



# Biennial Report

2 0 0 8 – 2 0 0 9

Vodňany, 2010





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**Vodňany, 2010**

## **Biennial Report 2008–2009**

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# INTRODUCTION

Again after two years, already for the third time, I present our traditional biennial report which summarises the main scientific, research and educational activities of the University of South Bohemia in České Budějovice (USB), Research Institute of Fish Culture and Hydrobiology (RIFCH) over the last two years. For the first time, not "only" Institute's activities are going to be summarized, but the first four-month activities of newly established Faculty of Fisheries and Protection of Waters (FFPW) are going to be included as well.

The prime idea about an establishment of the Faculty, in the meantime sleeping somewhere in the depth of brains, was born during 2007 when we had submitted an application for the accreditation of inaugural and professorial rights. We were very successful and gained the rights not only for lectureships but also for professorships. At the beginning of 2008 the Institute had all attributes of "lawful Faculty"; only the accreditations for bachelor and master education and higher number of docents were missing. Habilitation of docents, namely docent Kozák and docent Flajšhans, got through smoothly "magna cum laude" at the Faculty of Agriculture USB and another docent, docent Polícar, was already "born" at RIFCH in 2008/9. We realized that we could establish a new Faculty but we were not interested in a structure where we would have to create a "politicum" between the senate and the management. The University Institute with a doctoral study and a simple structure was convenient enough for us. However, there appeared three factors, matters or realities, which became the key trigger mechanisms for starting of preparation of the Faculty's establishment.

The first trigger mechanism was seen in the experience with rather impracticable negotiation on certain changes at RIFCH through the University senate. I had a feeling that this senate took us as something minor, exotic what was tolerated here, but it was not important whether our senators voted positively or negatively with the motto, „after all, the world will not collapse“. I always had frisson of the senate meetings or rather of that they did not meet, and I hoped that on the meeting day they had a good lunch, they gained credits, exams, partner's favour, etc.

The second trigger mechanism was seen in the attitude of the management of the Faculty of Agriculture USB towards RIFCH. I guess it was at the last "big" scientific board meeting of the University before the Christmas of 2008 where the dean of the faculty, of course "in good sense" (he cannot do it otherwise), announced that the Faculty of Agriculture USB „enabled“ us to teach at the fishery department of that time and that we should have been obliged to that. In other words "if we are not obliged we will not teach and thereby we will not have future docents and professors".

The third one was seen in our awareness that a future rector of USB could incorporate the Institute under one of the faculties and change the director de facto in 48 hours. We knew that the present rector, who keeps his word, can give us an assurance of a future development until the end of 2010, but what about the other??? It is difficult to guess, as it would depend on how the „politicum“ would work at the University. I remember that time I had invited the management of the Institute + other colleagues to a restaurant for the Christmas party, I explained them the current situation and we agreed that we would not wait until somebody would incorporate us somewhere in the future and that we would take our future in our hands and actively include into the University „politicum“ as a fledged Faculty part.

It was the beginning of 2009 and we prepared the crucial reform of the Institute to the Faculty and the essential reconstructions of our buildings. Thus, we took on a lot, not only me, but also many of my colleagues, double, than we presumed at the beginning of 2008. After all, we as the former management of RIFCH met together again at the end of 2009 and although mentally very tired, we stated that everything what we did was a success. We established a base of new Faculty of Fisheries and Protection of Waters with a new identity stemming from the successful RIFCH. The Faculty had started to operate on the 1st September 2009. We voted the senate in October, the dean was voted in November and the faculty status was born at the beginning of December. I have a good feeling of belonging, responsibility and itch to work during senate's meetings. I am pleasantly surprised mainly by the student's part of our senate. Our senate is what it is supposed to be. It is the part which unifies the Faculty and today I already know that a good partnership arose between the management and the senate of the Faculty. I think that we did the maximum for the future activities of the Faculty. We managed to gain a project for reconstruction of the whole infrastructure of RIFCH. We are going to be one of the best equipped scientific and research workplace in the field of fisheries and protection of waters in Europe from 2013. The Institute of Aquaculture in České Budějovice should also have a new building until 2013 and finally in Vodňany there should grow up an international training centre of the protection of waters. In the last biennial report I compared our incoming reconstruction "to the floods of 2002 although this is going to be worse because it is going to last longer". In the end with regard to all our activities the situation is going to be even worse than I presumed that time, because the reconstruction will affect all parts of the Faculty.

In the introduction I did not mention at all our scientific and pedagogical activities which are fairly described in detail throughout the biennial report and you will find out that we were extremely successful and it has no sense to analyse it more or comment it. I only want to thank all my colleagues for this.

Now I am going to use my usual motto which has "happified" my dear colleagues for many years: **It is better to aim towards the stars and maybe miss than aim towards a stack of dung and safely hit.** The following sentences hopefully will not sound as phrases. When I recap last two years, we have achieved a lot of material successes and it is naturally very important but the most valuable is new and **healthy self-confidence.** We became a good and self-confident team which believes that it can manage anything it does.

**I would like to thank to all my colleagues and I am looking forward to another shared time because the life is one challenge after another and its beauty is hidden in its ordinary and daily singularity.**

