owners whose livelihoods aren't solely reliant on fish farming. Simultaneously, it serves as a pilot project that could pave the way for a more extensive and enduring strategy aimed at preserving the valuable natural ecosystems within our landscape," explains Ján Regenda.

Fewer carp does not always mean a win

Today's fishpond management is often criticised for over-farming carp, which can reduce water quality. However, according to Ján Regenda, the reduction of carp stocking may not always result in improved water quality and enhanced biodiversity. "Instead, the absence of carp creates a vacuum that is promptly filled by invasive fish species such as the gibel carp, pumpkinseed, or the topmouth gudgeon. Consequently, both the pond keeper and the ecosystem incur economic losses due to the decline in carp numbers, resulting from polluted and species-poor ecosystems. Unlike carp, whose biomass can be effectively regulated over time, invasive species tend to proliferate rapidly and can disrupt the delicate balance of the pond ecosystem. As each pond is unique, management strategies must be tailored accordingly," he says.

This suggests that the careful selection of suitable sites was essential for the project's success. The process was preceded by extensive monitoring of the fishponds and thorough communication with their owners, including the Czech Nature and Landscape Protection Agency, the Military Forests and Estates, state enterprise, and the small company Fish Farm Srlín, s.r.o. The monitored ponds are situated in Brdy, the Karlovy Vary Region, Písek, Tábor, and the Třeboň area. These locations have the potential to become significant refuges for endangered fish

species and sanctuaries for aquatic invertebrates, amphibians, and water birds. So, how can a passing tourist recognize these ponds with alternative fish stocks? "They will first notice the abundance of aquatic plants, known as macrophytes. There will also be clearer water and increased biodiversity in and around the pond," reflects Ján Regenda.

Threat of invasive species

In addition to intensive fishpond and landscape management, and increasing pressure from piscivorous predators, the fish species targeted by the project are also suffering from the rapid spread of invasive species. While the sunbleak faces significant competition from the topmouth gudgeon, introduced to Europe from China in the 1960s, the decline of the crucian carp has been exacerbated by its relative, the gibel carp, which is now intensively interbreeding with the crucian carp. “Maintaining pure genetic lines of crucian carp is a vital objective of the project," notes Ján Regenda. "This is essential to ensure that, in 50 years, crucian carp are not only seen in photographs."

The RAGO project funded by Norwegian funds commenced in 2022 is scheduled to conclude in spring 2024. During this period, researchers have been conducting regular visits to the ponds, monitoring the water's physical and chemical parameters and biodiversity. After evaluating the results, they will present the project's benefits to both the professional and general public." There is no doubt that these valuable pond ecosystems require careful management. However, little attention has been given to whether sustainable management can also be economically viable," says Marek Baxa. ◀

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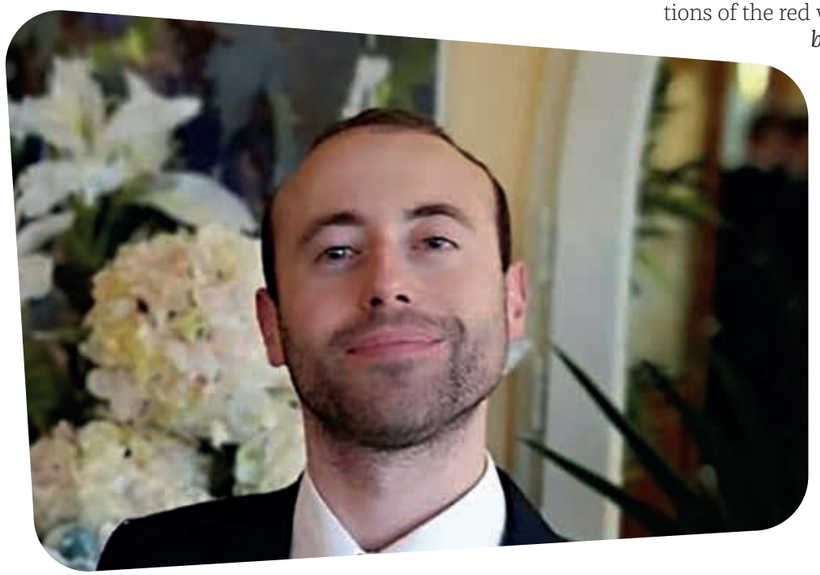
04

New Associate Professors and Professors

Assoc. Prof. Paride Balzani

Paride Balzani, Ph.D., (*1991) was unanimously recognized by the evaluation committee as qualified for the position of Associate Professor in Ecology on 7th November 2023 by the Ministry of University and Research (National Scientific Qualification, Italy). After his High School diploma in scientific studies, obtained in 2010 at the Liceo Scientifico Benedetto Varchi of Montevarchi (Italy), he continued studying at the University of Florence, obtaining a bachelor's degree in Natural Sciences in 2014. Subsequently, he obtained a master's degree in Sciences of Nature and Man (Curriculum of Nature Conservation and Management) at the University of Florence in 2018. He completed his Ph.D. (2018–2022) in Evolutionary Biology and Ecology (Curriculum of Ecology and Ethology) at the Universities of Parma, Florence, and Ferrara, defending his doctoral thesis entitled "Analysis of introduced and autochthonous populations of the red wood ant ***Formica paralugubris***: ecological interactions and conservation issues". Since April 2022, he has been a postdoctoral researcher at the Laboratory of Freshwater Ecosystems of the Faculty of Fisheries and Protection of Waters of the University of South Bohemia in České Budějovice. His research is mainly focused on animal ecology, invasive species, and trophic relationships, using stable isotope analysis as the primary analytical method. ◀



Assoc. Prof. Martin Bláha

Martin Bláha, Ph.D., (*1980) was appointed Associate Professor of Hydrobiology on 1st February 2022, following his presentation of a lecture titled "The Diversity of Crayfish and Major Threats They Face" to the Scientific Board of the Faculty of Science USB. Dr. Bláha attended grammar school in Strakonice from 1994 to 1998 and subsequently studied aquatic ecosystems at the High School of Water Management and Ecology in Vodňany for three years. He then pursued his higher education at the Faculty of Agriculture USB as part of the inaugural cohort of the new Fishery programme.

Dr. Bláha completed his doctoral studies at the Research Institute of Fish Culture and Hydrobiology in Vodňany (2006–2011). His dissertation, titled "Molecular and Morphological Aspects within ***Acanthocyclops*** Kiefer, 1927," investigated the species complex of planktonic crustaceans, specifically copepods of the genus ***Acanthocyclops***, utilizing morphological and molecular genetic methods to elucidate their complex relationships.