**Prof. Dipl.-Ing. Otomar Linhart, DSc.**

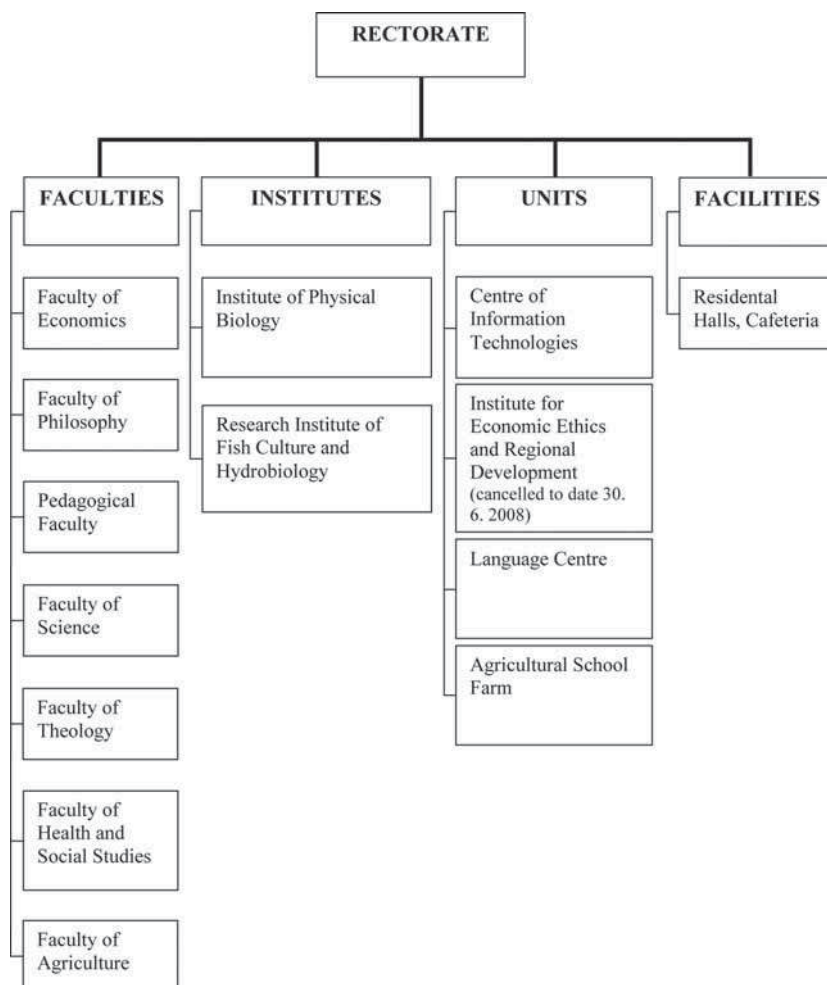
Dean FFPW

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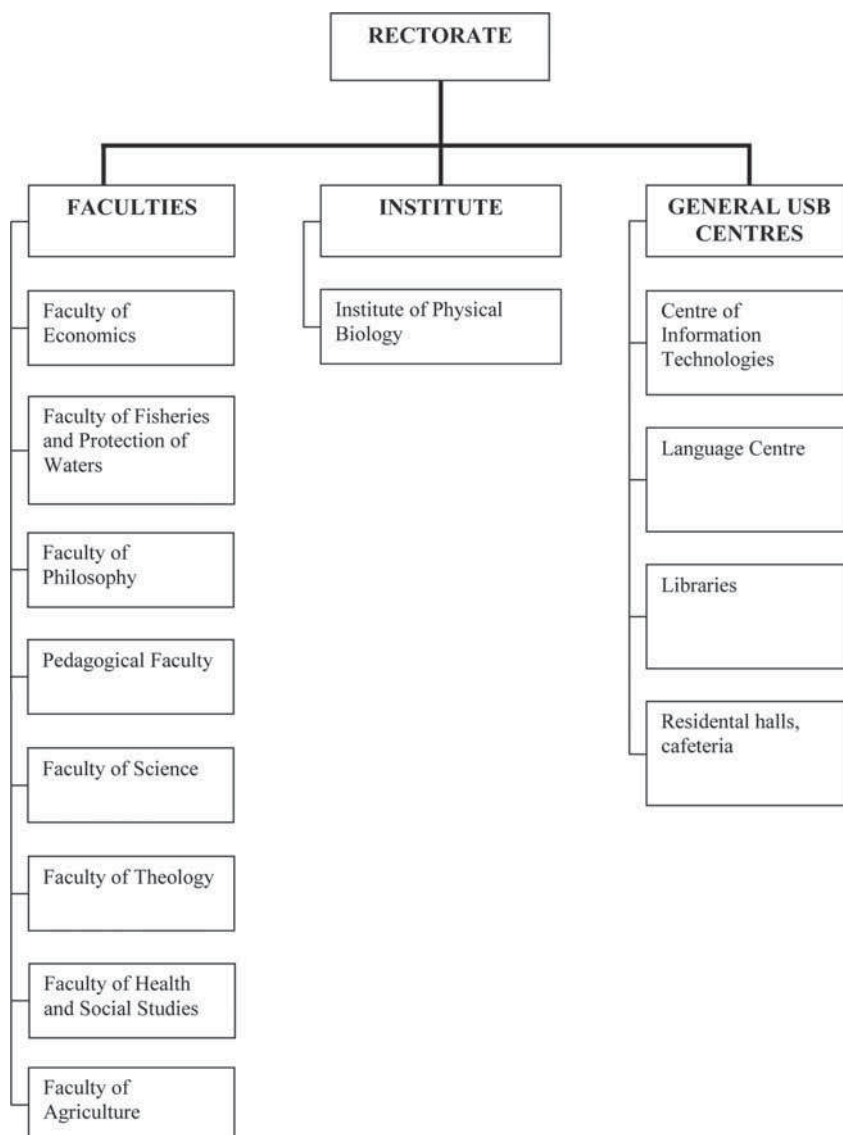
# STRUCTURE OF UNIVERSITY OF SOUTH BOHEMIA (USB) IN ČESKÉ BUDĚJOVICE

Information relevant to the 31st August 2009



# STRUCTURE OF UNIVERSITY OF SOUTH BOHEMIA (USB) IN ČESKÉ BUDĚJOVICE

Information relevant since the 1st September 2009

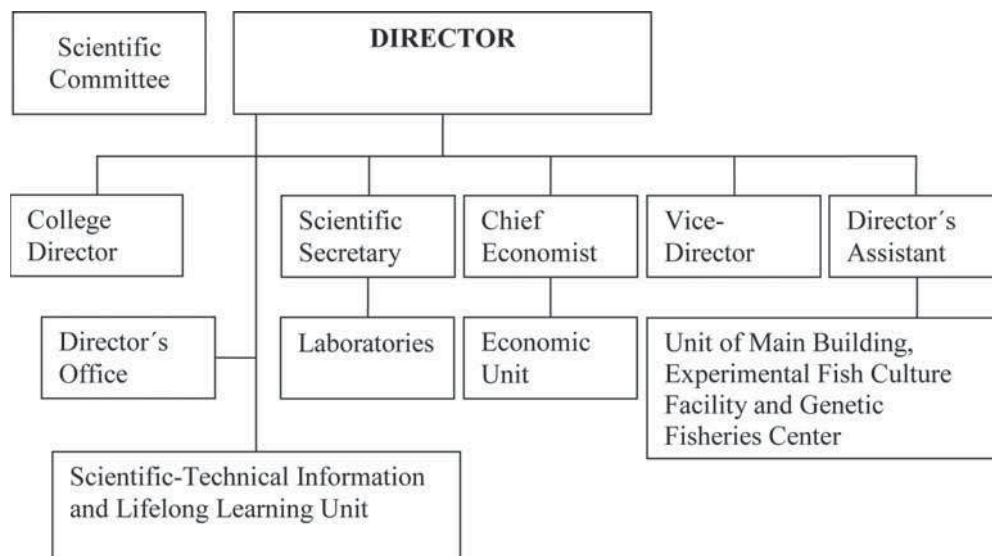




# RESEARCH INSTITUTE OF FISH CULTURE AND HYDROBIOLOGY (RIFCH) IN VODŇANY

Information relevant to the 31st August 2009

## STRUCTURE



### ***Main Building:***

**University of South Bohemia in České Budějovice**

**Research Institute of Fish Culture and Hydrobiology in Vodňany**

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# MANAGEMENT AND CONTACTS OF RIFCH

Information relevant to the 31st August 2009

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<b>Vice-Director</b>	<b>Assoc. Prof. Dipl.-Ing. Pavel Kozák, Ph.D.</b>	kozak@vurh.jcu.cz +420 724 504 921 +420 387 774 603	
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<b>Head of Director's Office, Project Manager</b>	<b>Dipl.-Ing. Petra Plachtová</b>	plachtov@vurh.jcu.cz +420 387 774 602 +420 602 390 634	
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# SCIENTIFIC COMMITTEE OF RIFCH

Information relevant to the 31st August 2009

## Chairman:

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RIFCH Vodňany, University of South Bohemia

## Internal members:

Assoc. Prof. Dipl.-Ing. Jan Kouřil, Ph.D.

RIFCH Vodňany, University of South Bohemia

Assoc. Prof. Dipl.-Ing. Pavel Kozák, Ph.D.

RIFCH Vodňany, University of South Bohemia

Assoc. Prof. Dipl.-Ing. Martin Flajšhans, Dr. rer. agr.

RIFCH Vodňany, University of South Bohemia

Dipl.-Ing. Martin Kocour, Ph.D.

RIFCH Vodňany, University of South Bohemia

Assoc. Prof. MSc. Dalibor Štys, CSc.

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University of South Bohemia

Assoc. Prof. Dipl.-Ing. Petr Hartvich, CSc.

Faculty of Agriculture České Budějovice,  
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Prof. MSc. Libor Grubhoffer, CSc.

Faculty of Science České Budějovice,  
University of South Bohemia

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Prof. Zdeňka Svobodová, DVM, DSc.

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Sciences Brno

Assoc. Prof. Dipl.-Ing. Petr Ráb, DSc.

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Assoc. Prof. MSc. Josef Matěna, CSc.

Institute of Hydrobiology  
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MSc. Jan Pokorný, CSc.

ENKI o.p.s., Třeboň

Dipl.-Ing. Martin Dušek

Agency for Nature Conservation  
and Landscape Protection of the CR, Prague

MSc. Pavel Punčochář, CSc.

Ministry of Agriculture of the CR, Prague

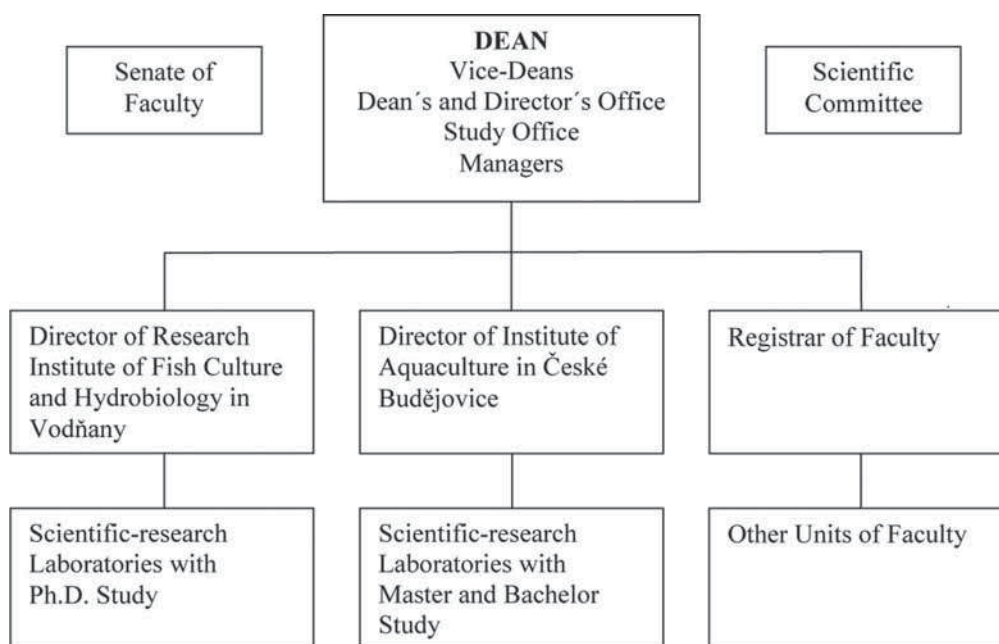
MSc. Petr Roth, CSc.

Ministry of the Environment of the CR, Prague

# FACULTY OF FISHERIES & PROTECTION OF WATERS (FFPW)

Information relevant since the 1st September 2009

## STRUCTURE



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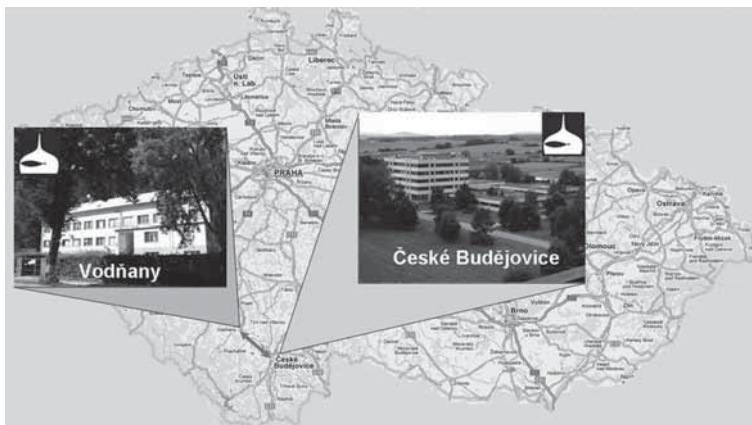
# DESCRIPTION OF FACULTY AND INSTITUTES

*Information relevant since the 1st September 2009*

**Faculty of Fisheries and Protection of Waters** of the University of South Bohemia (FFPW) was established to the 1st September 2009. It consists of the Research Institute of Fish Culture and Hydrobiology in Vodňany (RIFCH) and Institute of Aquaculture in České Budějovice (IA). The FFPW is the most complex workplace within Europe with bachelor, master and postgraduate studies, scientific and applied research, inaugural and professorial rights in the field of fisheries and protection of waters. The faculty has experimental background for study and research of aquaculture, hydrobiology, toxicology, fish diseases, reproduction, genetics, fish and crayfish breeding and a unique library on fisheries.

**The Research Institute of Fish Culture and Hydrobiology** (RIFCH) is nowadays the largest and most complex workplace focused on scientific and especially applied research in the field of fisheries and protection of waters in the Czech Republic. It has a fish farm, purpose river fishing ground, specialized laboratories, aquaristic rooms, two experimental objects for research of reproduction, genetics and fish breeding, intensive breeding of fish and crayfish including recirculation systems with water filtration. The Institute has the largest specialized library on fisheries in the Czech Republic. Periodically organized scientific and expert workshops, professional seminars and summer courses are also an integral part of the Institute's activities. Since 2004, the educational activity of the Institute has been concentrated on managing the doctoral study programme entitled Fisheries accredited at the University of South Bohemia in Czech and English languages.

**Institute of Aquaculture** (IA) in České Budějovice as one of parts of the Faculty of Fisheries and Protection of Waters offers students a wide range of possibilities of narrow specialization in various fields from water management through water protection to commercial or sport fishing. The IA provides especially pedagogic activities, assessment of ecological stability of rivers and reservoirs, monitoring of biological diversity in rivers, migration of fish and their protection, hydrobiology and limnology, nutrition of fish in pond aquaculture, assessment of quality of fish meat, sensory features of fish muscles, determination of texture features of muscles.