Since October 2011, Dr. Bláha has served as an academic researcher at the Faculty of Fisheries and Protection of Waters USB, within the Laboratory of Freshwater Ecosystems. His research primarily focuses on hydrobiology, with a particular emphasis on freshwater invertebrates and various aspects of the ecology of running waters and fishpond ecosystems. His scientific interest significantly extends into the phylogeography and genetics of European crayfish of the genera ***Astacus*** and ***Pontastacus***, as well as crayfish of the genus ***Cherax*** on the island of New Guinea. ◀

Assoc. Prof. Vlastimil Stejskal

Vlastimil Stejskal, Ph.D., (*1981) was appointed Associate Professor in the field of Fishery on 1st June 2022. He delivered a lecture titled "Recirculating Aquaculture Systems: History, Function, Advantages and Disadvantages Compared to Conventional Production Systems" to the Scientific Board of the Faculty of Fisheries and Protection of Waters USB. His habilitation dissertation, entitled "Optimization of Intensive Fish Culture and Nutrition in Recirculating Aquaculture Systems," reflects his extensive research in this area. Dr. Stejskal is an alumnus of the Secondary School of Fisheries in Vodňany (1999) and the Faculty of Agriculture USB in České Budějovice (2005), where he specialized in Fishery. He completed his doctoral studies at the Research Institute of Fish Culture and Hydrobiology in Vodňany, specifically within the Department of Aquaculture and Hydrobiology, defending his dissertation, "Intensive Culture and Reproduction of the European Perch (*Perca fluviatilis* L.)", in 2009.

In 2013, Dr. Stejskal became the head of the Laboratory of Controlled Reproduction and Intensive Fish Culture at the Institute of Aquaculture and Protection of Waters in České Budějovice, a position he continues to hold. From 2016 to 2020, he undertook internships in Ireland and Vietnam, with the longest tenure being at University College Cork from 2018 to 2020, where he served as a research assistant. His research specialization includes the biology, nutrition, and rearing technology of various economically significant fish species. ◀

Prof. Tomáš Policar

On 21st June 2023, Professor Tomáš Policar (*1975), an expert in intensive aquaculture and fish, ascended to the esteemed position of the eighth professor in the field of Fishery at our faculty. This momentous occasion was marked by the conferment of his appointment decree by the President of the Czech Republic, Petr Pavel. Prof. Policar's academic journey commenced at the Secondary School of Agriculture in Jihlava, where he graduated in 1993. He furthered his education at the Faculty of Agriculture University of South Bohemia in České Budějovice (USB), culminating in his graduation in 1998. It was at this institution where he also defended his postgraduate dissertation titled "Influence of Environment on Reproduction, Growth, and Survival of the Noble Crayfish (*Astacus astacus* L.) in Natural and Experimental Conditions" in 2004. In 2009, Prof. Policar made significant strides in his career by becoming the first Associate Professor in the field of "Fishery" at the Research Institute of Fish Culture and Hydrobiology USB. His habilitation dissertation, titled "New Methods of Intensive Culture of the Noble Crayfish (*Astacus astacus* L.) and Selected Fish Species," underscored his expertise in the domain. Notably, he served as the Vice-dean for Science and Research at the Faculty of Fisheries and Protection of Waters USB from 2009 to 2014. Additionally, since 2009, he has spearheaded the Laboratory of Intensive Aquaculture, and from June 2022, he assumed the position of Director of the Institute of Aquaculture and Protection of Waters. Professor Policar's research endeavours centre on innovations in controlled reproduction and intensive culture of native crayfish species, along with economically important supplementary fish species. His areas of focus include the stimulation of off-season spawning, domestication, and efficient rearing across all age categories. Employing various technologically innovative and optimized aquaculture production systems, his work underscores the imperative using of long-term sustainable aquaculture practices, with considerable applicative implications. ◀

05

Education

Degree programmes and fields of study

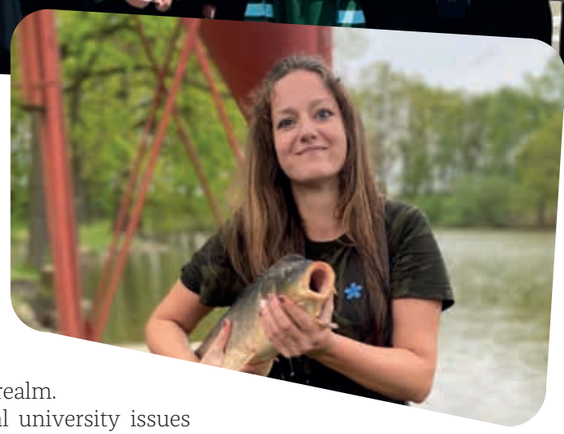
The Faculty of Fisheries and Protection of Waters offers higher education across all levels of study, from bachelor's and master's to doctoral degree programmes. These programmes are available in both full-time and part-time modes. Bachelor's and master's programme tuition primarily takes place at the Institute of Aquaculture and Protection of Waters, located on the University of South Bohemia campus in České Budějovice and in nearby facility buildings. The majority of Ph.D. students conduct their research in the laboratories of the Research Institute of Fish Culture and Hydrobiology in Vodňany.

Bachelor's degree programme

B.Sc.

Upon completing three years of study, students earn a bachelor's degree (Bc.). The Faculty of Fisheries and Protection of Waters, University of South Bohemia (FFPW USB) offers two programmes of study: **Fishery** and **Protection of Waters**. Both programmes place an emphasis on English language preparation, ensuring that graduates can communicate effectively, both orally and in writing. Full-time students participate in professional and operational practical training with companies involved in aquaculture, water management, and related fields. Additionally, students have the opportunity to undertake work placements abroad, primarily supported by the Erasmus+ programme. The bachelor's degree programmes at FFPW USB are offered exclusively in the Czech language.

The study programme "**Fishery**" integrates specialized knowledge of the biological and ecological relationships of aquatic organisms with modern technologies and techniques employed in fish culture and the fishing industry. Students also gain insight into water protection and management, along with relevant legal frameworks in fisheries and water conservation. Upon graduation, students are equipped for roles in fish culture, the enforcement of fishery and hunting laws, and professional engagements in environmental conservation, water management, and water quality control, typically at the lower to middle management levels.



The study programme "**Protection of Waters**" aligns with the interdisciplinary approach of the "Fishery" field, blending foundational knowledge from core courses with specialized theoretical and practical expertise in the respective realm. Graduates adeptly navigate fundamental university issues rooted in the natural sciences. These foundational principles are then applied and expanded upon within focused areas such as water environment chemistry and ecology, legislative frameworks governing water usage and protection within the European Union, as well as the technological elements in wastewater treatment, hydraulic engineering, water constructions, and water resource management. Furthermore, students acquire insights into the physi-

cal properties of water across various environments, the dynamics of the hydrological cycle within landscapes, the interplay between climate and water distribution, environmental nutrient levels, and pertinent fisheries-related topics. The objective of this programme is to cultivate a cadre of professionals with both ecological and technical competencies, poised to uphold and enhance regulations concerning water and environmental conservation, operating effectively within the realms of lower to middle management.

Master's degree programme

Dipl.-Ing.

Upon completing the two-year follow-up study, students earn a Master of Science (Dipl.-Ing.) degree. Within FFPW USB, students can pursue a master's degree in "**Fishery and Protection of Waters**" in either Czech or English. Similar to the bachelor's degree programme, significant emphasis is placed on rigorous language preparation and completion of professional practical training.

The study programme "**Fishery and Protection of Waters**" offers a comprehensive curriculum that delves into the biological, ecological, and technological facets of fisheries, alongside issues related to water management and the preservation of aquatic environments. This interdisciplinary approach of this programme ensures a holistic understanding of fisheries and water conservation, aligning with legislative requirements as well as contemporary trends and needs. The programme covers topics such as specialized fish culture, reproduction, and breeding, along with water resource protection, measures to promote biodiversity of organisms living in the wild, open water management, wastewater treatment, and environmental contamination mitigation. This programme is suitable for graduates of both Bachelor's degree programmes/fields offered at our faculty, while also being able to accommodate graduates from related Bachelor's degree programmes/fields.

Doctoral degree programmes

Ph.D.

The doctoral studies at FFPW USB offer an enriching opportunity to advance scientific knowledge and deepen expertise acquired during Master's studies. These programmes are strongly research-oriented, with students actively engaged as members of research laboratory teams. The primary objective is to equip students for future scientific, research or teaching careers within higher education or research institutions. The programme can be pursued in full-time or part-time modes in Czech and English. Since 2020, FFPW USB has been offering two doctoral degree programmes, "**Fishery**" and "**Protection of Aquatic Ecosystems**".

The "**Fishery**" programme focuses on various aspects of fishpond management, including biology, fish breeding and rearing, as well as the conservation of fish populations. It also covers fishery management of open waters, with an emphasis on preserving hydrocenoses in accordance with contemporary conservation principles and related areas.

Meanwhile, the "**Protection of Aquatic Ecosystems**" programme enhances students' knowledge and skills in fields such as environmental chemistry, toxicology, aquatic ecology, molecular biology, and environmental protection. ◀

Successful students

FFPW USB boasts a number of highly active students who consistently represent the faculty with distinction at both national and international conferences.

Nearly every year, fresh graduates from the faculty participate in the Science for the Earth competition, organized by the National Museum of Agriculture in collaboration with the Czech Academy of Agricultural Sciences. This competition honours the best bachelor's and master's theses as well as Doctoral dissertations related to agricultural topics.

In 2022, Koushik Roy, Ph.D., secured second place in the dissertation category with his dissertation titled "Circular and Sustainable Fish Nutrition". Deepali Rahi Roy, Ph.D., earned third place for her dissertation titled "Fish Sperm Respiration: Species Specificity and Effect of Environmental Temperature". The following year, three students achieved notable success in the same competition: Ondřej Nikl, who won first place in the master's thesis category with "Effect of alternative protein sources in fish feed on fish and plant growth in a two-loop aquaponic system", Jan Pastejřík, who earned second place in the Master's thesis category with "Is the introduction of fast-running European grayling broodstock an appropriate practice to support this species in open water?", and Tran Quang Hung, Ph.D., who secured second place in the Doctoral dissertation category with "Insect Meal as a Feeding Source in the Diet of Percidae, European perch (*Perca fluviatilis*), and European pikeperch (*Sander lucioperca*)".

Our Ph.D. student Alžběta Strouhová, who researches the effects of pesticides on various aquatic organisms, particularly crayfish and fish, consistently excels in presenting her findings. In 2022, at the 20th Toxicology Conference titled “Toxicity and Biodegradability of Wastes and Substances of Significance in the Aquatic Environment”, she secured second place in the young scientists' competition, the "Prof. Vladimír Sládeček Award". A year later, she delivered one of the four best presentations at the 3rd university-wide conference of Ph.D. students at the University of South Bohemia in České Budějovice.

In 2022, our Ph.D. student Martin Musil won the student poster section at the 22nd International Conference on Aquatic Invasive Species held in Oostende, Belgium. His contribution discussed the impact of fish predator odour on food intake in crayfish.

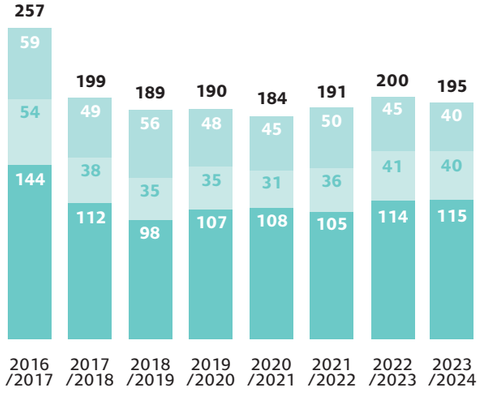
In 2023, Anil Axel Tellbüscher represented us at the Falling Walls Lab Czech Republic conference, held at the National Technical Library in Prague. The unique global concept of Falling Walls connects science, business, and individuals passionate about shaping the future of humanity through ideas and knowledge. His presentation, titled "Breaking the Wall of Aquaculture Waste," impressed the jury, earning him first place and a EUR 1,000 award. Anil subsequently represented both the faculty and the Czech Republic at the Falling Walls World Finals in Berlin in November 2023.

We encourage our students to participate in scientific conferences starting from their undergraduate studies. In 2023, this opportunity was embraced by second-year "Fishery" students Jan Škrabánek and Lukáš Beránek. They were among the youngest participants at Aquaculture Europe 2023, Europe's largest aquaculture conference held in Vienna. Their poster, which evaluated the feeding preferences of common carp in fishponds during the growing season, garnered significant attention. The students also established numerous professional connections at the conference. Our Ph.D. student, Lenka Kajgrová, who serves as the national coordinator of the European Aquaculture Society Student Group (EAS-SG), played an active role in preparing and coordinating the student delegation. ◀

Number of students in 2016–2023

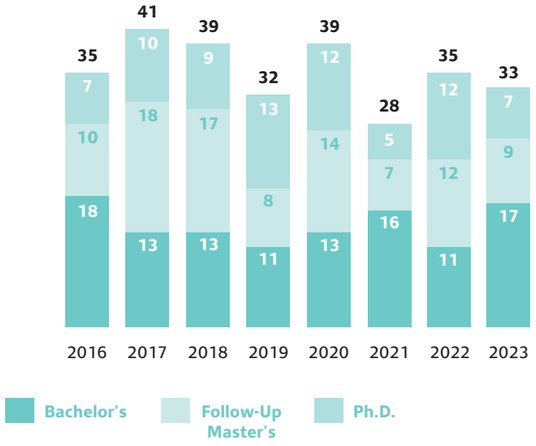
Number of students in 2016–2023

(academic year)



The number of graduates in 2016–2023

(calendar year)



The total number of successful graduates from the establishment of FFPW USB in 2009 up to the end of 2023 amounts to 529.

Scholarships

Scholarships at FFPW USB encompass a diverse range of opportunities. Full-time students can access **merit and premium scholarships** for outstanding academic performance, while exceptional students and sportsmen may qualify for **extraordinary scholarships**. Since 2018, the faculty has extended support to undergraduate students with exemplary academic records through an **additional extraordinary scholarship**. Moreover, the Dean reserves the discretion to grant **extraordinary scholarships in cases of notable contributions to the faculty**, such as representation or promotion of the faculty, active involvement in FFPW USB research laboratories, etc.

In 2022 and 2023, the faculty awarded extraordinary scholarships to gifted students, namely Lucie Bártová, Anna Hovorková, Jakub Kocour, Jan Škrabánek, and Lukáš Beránek.

The total scholarship allocation amounted.