# MANAGEMENT AND CONTACTS OF FFPW

Information relevant since the 1st September 2009

## DEAN'S OFFICE

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Information relevant since the 15th December 2009

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FFPW, University of South Bohemia

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FFPW, University of South Bohemia

## Internal Members:

Assoc. Prof. Dipl.-Ing. Jan Kouřil, Ph.D.

FFPW, University of South Bohemia

Assoc. Prof. Dipl.-Ing. Pavel Kozák, Ph.D.

FFPW, University of South Bohemia

Assoc. Prof. Dipl.-Ing. Martin Flajšhans, Dr.rer.agr.

FFPW, University of South Bohemia

Dipl.-Ing. Tomáš Randák, Ph.D.

FFPW, University of South Bohemia

Dipl.-Ing. Marek Rodina, Ph.D.

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University of South Bohemia

## External Members:

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Prof. Dipl.-Ing. Petr Ráb, DSc.

Institute of Animal Physiology  
and Genetics of the ASCR, v. v. i., Liběchov

Assoc. Prof. MSc. Jana Pěkníková, CSc.

Institute of Biotechnology AS CR v. v. i., Prague

Assoc. Prof. MSc. Milan Gelnar, CSc.

Masaryk University, Brno

Prof. Ivo Pavlík, DVM, CSc.

Veterinary Research Institute, Brno

Prof. Dipl.-Ing. Josef Dvořák, CSc.

Mendel University in Brno

MSc. Pavel Punčochář, CSc.

Ministry of Agriculture of the CR, Prague

Assoc. Prof. MSc. Adam Petrusek, Ph.D.

Charles University in Prague, Faculty of Science

Assoc. Prof. MSc. Pavel Stopka, CSc.

Charles University in Prague, Faculty of Science



# SENATE OF FFPW

*Information relevant since the 23rd October 2009*

## **Academisc:**

### **Chairman:**

Dipl.-Ing. Petr Dvořák, Ph.D.	Institute of Aquaculture
Assoc. Prof. Dipl.-Ing. Petr Hartvich, CSc.	Institute of Aquaculture
Assoc. Prof. Dipl.-Ing. František Vácha, CSc.	Institute of Aquaculture
Dipl.-Ing. David Gela, Ph.D.	RIFCH
Dipl.-Ing. Martin Bláha	RIFCH
Assoc. Prof. Dipl.-Ing. Jan Kouřil, Ph.D.	RIFCH
Dipl.-Ing. Tomáš Randák, Ph.D.	RIFCH
Dipl.-Ing. Petra Plachtová	RIFCH

## **Students:**

### **Vice-Chairman:**

Dipl.-Ing. Tomáš Zajíc	Fishery, DSP, 1st year
Dipl.-Ing. Vojtěch Kašpar	Fishery, DSP, 4th year
Dipl.-Ing. Jan Másílko	Fishery, DSP, 1st year
Jakub Zrostlík	Fishery, Bc., 4th year

# RESEARCH PROJECTS

## Year 2008

### PROJECTS SUPPORTED BY THE MINISTRY OF EDUCATION, YOUTH AND SPORT

#### *Institutional research plans*

- MSM6007665809 – *Biological, environmental and breeding aspects in fish culture (2005–2011, leader Prof. Dipl.-Ing. Otomar Linhart, DSc.)*

#### *Research centres*

- LC06073 – *Centre for research of biodiversity (2006–2010, Institute of Systems Biology and Ecology of CAS in České Budějovice, leader for a part solved at RIFCH Prof. Dipl.-Ing. Otomar Linhart, DSc.)*

#### *Bilateral projects – Programme CONTACT*

- ME 855 – *Utilization of noble crayfish (*Astacus astacus* L.) as bioindicator of open waters and support of its occurrence (2006–2009, leader Assoc. Prof. Dipl.-Ing. Tomáš Policar, Ph.D.)*
- ME 853 – *New fish species and rearing aspects in aquaculture (2006–2008, leader Assoc. Prof. Dipl.-Ing. Jan Kouřil, Ph.D.)*

### PROJECTS SUPPORTED BY MINISTRY OF AGRICULTURE

#### *Projects of National Agency for Agricultural Research*

- QH71305 – *Development of new methods of rearing selected promising species for aquaculture using non-traditional technologies (2007–2011, leader Assoc. Prof. Dipl.-Ing. Pavel Kozák, Ph.D.)*
- QH71057 – *Monitoring of the koi herpes virus disease (KHVD) occurrence in breeds of common carp in CR and testing of susceptibility of chosen strains of common carp to KHV (2007–2011, coordinator Veterinary Research Institute in Brno, leader for a part solved at RIFCH Veronika Piačková, DVM, Ph.D.)*
- QH82117 – *Environment friendly and effective pond management with maximal utilisation of current trophic potential and sustainable good water quality and fish production (2008–2012, leader Dipl.-Ing. Jana Máchová)*
- QH82118 – *Maintenance of biodiversity in cultured breeds of common carp (2008–2012, leader Dipl.-Ing. Martin Kocour, Ph.D.)*
- QH82119 – *Research of sperm and embryos cryopreservation (2008–2012, leader Prof. Dipl.-Ing. Otomar Linhart, DSc.)*

#### *Other subsidies and programmes*

- *National programme for conservation and utilization of genetic resources of farm animals – Maintenance of genetic resources in fish (leader Assoc. Prof. Dipl.-Ing. Martin Flajšhans, Dr. rer. Agr.)*

- *Subsidiary programme 2.A.e.1a): Maintenance and improving of genetic quality of farm animals and plants, Controls of performance – fish (leaders Dipl.-Ing. Martin Kocour, Ph.D. and Assoc. Prof. Dipl.-Ing. Martin Flajšhans, Dr. rer. Agr.)*

#### PROJECTS SUPPORTED BY THE GRANT AGENCY OF THE CZECH REPUBLIC

- *524/06/0817 – Ultrastructure, energetic and competition in spermatozoa: A comparative study using two model species of chondrosteian and teleostean fishes (2006–2008, leader Prof. Dipl.-Ing. Otomar Linhart, DSc.)*
- *525/06/P234 – Effect of endocrine disruptors on chub (*Leuciscus cephalus* L.) – experimental studies (2006–2008, leader Dipl.-Ing. Vladimír Žlábek, Ph.D.)*
- *523/06/P142 – The evaluation of growth and reproduction in common barbel (*Barbus barbus* L.) under intensive and controlled conditions (2006–2008, leader Assoc. Prof. Dipl.-Ing. Tomáš Polícar, Ph.D.)*
- *GA524/07/0188 – The role of immune investment in the context of trade-offs: immuno-ecological study of the relationships among reproduction, immunity and parasitism of fresh water fish (2007–2011, Masaryk University in Brno, leader for a part solved at RIFCH Assoc. Prof. Dipl.-Ing. Martin Flajšhans, Dr. rer. Agr.)*
- *GA523/08/0824 – Relationships of ploidy level, genome and cell size in model polyploid fish with cytological and physiological impacts on conservation and culture (2008–2012, leader Assoc. prof. Dipl.-Ing. Martin Flajšhans, Dr. rer. Agr.)*

#### PROJECTS SUPPORTED BY GRANT AGENCY OF THE CZECH ACADEMY OF SCIENCE

- *IAA601870701 – Factors influencing negative impact of invasive crayfish in the Czech Republic: migratory capability, reproduction, and pathogen transmission of crayfish plague pathogen (2007–2009, University of Ostrava, Faculty of Science Ostrava, leader for a part solved at RIFCH Assoc. Prof. Dipl.-Ing. Pavel Kozák, Ph.D.)*
- *IAA608030801 – Diversity of Bioenergetics Pathways, Membrane Functions, Signaling Mechanisms and Proteomics of Cryopreserved Sperm of Evolutionary Different Fish Species (2008–2012, leader Prof. Dipl.-Ing. Otomar Linhart, DSc.)*

#### PROJECTS SUPPORTED BY MINISTRY OF ENVIRONMENT

- *SP/2e7/229/07 – Labe V. (2007–2011, TGM Water Research Institute Prague, leader for a part solved at RIFCH Dipl.-Ing. Tomáš Randák, Ph.D.)*
- *SP/2e7/73/08 – Identification of anthropogenic pressures on the qualitative state of water and water ecosystems in the Morava and Dyje River basins districts (2008–2010, TGM Water Research Institute Prague, leader for a part solved at RIFCH Assoc. Prof. MSc. Zdeněk Adámek, CSc.)*
- *SP/2e7/67/08 – Identification of anthropogenic pressures at the Czech part of the International Odra River Basin (2008–2012, TGM Water Research Institute Prague, leader for a part solved at RIFCH Dipl.-Ing. Jana Máčková)*

## INTERNATIONAL RESEARCH PROJECTS

### 6<sup>th</sup> Framework programme

- COLL-CT-2006-030384-SUSTAINAQUA – *Integrated approach for a sustainable and healthy fresh water aquaculture (2006–2009, Verein zur Foerderung des Technologie Transfers an der Hochschule Bremerhaven E.V., Germany, leader for a part solved at RIFCH Assoc. Prof. MSc. Zdeněk Adámek, CSc.)*
- SSA-043150-SUSTAINAQ – *Sustainable aquaculture production through the use of recirculation systems (2007–2009, Norwegian Institute of Fisheries and Aquaculture Research, Norway, leader for a part solved at RIFCH Assoc. Prof. MSc. Zdeněk Adámek, CSc.)*

## PROJECT SUPPORTED BY GRANT AGENCY OF UNIVERSITY OF SOUTH BOHEMIA

- 57/2007/P-VÚRH – *Competition between gametes of different males and females of common carp during fertilization process (2008, leader Dipl.-Ing. Vojtěch Kašpar)*
- 58/2007/P-VÚRH – *Phylogenetic origin of brown trout populations (*Salmo trutta* L.) in the Balkan Peninsula and their relationship to the populations in the Czech Republic (2008, leader Dipl.-Ing. Jan Kohout)*

## Year 2009

## PROJECTS SUPPORTED BY THE MINISTRY OF EDUCATION, YOUTH AND SPORT

### *Institutional research plans*

- MSM6007665809 – *Biological, environmental and breeding aspects in fish culture (2005–2011, leader Prof. Dipl.-Ing. Otomar Linhart, DSc.)*

### *Research centres*

- LC06073 – *Centre for research of biodiversity (2006–2010, Institute of Systems Biology and Ecology of CAS in České Budějovice, leader for a part solved at FFPW Prof. Dipl.-Ing. Otomar Linhart, DSc.)*

### *Bilateral projects – Programme CONTACT*

- ME 855 – *Utilization of noble crayfish (*Astacus astacus* L.) as bioindicator of open waters and support of its occurrence (2006–2009, leader Assoc. Prof. Dipl.-Ing. Tomáš Policar, Ph.D.)*

### *Projects of international cooperation – Programme COST*

- COST OC-09042 *Common carp (*Cyprinus carpio* L.) welfare in pond aquaculture and market (2009–2011, leader Assoc. Prof. Dipl.-Ing. František Vácha, CSc.)*

## PROJECTS SUPPORTED BY MINISTRY OF AGRICULTURE

### *Projects of National Agency for Agricultural Research*

- QH71305 – *Development of new methods of rearing selected promising species for aquaculture using non-traditional technologies (2007–2011, leader Assoc. Prof. Dipl.-Ing. Pavel Kozák, Ph.D.)*

- QH71011 – Assessment and characteristic of biological potential of product “Czech Carp” (2007–2012, leader Assoc. Prof. Dipl.-Ing. František Vácha, CSc.)
- QH71057 – Monitoring of the koi herpes virus disease (KHVD) occurrence in breeds of common carp in CR and testing of susceptibility of chosen strains of common carp to KHV (2007–2011, Veterinary Research Institute in Brno, leader for a part solved at FFPW Veronika Piačková, DVM, Ph.D.)
- QH82117 – Environment friendly and effective pond management with maximal utilisation of current trophic potential and sustainable good water quality and fish production (2008–2012, leader Dipl.-Ing. Jana Máchová)
- QH82118 – Maintenance of biodiversity in cultured breeds of common carp (2008–2012, leader Dipl.-Ing. Martin Kocour, Ph.D.)
- QH82119 – Research of sperm and embryo cryopreservation (2008–2012, leader Prof. Dipl.-Ing. Otomar Linhart, DSc.)

#### **Projects of National Agency for Agricultural Research with special rules for agriculture and fishery**

- QH92307 – The use of inovative biotechnological and genetical procedures for production of high-quality carp flesh with increased amount of omega 3 fatty acids and its effect on recovery of patients suffering from arterosclerosis (2009–2011, leader Assoc. Prof. Dipl.-Ing. Pavel Kozák, Ph.D.)
- QH91310 – Optimization of artificial induced spawning of females in important commercial fish species (2009–2011, leader Assoc. Prof. Dipl.-Ing. Jan Kouřil, Ph.D.)
- QH92308 – Genetic diversity of sterlet (*Acipenser ruthenus*) concerning in situ and biodiversity conservation (2009–2011, leader Dipl.-Ing. Martin Hulák, Ph.D.)

#### **Other subsidies and programmes**

- National programme for conservation and utilization of genetic resources of farm animals – Maintenance of genetic resources in fish (leader Assoc. Prof. Dipl.-Ing. Martin Flajšhans, Dr. rer. Agr.)
- Subsidiary programme 2.A.e.1a): Maintenance and improving of genetic quality of farm animals and plants, Controls of performance – fish (leaders Dipl.-Ing. Martin Kocour, Ph.D. and Assoc. Prof. Dipl.-Ing. Martin Flajšhans, Dr. rer. Agr.)

### **PROJECTS SUPPORTED BY THE GRANT AGENCY OF THE CZECH REPUBLIC**

- GA524/07/0188 – The role of immune investment in the context of trade-offs: immuno-ecological study of the relationships among reproduction, immunity and parasitism of fresh water fish (2007–2011, Masaryk University in Brno, leader for a part solved at FFPW Assoc. Prof. Dipl.-Ing. Martin Flajšhans, Dr. rer. Agr.)
- GA523/08/0824 – Relationships of ploidy level, genome and cell size in model polyploid fish with cytological and psysiological impacts on conservation and culture (2008–2012, leader Assoc. prof. Dipl.-Ing. Martin Flajšhans, Dr. rer. Agr.)