2022

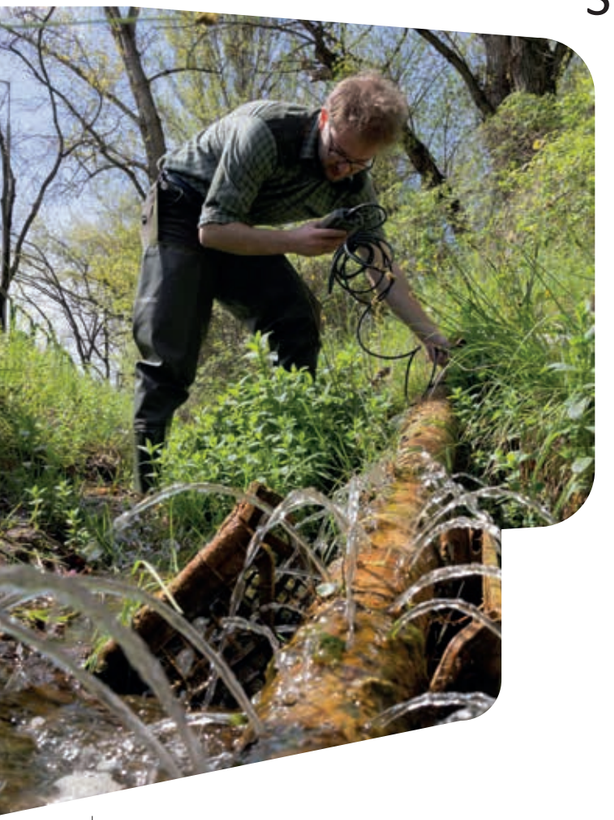
CZK 741,000

2023

CZK 745,000

Additional activities and academic opportunities offered by the faculty

Student excursions



The faculty provides its students with a wide array of excursion opportunities, both within the Czech Republic and abroad. These excursions offer firsthand exposure to various water management facilities, aquaculture enterprises, and significant protected areas, enriching the theoretical knowledge gained in their coursework. Domestically, excursions typically span one or two days, while international trips often include visits to countries such as Slovakia, Hungary, Austria, Germany, and Poland. These multi-day excursions enable students to explore diverse locations and make their own comparisons. Apart from academic enrichment, these excursions serve as vital team-building experiences for students and consistently receive positive evaluations.

As part of the courses "Ecology of Non-native Aquatic Organisms" and "Applied Hydrobiology," students embarked on a week-long excursion to Hungary in May 2023. The itinerary included visits to sites that have been the subject of recent research by our faculty colleagues. Students acquired valuable insights into the distinctive communities thriving within these particular habitats. They had the opportunity to explore the outflows of lake Hévíz, Europe's largest thermal lake, the hydrothermal spring waters of Városliget Park in central Budapest, and a thermal tributary of the Barát stream. At these locations, students engaged in capturing crayfish, fish, and macrozoobenthos, observing firsthand the diverse communities of cichlids, spiny-cheek crayfish, red swamp crayfish, marbled crayfish, and the popular red cherry shrimp among other non-native species. After an intense day of capturing, students savoured the crayfish they had caught, which served as a rewarding treat. Contrasting with these habitats teeming with non-native species, participants also explored the natural wetlands of Kis-Balaton, established to enhance the quality of inflowing water to Lake Balaton, and Lake Velence, known for its distinctive water properties and expansive reed-covered floating islands, as well as its rich diversity of waterfowl and wetland birds.

Students enrolled in the course "Culture of Salmonids" participate in regular multi-day foreign excursions. For example, on a three-day excursion in 2022, students visited and compared different operations. These included Happy Fish (Tilapia s.r.o.), a fish hatchery and storage ponds site located in Žďár nad Sázavou, as well as a salmonids fish farm and fish hatchery in Žilina, along with aquarium fish breeding facilities in Turčianske Teplice. During a four-day excursion in 2023, students saw 11 different facilities across the Czech Republic and Germany. These encompassed trout farms, fish production facilities, fish hatcheries, fishponds, aquaponic and recirculating aquaculture systems, water constructions, fish processing plants, fish shops, and expositions. Additionally, the programme offered students the chance to taste various fish specialties, including dishes known as "Blue Carp" or "Aischgrund Carp".

Erasmus mobility opportunities

Students across all academic levels have the chance to participate in Erasmus+ mobility programmes, which offer opportunities for study, work, and graduate experiences abroad. For a study stay lasting 3 to 12 months at a partner university under the Erasmus+ programme, students are required to acquire a minimum of 18 ECTS credits, which are then recognized as part of their curriculum at FFPW

USB. Additionally, students have the option to engage in work placements or graduate internships lasting from 2 to 12 months at various universities, institutions, organizations, and companies located in participating Erasmus+ countries. Despite the challenges posed by the Covid-19 pandemic, students resumed their mobility activities in 2022 and 2023. In 2022, two bachelor's degree students, one master's degree student, and 16 Ph.D. students travelled abroad. This trend continued in 2023, with a total of 22 FFPW USB students undertaking international experiences, including one master's degree student and 21 doctoral students. Destinations for these mobility experiences during these years spanned numerous countries, including Belgium, France, Ireland, Iceland, Italy, Canada, Hungary, Germany, Poland, Portugal, Greece, Slovenia, the United States of America, Spain, Sweden, Switzerland, and the United Kingdom.

Practical training opportunities abroad

Throughout their bachelor's and master's studies, students have the chance to gain hands-on experience through professional and operational practical training within aquaculture enterprises, water management organizations, and related industries. Additionally, students can opt for practical training abroad by participating in work placements facilitated through the Erasmus+ programme.

In 2022, seven students seized this opportunity, embarking on practical training experiences in Slovakia and Germany. The following year, eight students expanded their horizons further, undertaking practical training in Slovakia, Germany, and Switzerland.

Students don't just travel abroad for professional practical internships in research institutions or aquaculture companies. They also explore opportunities in diverse settings, such as the embassies of the Czech Republic. As an example, Martin Musil, a Ph.D. student of study programme "Fishery", embarked on an eight-month foreign internship at the Permanent Representation of the Czech Republic to the European Union during the Czech Presidency of the EU Council. Martin contributed his expertise in freshwater aquaculture, fishing, and the conservation of migratory fish species, particularly eels and salmon, as a member of the Presidency team handling EU fisheries policy issues. The team's responsibilities included chairing EU Council working groups, preparing meetings for the Committee of Permanent Representatives of the Governments of the Member States and the Agriculture and Fisheries Council, among others. They also addressed issues concerning the Common Fisheries Policy, focusing on sustainable fisheries and aquaculture in the EU. One of the team's key achievements was the allocation and setting of Total Allowable Catches (TACs) for various species and fish stocks in EU waters, as well as the formulation of strategic principles for sustainable aquaculture. Martin played a pivotal role in the day-to-day operations of the Permanent Representation of the Czech Republic to the EU, attending numerous meetings at various levels and facilitating bilateral meetings between Member States and the Presidency team. He was instrumental in planning and preparing background documents for these meetings, particularly those concerning the European eel and the Baltic Sea. Martin also made a substantial contribution to the development of a trilingual dictionary encompassing Czech, English, and Latin translations of fish species within the EU, tailored for use by translators. Throughout his tenure in Brussels, he actively engaged in the organization and attendance of conferences focused on sustainable aquaculture, fisheries management, and fish migration. During the concluding month of the Presidency, Martin was accompanied in Brussels by fellow Ph.D. student, Alžběta Strouhová. Both scholars perceive this internship as a paramount and gratifying international experience during their studies at FFPW USB.