- GA525/09/P218 – *The Effect of sublethal concentration of triazinons on the common carp (Cyprinus carpio L.) (2009–2011, leader Dipl.-Ing. Josef Velíšek, Ph.D.)*
- GA521/09/0656 – *Algae biomass as feeding supplement in the fish and crayfish aquaculture (2009–2011, Institute of Microbiology of Czech Academy Sciences, leader for a part solved at FFPW Assoc. Prof. Dipl.-Ing. Pavel Kozák, Ph.D.)*
- GA523/09/1793 – *The effect of endocrine disruptors on the reproduction parameters and gene expression in chosen gene of mouse and fish gonads (2009–2011, Biotechnological Institute of Czech Academy Sciences, leader for a part solved at FFPW Hadi Alavi, MSc.)*

#### PROJECTS SUPPORTED BY GRANT AGENCY OF THE CZECH ACADEMY OF SCIENCE

- IAA601870701 – *Factors influencing negative impact of invasive crayfish in the Czech Republic: migratory capability, reproduction, and pathogen transmission of crayfish plague pathogen (2007–2009, University of Ostrava, faculty of Science Ostrava, leader for a part solved at FFPW Assoc. Prof. Dipl.-Ing. Pavel Kozák, Ph.D.)*
- IAA608030801 – *Diversity of Bioenergetics Pathways, Membrane Functions, Signaling Mechanisms and Proteomics of Cryopreserved Sperm of Evolutionary Different Fish Species (2008–2012, leader Prof. Dipl.-Ing. Otomar Linhart, DSc.)*
- KJB608030901 – *Nucleotide polymorphism of mitochondrial genes of common carp: Implication for phylogeography, evolutionary and colonization history (2009–2011, leader Dipl.-Ing. Martin Hulák, Ph.D.)*

#### PROJECTS SUPPORTED BY MINISTRY OF ENVIRONMENT

- SP/2e7/229/07 – *Labe V. (2007–2011, TGM Water Research Institute Prague, leader for a part solved at FFPW Dipl.-Ing. Tomáš Randák, Ph.D.)*
- SP/2e7/73/08 – *Identification of anthropogenic pressures on the qualitative state of water and water ecosystems in the Morava and Dyje River basins districts (2008–2010, TGM Water Research Institute Prague, leader for a part solved at FFPW Assoc. Prof. MSc. Zdeněk Adámek, CSc.)*
- SP/2e7/67/08 – *Identification of anthropogenic pressures at the Czech part of the International Odra River Basin (2008–2012, TGM Water Research Institute Prague, leader for a part solved at FFPW Dipl.-Ing. Jana Máčková)*
- SPII2d1/9/07 – *The biological and ecological requirements of fishes: factors determining the function of fish ladders (2007–2010, leader Assoc. Prof. Dipl.-Ing. Petr Hartvich, CSc.)*

## INTERNATIONAL RESEARCH PROJECTS

### 6<sup>th</sup> Framework programme

- *COLL-CT-2006-030384-SUSTAINAQUA – Integrated approach for a sustainable and healthy fresh water aquaculture (2006–2009, Verein zur Foerderung des Technologie Transfers an der Hochschule Bremerhaven E.V., Germany, leader for a part solved at FFPW Assoc. Prof. MSc. Zdeněk Adámek, CSc.)*
- *SSA-043150-SUSTAINAQ – Sustainable aquaculture production through the use of recirculation systems (2007–2009, Norwegian Institute of Fisheries and Aquaculture Research, Norway, leader for a part solved at FFPW Assoc. Prof. MSc. Zdeněk Adámek, CSc.)*

## PROJECT SUPPORTED BY GRANT AGENCY OF UNIVERSITY OF SOUTH BOHEMIA

- *018/2008/P-VÚRH – Ice-age endurance: difference expressions of sperm proteins before and after cryopreservation in teleost fishes (2009, leader Ping Li, MSc.)*
- *022/2008/P-VÚRH – Impact of sesamin on the content of n-3 fatty acids in common carp (2009, leader Dipl.-Ing. Jan Mráz)*

Processed by: *Pavčina Nováková*

# LIST OF PUBLICATIONS

## Year 2008

### PAPERS IN JOURNALS INCLUDED IN WEB OF SCIENCE (TOTAL 57)

- Alavi, SMH., Pšenička, M., Policar, T., Linhart, O. Morphology and fine structure of *Barbus barbuis* (Teleostei: Cyprinidae) spermatozoa. *Journal of Applied Ichthyology*, 2008, volume 24, issue 4, pp. 378–381, ISSN 0175-8659.
- Alavi, SMH., Pšenička, M., Policar, T., Rodina, M., Kozák, P., Linhart, O. Sperm characteristic in *Barbus barbuis* as a function of nutrition throughout the reproductive season. *Cybium*, 2008, volume 32, issue 2, pp. 200–201, ISSN 0399-0974.
- Alavi, SMH., Pšenička, M., Rodina, M., Policar, T., Linhart, O. Changes of sperm morphology, volume, density and motility and seminal plasma composition in *Barbus barbuis* (Teleostei: Cyprinidae) during the reproductive season. *Aquatic Living Resources*, 2008, volume 21, issue 1, pp. 75–80, ISSN 0990-7440.
- Alavi, SMH., Rodina, M., Cosson, J., Pšenička, M., Linhart, O. Roles of extracellular Ca<sup>2+</sup> and pH on motility and flagellar wave form parameters in sturgeon spermatozoa. *Cybium*, 2008, volume 32, issue 2, pp. 124–126, ISSN 0399-0974.
- Alavi, SMH., Rodina, M., Policar, T., Cosson, J., Kozák, P., Pšenička, M., Linhart, O. Physiology and behavior of stripped and testicular sperm in *Perca fluviatilis* L. 1758. *Cybium*, 2008, volume 32, issue 2, pp. 162–163, ISSN 0399-0974.
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- Buřič, M., Kozák, P., Vích, P. Evaluation of different marking methods for spiny-cheek crayfish (*Orconectes limosus*). *Knowledge and Management of Aquatic Ecosystems*, 2008, volume 389, issue 1, pp. 1–8, ISSN 1961-9502.
- Fabrik, I., Svobodová, Z., Adam, V., Křížková, S., Trnková, L., Beklová, M., Rodina, M., Kizek, R. Metallothionein levels in sperm of various fish species. *Journal of Applied Ichthyology*, 2008, volume 24, issue 4, pp. 522–525, ISSN 0175-8659.
- Flajšhans, M., Rodina, M., Halačka, K., Vetešník, L., Gela, D., Lusková, V., Lusk, S. Characteristics of sperm of polyploid Prussian carp, *Carassius gibelio* (Bloch). *Journal of Fish Biology*, 2008, volume 73, issue 1, pp. 323–328, ISSN 0022-1112.
- Gomulka, P., Wlasow, T., Velíšek, J., Svobodová, Z., Chmielinska, E. Effects of Eugenol and MS-222 Anaesthesia on Siberian Sturgeon *Acipenser baerii* Brandt. *Acta Veterinaria Brno*, 2008, volume 77, issue 3, pp. 447–453, ISSN 0001-7213.
- Havelková, M., Blahová, J., Kroupová, H., Randák, T., Slatinská, I., Leontovyčová, D., Grabic, R., Pospíšil, R., Svobodová, Z. Biomarkers of Contaminant Exposure in Chub (*Leuciscus cephalus* L.) – Biomonitoring of Major Rivers in the Czech Republic. *Sensors*, 2008, volume 8, issue 4, pp. 2589–2603, ISSN 1424-8220.
- Havelková, M., Dušek, L., Némethová, D., Poleszczuk, G., Svobodová, Z., Comparison of Mercury Distribution Between Liver and Muscle – A Biomonitoring of Fish from Lightly and Nespily Contaminated Localities. *Sensors*, 2008, volume 8, issue 7, pp. 4095–4109, ISSN 1424-8220.
- Havelková, M., Svobodová, Z., Kolářová, J., Krijt, J., Démethová, D., Jarkovský, J., Pospíšil, R. Organic Pollutant Contamination of the River Tichá Orlice as Assessed by Biochemical Markers. *Acta Veterinaria Brno*, 2008, volume 77, issue 1, pp. 133–141, ISSN 0001-7213.



- Horký, P., Slavík, O., Bartoš, L. A telemetry study on the diurnal distribution and activity of adult pikeperch *Sander lucioperca* (L.) in a riverine environment. *Hydrobiologia*, 2008, volume 614, issue 1, pp. 151–157, ISSN 0018-8158.
- Hulák, M., Paroulek, M., Šimek, P., Kocour, M., Gela, D., Rodina, M., Linhart, O. Water polluted by 17 $\alpha$ -methyltestosterone provides successful male sex inversion of common carp (*Cyprinus carpio* L.) from gynogenetic offspring. *Journal of Applied Ichthyology*, 2008, volume 24, issue 6, pp. 707–710, ISSN 0175-8659.
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- Hulák, M., Rodina, M., Gela, D., Kocour, M., Linhart, O. Sex control strategies for the masculinization of common carp (*Cyprinus carpio* L.) and tench (*Tinca tinca*). *Cybium*, 2008, volume 32, issue 2, pp. 100–101, ISSN 0399-0974.
- Hulák, M., Rodina, M., Linhart, O. Characteristics of stripped and testicular Northern pike (*Esox lucius*) sperm: spermatozoa motility and velocity. *Aquatic Living Resources*, 2008, volume 21, issue 2, pp. 207–212, ISSN 0990-7440.
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- Zamaratskaia, G., Žlábek, V. EROD and MROD as Markers of Cytochrome P450 1A Activities in Hepatic Mitochondria from Entire and Castrated Male Pigs. *Sensors*, 2009, volume 9, issue 3, pp. 2134–2147, ISSN 1424-8220.



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- Buřič, M., Kouba, A., Policar, T., Kozák, P. Invasive crayfishes in Czech open waters and the mechanisms supporting their negative effect on native crayfish stocks. *Bulletin*, 2009, volume 45, issue 2–3, pp. 5–16, ISSN 0007-389X.
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- Kouba, A., Buřič, M., Policar, T., Kozák, P. Possibilities of artificial incubation, transport and storage of crayfish eggs: A review. *Bulletin*, 2009, volume 45, issue 2–3, pp. 17–24, ISSN 0007-389X.
- Kozák, P., Policar, T., Kouba, A., Buřič, M., Ďuriš, Z. Reintroduction and commercial use of native crayfish species in Europe, reality and prospects in the Czech Republic. *Bulletin*, 2009, volume 45, issue 2–3, pp. 25–33, ISSN 0007-389X.
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- Alavi, S.M.H. *Sperm motility and behavior in models of teleostean and chondrosteian fish*. Ph.D. Thesis. FFPW USB Vodňany, 2009, 146 pp.
- Buřič, M. *Biology of spiny-cheek crayfish (*Orconectes limosus*, Rafinesque, 1817) under conditions of the Czech Republic and the study of factors influencing its invasive spreading*. Ph.D. Thesis. FFPW USB Vodňany, 2009, 145 pp.
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- Kolářová, J., Svobodová, Z. *Therapeutical procedures in fishculture*. Edition of Methodics (Technological series), FFPW USB Vodňany, 2009, No. 88, 30 pp.
- Kouba, A., Hamáčková, J., Kozák, P. *Decapsulation, hatching and rearing of brine shrimps belonging to genus Artemia*. Edition of Methodics (Technological series), FFPW USB Vodňany, 2009, No. 94, 35 pp.
- Kozák, P., Policar, T., Buřič, M., Kouba, A. *Basic morphological characteristics of crayfish in the Czech Republic*. Edition of Methodics (Technological series), FFPW USB Vodňany, 2009, No. 92, 27 pp.
- Másílko, J., Urbánek, M., Hartvich, P., Hůda, J. *Efficient additional feeding with mechanically treated ce-reals in the breed of market carp in fisheries Rybářství Třeboň Hld. a.s.* Edition of Methodics (Technological series), FFPW USB Vodňany, 2009, No. 98, 11 pp.
- Policar, T., Drozd, B., Kouřil, J., Kozák, P., Hamáčková, J., Alavi, SMH., Vavřečka, A. *Recent state, artificial reproduction and rearing of common barbel (Barbus barbus L.) for production of suitable stocking material*. Edition of Methodics (Technological series), FFPW USB Vodňany, 2009, No. 95, 39 pp.
- Policar, T., Stejskal, V., Bláha, M., Alavi, SMH., Kouřil, J. *Technology of intensive culture of Eurasian perch (Perca fluviatilis L.)*. 2009. Edition of Methodics (Technological series), FFPW USB Vodňany, 2009, No. 89, 51 pp.
- Pšenička, M. *Ultrastructure of spermatozoa and fertilization process in sturgeon*. Ph.D. Thesis. FFPW USB Vodňany, 2009, 104 pp.
- Randák, T., Turek, J., Kolářová, J., Kocour, M., Hanák, R., Velíšek, J., Žlábek, V. *Technology of brown trout culture in control conditions for running waters stocks production*. Edition of Methodics (Technological series), FFPW USB Vodňany, 2009, No. 96, 20 pp.
- Randák, T., Turek, J., Kolářová, J., Kocour, M., Kouřil, J., Hanák, R., Velíšek, J., Žlábek, V. *Technology of european grayling broodfish culture in control conditions for sustainable running waters stocks production*. Edition of Methodics (Technological series), FFPW USB Vodňany, 2009, No. 97, 24 pp.
- Stejskal, V. *Intensive culture and reproduction of Eurasian perch (Perca fluviatilis L.)*. Ph.D. Thesis. FFPW USB Vodňany, 2009, 108 pp.
- Sudová, E. *Pharmacovigilance in aquaculture with attention to antibiotics and antiparasitics*. Ph.D. Thesis. FFPW USB Vodňany, 2009, 79 pp.
- Valentová, O., Máchová, J., Faina, R., Kroupová, H., Svobodová, Z. *COMBI set – field water analyses*. 2009. Edition of Methodics (Technological series), FFPW USB Vodňany, 2009, No. 90, 28 pp.