Student engagement and social activities

Numerous students at FFPW actively participate in the vibrant social sphere of the University of South Bohemia. This involvement extends to membership in student organizations and clubs, as well as attendance at various social gatherings. Notable among these events is the traditional ceremony of admitting bachelor's and master's students into the fishing guild, a cherished tradition at the faculty. Typically organized by first-year master's students, this ceremony occurs annually in April

at the Branišov Pond System near České Budějovice. Attended by current students, alumni, faculty, and academic personnel, the ceremony serves as a significant communal gathering. Despite a hiatus due to the Covid-19 pandemic, the tradition resumed in 2022, maintaining its historical significance.

In December 2022, doctoral students from FFPW, Lenka Kajgrová, Anil Axel Tellbüscher and Tomáš Pěnka, took the initiative to organize the 1st Winter Workshop under the auspices of the European Aquaculture Society (EAS) – Student Group (EAS-SG). Held at the International Environmental Educational, Advisory, and Information Centre for the Protection of Waters in Vodňany, this event convened students representing various European nations. The primary objective was to foster dialogue on future strategies for the EAS-SG, with a focus on making connections among students across Europe. Hosting 15 national coordinators from 10 different countries, the faculty provided participants with the opportunity to familiarize themselves with the hosting institution and its facilities, as well as to gain a better understanding of the functioning of its research infrastructure. The agenda encompassed presentations by representatives of diverse associations and scientific groups, alongside discussions on the operational dynamics and restructuring of the EAS student group. Concluding with a tour of Prague, the inaugural workshop set the stage for the 2nd Winter Workshop in December 2023, which not only showcased FFPW but also emphasized the promotion and enhancement of international collaborations and evaluated prospects for further international cooperation. ◀

EAS-SG
European Aquaculture Society
Student Group

06

Popularization

Publicity

In today's digital age, maintaining an active presence on social media is essential. We share our activities and updates on Facebook and Instagram, and we have recently produced promotional videos available on our YouTube channel. These videos offer insights into various topics, such as filleting fish, exploring our Aquaponic Hall, and discussing numerous fascinating aspects of fishing and water conservation.

Additionally, we present the Faculty of Fisheries and Protection of Waters' podcast series, FROVcast – Water to Your Mill, hosted by Miroslav Boček. This podcast features interviews with scientists, fishermen, environmentalists, and other stakeholders, addressing critical issues related to water, science, and sustainable future. Topics include sustainable aquaculture, wetland ecology, fishpond pollution, and the future of carp stall sales. Our guests comprise not only faculty scientists but also experts from other research institutions and the non-profit sector. We consistently publish in both professional and general public magazines, such as Rybářství (Fisheries), Rybníkářství (Fishpond Management), and Veterinářství (Veterinary). For instance, in the article "Fishing Traps," Dr. Bořek Drozd highlights the dangers associated with discarded fishing tackle. He emphasizes that in the Czech Republic, several hundred wild animals die or sustain permanent injuries each year due to the so-called “fishing traps”, i.e. leftover fishing lines, hooks, and other tackle.

Since 1982, the Edition of Methodologies has published practical guides in a convenient A5 format, often referred to as "fishing cookbooks." These publications provide clear and accessible responses to the latest developments in fisheries, fishpond management, and related fields. Topics include the breeding and reproduction of various fish species, fish culture in recirculating aquaculture systems, and fish diseases. Other guides address fish nutrition, crayfish issues, and more. All publications are freely available for download from the faculty website. ◀

Edition of METHODOLOGIES

"TalentAkademie" of South Bohemian Hopes

The "TalentAkademie" of South Bohemian Hopes is an enrichment programme designed for exceptionally gifted students in the Region of South Bohemia. It is a three-day programme for secondary/high school students in various fields. This three-day programme targets secondary and high school students across various fields. This year, it brought these outstanding students to the Faculty of Fisheries and Protection of Waters USB in České Budějovice and Vodňany.

At our faculty, students explored modern analytical methods for detecting pollutants and listened to captivating stories about native and non-native crayfish in our rivers. In the Aquaponic Hall, they participated in an excursion where they learnt the principles of aquaponics and how this technology can help address global challenges. The students then constructed their own hobby aquaponic systems, complete with fish and lettuce seedlings. This hands-on experience was met with great enthusiasm, and several students expressed interest in setting up similar systems at home in their gardens or on their balconies. ◀

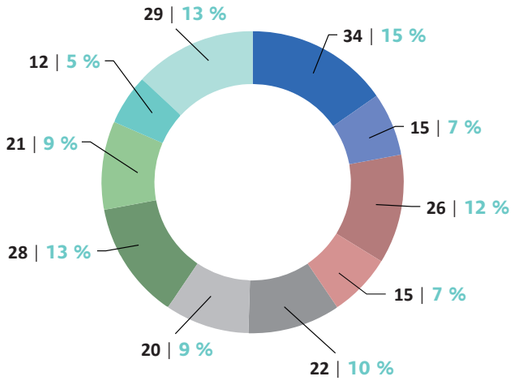
07

Faculty in Numbers

Employees

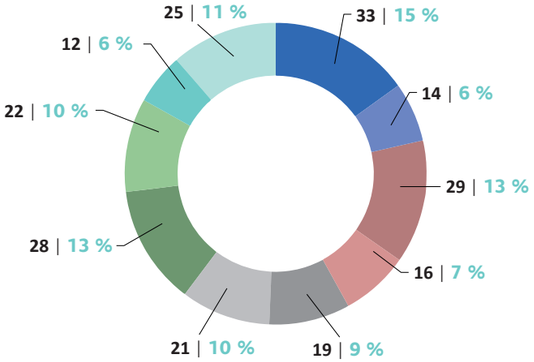
Average registered number of employees calculated as of 31st December 2022

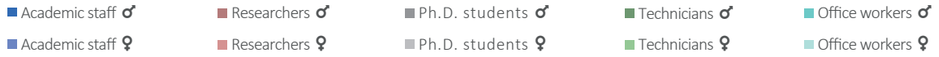
222

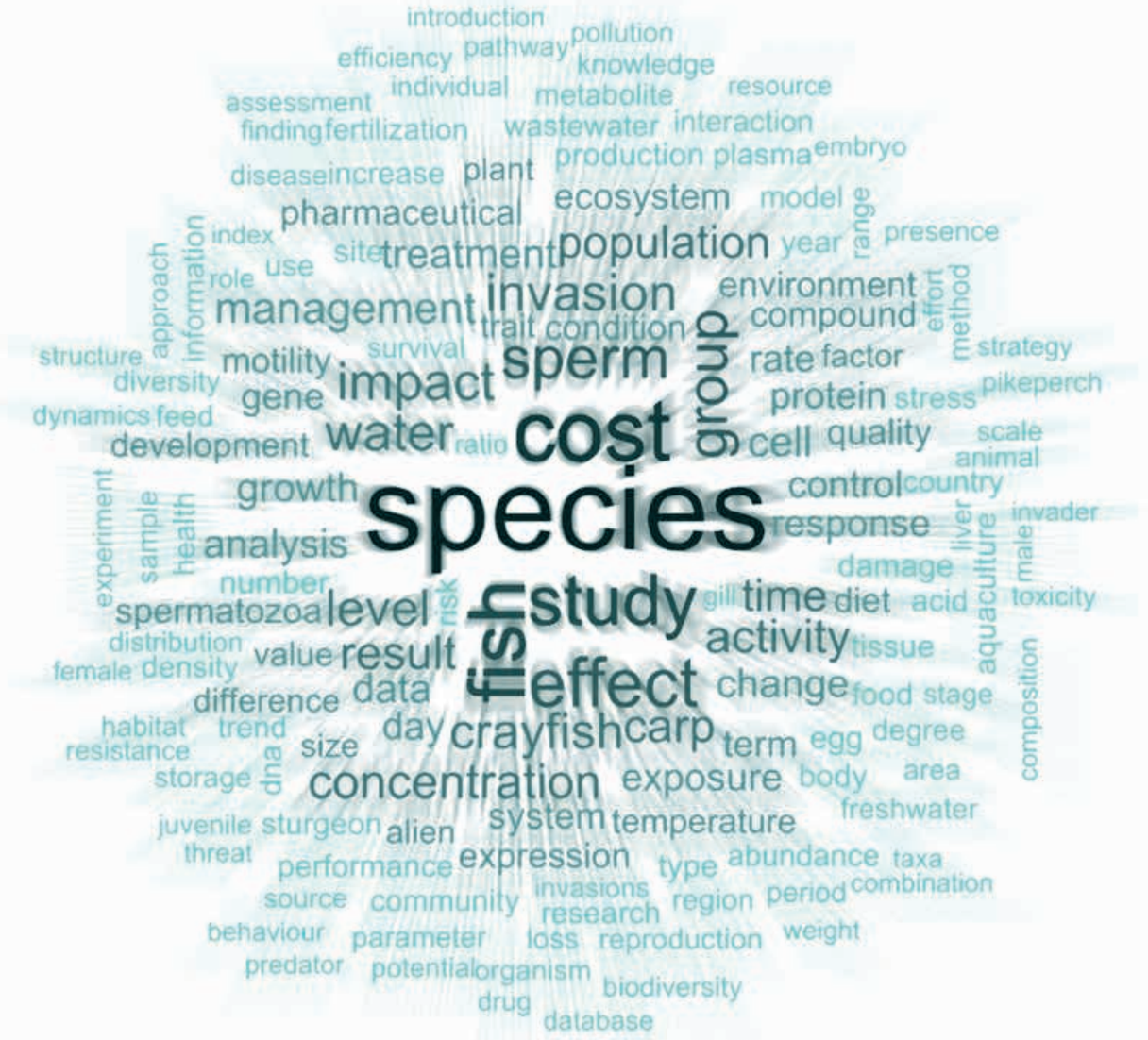


Average registered number of employees calculated as of 31st December 2023

219



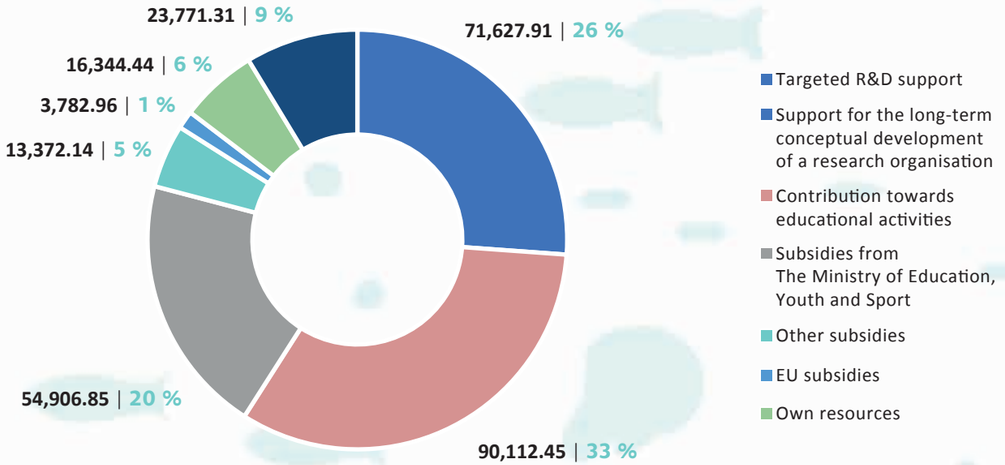




Economics

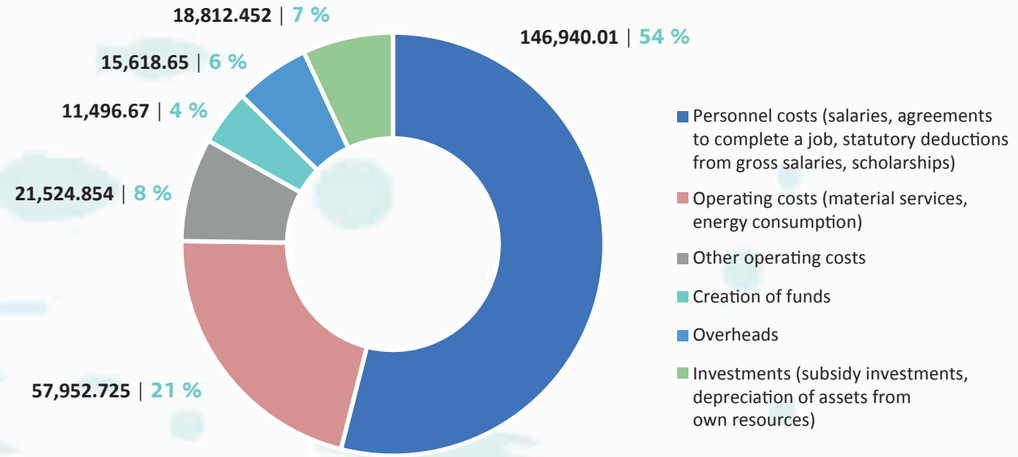
Sources of financing in 2022 including the Targeted Support Fund/Project Preparation fund in thousands CZK

273,918.06



Expenditure of the sources in 2022 in thousands CZK

272,345.35



Economics

Sources of financing in 2023 including the Targeted Support Fund/Project Preparation fund in thousands CZK

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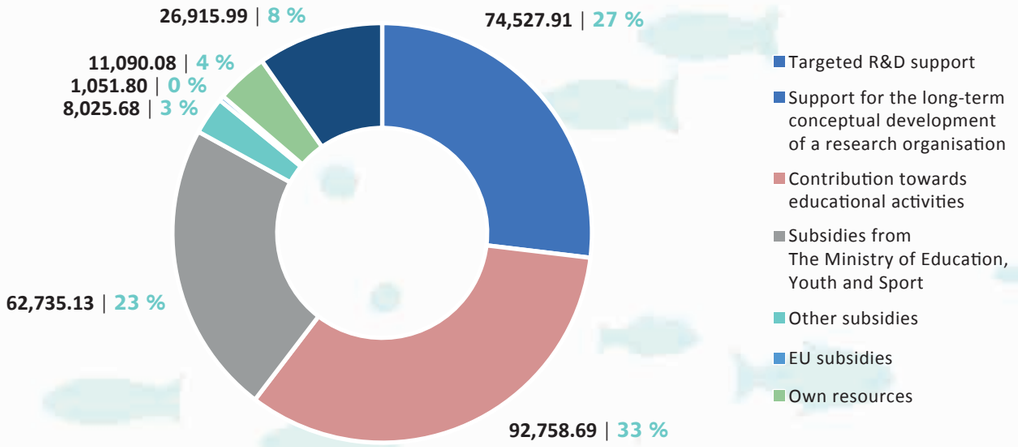
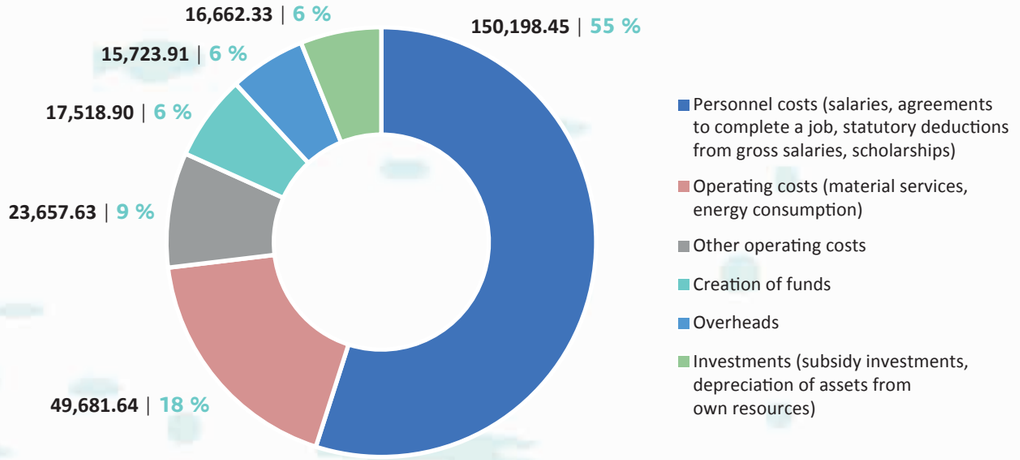


Expenditure of the sources in 2023 in thousands CZK

273,442.85

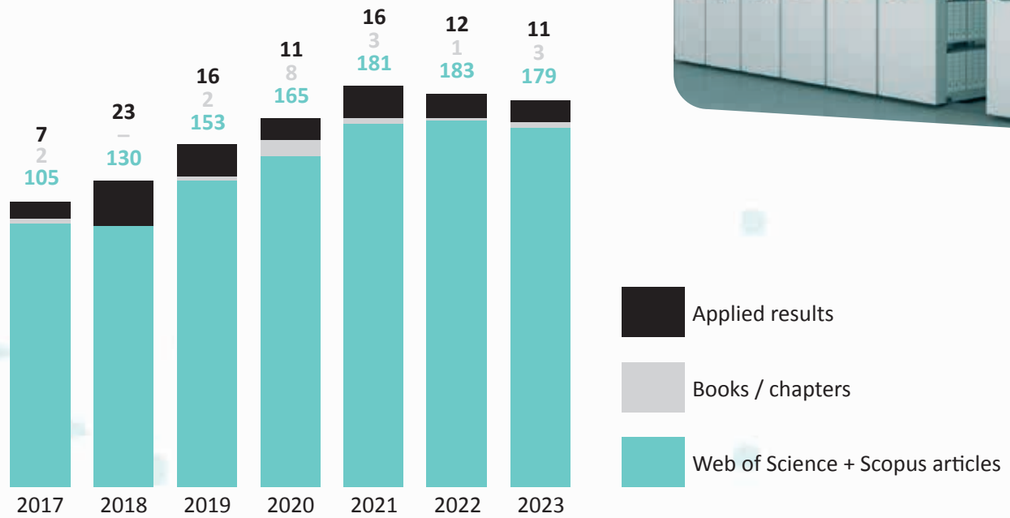


Projects

National and international projects 2017–2023

Publication

Publication activities 2018–2023



08

Faculty Structure

FACULTY OF FISHERIES AND PROTECTION OF WATERS

- Academic Senate of FFPW USB
- Scientific Committee of FFPW USB
- International Board of FFPW USB and CENAKVA
- Board of Commerce and Social Relevance
- Dean's Collegium
- Other councils, commisions and bodies

Dean's Office

- Dean's Section
  - Dean's Office
  - Office for Property Management and Maintenance
- Registrar's Section
  - Economic Office
- Vice-dean for Study Affairs's Section
  - Study Office
- Vice-dean for Science and Research's Section
  - Office of Science and Research
  - Editorial Board and Library
- Vice-dean for Development's Section
- Vice-dean for International Relations's Section
  - Office of Foreign Relations
- Management's Section
  - Office of Project's Managers
  - IEEAIC

South Bohemian Research Centre of Aquaculture and Biodiversity of Hydrocenoses /CENAKVA/

- Office of CENAKVA
- RP1: Reproductive and genetic procedures for fish biodiversity and aquaculture conservation
- RP2: „New" pollutants in the environment and their effect on freshwater ecosystems
- RP3: Sustainable aquaculture with a responsible water and nutrient management
- RP4: Freshwater ecosystems in the era of global change

Institutes

Research Institute of Fish Culture and Hydrobiology /RIFCH/

- Office of RIFCH
- Experimental Fish Culture Facility /EFCF/
- Genetic Fisheries Center /GFC/
- Laboratory of Molecular, Cellular and Quantitative Genetics /LMCQG/
- Laboratory of Reproductive Physiology /LRP/
- Laboratory of Germ Cells /LGC/
- Laboratory of Intensive Aquaculture /LIA/
- Laboratory of Aquatic Toxicology and Ichthyopathology /LATI/
- Laboratory of Environmental Chemistry and Biochemistry /LECB/
- Laboratory of Freshwater Ecosystems /LFE/

Institute of Aquaculture and Protection of Waters (IAPW)

- Office of IAPW
- Laboratory of Controlled Reproduction and Intensive Fish Culture /LCRIFC/
- Laboratory of Nutrition /LN/
- Processing Unit and Shop with Fish and Aquculture Products

Institute of Complex Systems /ICS/

- Office of ICS
- Laboratory of Experimental Complex Systems /LECS/
- Laboratory of Signal and Image Processing /LZSO/

Faculty Management

Dean
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Vice-dean for Study Affairs, deputy of the Dean
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Vice-dean for Science and Research
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Vice-dean for International Relations
and Director of South Bohemian Research Center CENAKVA
Assoc. Prof. Vladimír Žlábek
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Vice-dean for Development, Director of Institute of Complex Systems
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Director of Institute of Aquaculture and Protection of Waters
Prof. Tomáš Policar (since 1. 6. 2022) **/ Dipl.-Ing. Jan Kašpar** (till 31. 5. 2022)
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Director of Research Institute of Fisheries and Hydrobiology
Prof. Tomáš Randák
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Head of Management Section
Dipl.-Ing. Martin Vlček (since 16. 6. 2023) **/ Dipl.-Ing. Michal Hojdekr, MBA** (till 15. 6. 2023)
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Faculty Registrar
Dipl.-Ing. Jaromíra Vondrášková
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Scientific Committee

Prof. Pavel Kozák, FFPW USB, Vodňany – Chairman
Assoc. Prof. Antonín Kouba, FFPW USB, Vodňany – Registrar

Internal members

Prof. Tomáš Policar, FFPW USB, Vodňany
Assoc. Prof. Vladimír Žlábek, FFPW USB, Vodňany
Prof. Otomar Linhart, FFPW USB, Vodňany
Prof. Martin Flajšhans, FFPW USB, Vodňany
Prof. Tomáš Randák, FFPW USB, Vodňany
Assoc. Prof. Jan Mráz, Ph.D. FFPW USB, České Budějovice
Assoc. Prof. Martin Kocour, FFPW USB, Vodňany
Prof. Dalibor Štys, FFPW USB, Nové Hrady
Petr Císař, Ph.D., FFPW USB, Nové Hrady
Assoc. Prof. Roman Grabic, FFPW USB, Vodňany
Prof. Tomáš Polívka, Faculty of Science USB, České Budějovice
Assoc. Prof. Petr Bartoš, Faculty of Agriculture and Technology USB, České Budějovice

External members

Prof. Petr Ráb, Institute of Animal Physiology and Genetics CAS, Liběchov
Prof. Luděk Bláha, Faculty of Science, Masaryk University, Brno
Prof. Milan Gelnar, Faculty of Science, Masaryk University, Brno
Prof. Eva Zažímalová, Czech Academy of Sciences, Praha
Prof. Ondřej Slavík, Faculty of Agrobiology, Food and Natural Resources, Czech University of Life Sciences, Prague
Prof. Radka Kodešová, Faculty of Agrobiology, Food and Natural Resources, Czech University of Life Sciences, Prague
Dr. Pavel Jurajda, Institute of Vertebrate Biology CAS, Brno
Assoc. Prof. Pavel Drozd, Faculty of Science, University of Ostrava, Ostrava

Academic Senate

Academic staff

Eliška Zusková, Ph.D. – předsedkyně
Prof. Tomáš Policar (till 31. 5. 2022) / **M.Sc. Hana Ash** (since 1. 6. 2022)
Assoc. Prof. Roman Grabic
David Gela, Ph.D.
Assoc. Prof. Martin Bláha
Pavel Lepič, Ph.D.
Kateřina Grabicová, Ph.D.
Assoc. Prof. Jan Mráz

Students

Dipl.-Ing. Lenka Kajgrová – Vice-chairman
Martin Hubálek, Ph.D. (till 30. 9. 2022) **/ B.Sc. Anna Hovorková** (since 1. 10. 2022)
Dipl.-Ing. Nikola Mikšovská
Lucie Bártová

Board of Commerce and Social Relevance of the FFPW USB and CENAKVA

Prof. Bohumil Jiroušek
Rector, USB in České Budějovice

Prof. Pavel Kozák
Dean, FFPW USB

Assoc. Prof. Vladimír Žlábek
Director CENAKVA, FFPW USB

Růžena Štemberková, Ph.D.
Leader, USB, Technology Transfer Office

DiIpl.-Ing. Rut Bízková
Member, The Research, Development and Innovation Council

Vlastislav Bříza Ph.D.
KOH-I-NOOR holding

Dipl.-Ing. Jan Cihlář
Director, Water Management Development and Construction

Jakub Horecký, Ph.D.
Ministerial Council, Ministry of the Environment of the Czech Republic

M.Sc. Pavel Hubený
Director, Šumava National Park

Jan Hůda, Ph.D.
President, Czech Fish Farmers Association

Eva Janouškovcová, Ph.D.
Director, MU, Technology Transfer Office

Dipl.-Ing. Silvana Jirotková
Deputy Minister, Ministry of Industry and Trade, Economic Policy and Enterprise

Assoc. Prof. Jiří Krechl
CzechInvest

Ing. Jan Kříž
Deputy for Management, EU Funds Section Ministry of the Environment of the Czech Republic

M.D. Martin Kuba
Governor, South Boehmian Region

Petr Kubala, Ph.D.
Director General, Vltava River Basin

Pavel Punčochář, Ph.D.
Ministry of Agriculture of the Czech Republic, Water Management

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South Bohemian Research Centre
for Aquaculture and Biodiversity of Hydrocenoses (CENAKVA)

South Bohemian
Research
Center
CENAKVA
of Aquaculture
and Biodiversity
of Hydrocenoses

Brief overview 2022/2023

222/219
employees consisting of
90/92 academic and scientific staff and
90/87 technical and office staff

183/179
Web of Science + Scopus articles

12/11
applied results

89/65
Projects consisting of
71/51 national projects
18/14 international projects

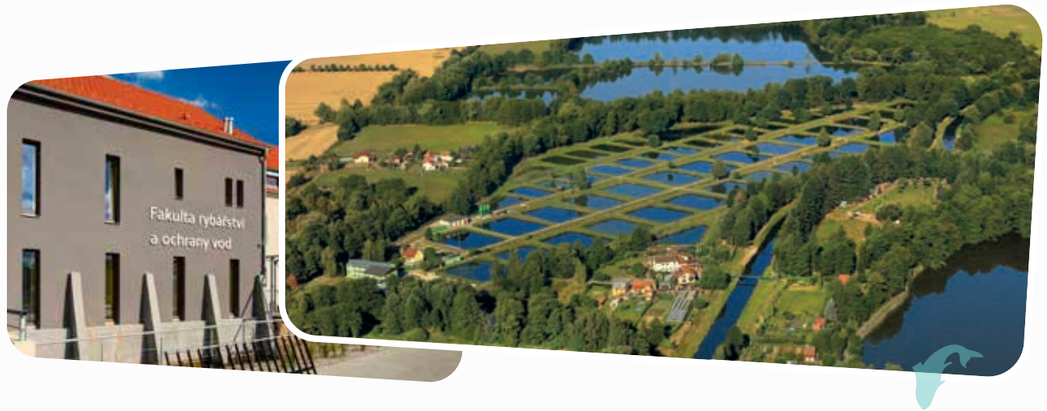
114/115
Bachelor students

41/40
Master students

45/40
Ph.D. students

data for **2022** / *data for* **2023**

CENAKVA
South Bohemian Research Center of Aquaculture and Biodiversity of Hydrocenoses



3
Institutes

1
Research center CENAKVA

14
Laboratories and service units

8
ponds over 1 ha (total **41.2** ha)

68
experimental ponds (total **9.3** ha)

274,000
277,000
budget in thousands CZK

FISH FRIENDLY
PRODUCTS

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

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

STURGEON / TROUT FRIENDLY CAVIAR COSMETICS

We followed up on the successful caviar project and developed a method of obtaining an oil base from ovulated sturgeon roes. The extract obtained in this way from roe from the faculty farm is called ***Sturgeon Friendly Caviar Extract***. Handmade processed extract from the eggs is then used as a unique ingredient of specially developed cosmetics. From the beginning, we wanted to have the most effective cosmetics. That's why we chose the path of the highest quality. In addition to the friendly handling of the sturgeon, our cosmetics are also characterized by a high concentration of pure Sturgeon Friendly Caviar Extract up to the level of 0.5%. Sturgeon Friendly Caviar Extract contains unsaturated fatty acids, vitamins, minerals, and other components that are important for a newly created life. These substances can regenerate your skin, giving it strength and elasticity.

SPECIAL DAY CREAM
with sturgeon caviar extract

SPECIAL NIGHT CREAM
with sturgeon caviar extract

24H REGENERATION CREAM
with trout caviar extract

University of South Bohemia
in České Budějovice
Faculty of Fisheries
and Protection of Waters
Zátiší 728/II, 389 25 Vodňany CZ

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