# SCIENTIFIC CITATION INDEX (SCI)










of individual staff: (from Web of Knowledge)

<b>Staff</b>	<b>2008</b>	<b>2009</b>
<b>Laboratory of Ethology and Nutrition of Fish and Crayfish</b>		
Assoc. Prof. Dipl.-Ing. Pavel Kozák, Ph.D.	12	18
Assoc. Prof. MSc. Zdeněk Adámek, CSc.	12	8
Dipl.-Ing. Miloš Buřič, Ph.D.	1	4
Prof. Jana Pícková	37	58
James Sales, Ph.D.	72	45
Dipl.-Ing. Jan Mráz	0	2
<b>Laboratory of Fish Reproduction and Intensive Culture</b>		
Assoc. Prof. Dipl.-Ing. Tomáš Polícar, Ph.D.	8	21
Assoc. Prof. Dipl.-Ing. Jan Kouřil, Ph.D.	11	7
Dipl.-Ing. Andrea Lepičová	5	11
Dipl.-Ing. Vlastimil Stejskal, Ph.D.	0	1
<b>Laboratory of Fish Reproductive Physiology</b>		
Prof. Dipl.-Ing. Otomar Linhart, DSc.	88	93
Dipl.-Ing. Marek Rodina, Ph.D.	50	73
MSc. S. M. H. Alavi, Ph.D.	46	42
MSc. Boris Dzyuba, Ph.D.	5	8
MSc. Sergey Boryshpolets	0	1
MSc. Azadeh Hatef	1	4
<b>Laboratory of Molecular, Cellular and Quantitative Genetics</b>		
Assoc. Prof. Dipl.-Ing. Martin Flajšhans, Dr.rer.agr.	53	28
Dipl.-Ing. Martin Hulák, Ph.D.	4	6
Dipl.-Ing. Martin Kocour, Ph.D.	35	52
Dipl.-Ing. Martin Pšenička, Ph.D.	8	15
Dipl.-Ing. Vojtěch Kašpar	1	1
Msc. Ping Li	5	4
<b>Laboratory of Environmental Chemistry and Biochemistry</b>		
Dipl.-Ing. Tomáš Randák, Ph.D.	23	45
Dipl.-Ing. Vladimír Žlábek, Ph.D.	24	26
MSc. Roman Grabic, Ph.D.	5	19
Jitka Kolářová, DVM	24	39
MSc. Zhihua Li	2	7
<b>Laboratory of Aquatic Toxicology and Ichthyopathology</b>		
Dipl.-Ing. Jana Máchová	15	33
Prof. Zdeňka Svobodová, DVM, DSc.	52	74
Dipl.-Ing. Josef Velišek, Ph.D.	24	32
Dipl.-Ing. Hana Kroupová, Ph.D.	8	23
Veronika Piačková, DVM, Ph.D.	22	22
Eliška Sudová, DVM, Ph.D.	2	8
Dipl.-Ing. Olga Valentová	1	6
<b>Laboratory of Aquaculture</b>		
Assoc. Prof. Dipl.-Ing. Petr Hartvich, CSc.	2	1
Assoc. Prof. Dipl.-Ing. František Vácha, CSc.	2	11
<b>Experimental Fish Culture and Facility</b>		
Dipl.-Ing. Pavel Lepič	3	4
<b>Genetic Fisheries Center</b>		
Dipl.-Ing. David Gela, Ph.D.	43	66
<b>Scientific-Technical Information and Lifelong Learning Unit</b>		
Dipl.-Ing. Blanka Vykusová, CSc.	11	17

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# SCIENTIFIC-RESEARCH LABORATORIES OF RIFCH

## Laboratory of Ethology & Nutrition of Fish & Crayfish

<b>Assoc. Prof. Dipl.-Ing. Pavel Kozák, Ph.D.</b> , Head of Laboratory <i>Research on occurrence, biology, protection and breeding of crayfish, conservation programs of crayfish, research on biology and ethology of introduced crayfish species, research on fish reproduction, roe incubation, rearing and fattening of fish fry in controlled conditions</i>	<a href="mailto:kozak@vurh.jcu.cz">kozak@vurh.jcu.cz</a>	
<b>Dipl.-Ing. Antonín Kouba, Ph.D. student</b> , Assistant manager <i>Distribution, biology, conservation, and breeding of crayfish</i>	<a href="mailto:koubaa00@vurh.jcu.cz">koubaa00@vurh.jcu.cz</a>	
<b>Assoc. Prof. MSc. Zdeněk Adámek, CSc.</b> <i>Applied hydrobiology, influence of piscivorous predators on pond aquacultures</i>	<a href="mailto:adamek@ivb.cz">adamek@ivb.cz</a>	
<b>Dipl.-Ing. Miloš Buřič, Ph.D.</b> (Ph.D. student till 2. 9. 2009) <i>Research of biology and ethology of derived crayfish species</i>	<a href="mailto:buric@vurh.jcu.cz">buric@vurh.jcu.cz</a>	
<b>Prof. Jana Picková</b> <i>Meat quality and fish nutrition</i>	<a href="mailto:jana.pickova@lmv.slu.se">jana.pickova@lmv.slu.se</a>	
<b>James Sales, Ph.D.</b> <i>Fish nutrition, meta-analyses</i>		
<b>Dipl.-Ing. Jan Mráz, Ph.D. student</b> <i>Fish meat quality</i>	<a href="mailto:jmraz@vurh.jcu.cz">jmraz@vurh.jcu.cz</a>	
<b>Dipl.-Ing. Martin Bláha, Ph.D. student</b> <i>Applied hydrobiology</i>	<a href="mailto:blaha@vurh.jcu.cz">blaha@vurh.jcu.cz</a>	
<b>Dipl.-Ing. Jiří Kortan, Ph.D. student</b> <i>Influence of piscivorous predators on pond aquacultures</i>	<a href="mailto:kortan@vurh.jcu.cz">kortan@vurh.jcu.cz</a>	
<b>MSc. Ivo Prikryl</b> <i>Applied hydrobiology</i>	<a href="mailto:prikryl@enki.cz">prikryl@enki.cz</a>	

## ***Undergraduates and bachelors***

Petr Vích	Josef Ťuk	Petr Čtrnáct
Libor Kočí	Jan Zeman	Jakub Mačej
Jiří Chleboun	Daniel Hercig	Michal Pavlíček
Jan Watzek	Karel Němec	Petr Hulan
Ivana Mahovská	Josef Strapina	Jan Opatřil
Jakub Šabata	Jan Šampalík	Chloe Kemigabo

## **RESEARCH PRIORITIES AND SELECTED RESEARCH RESULTS**

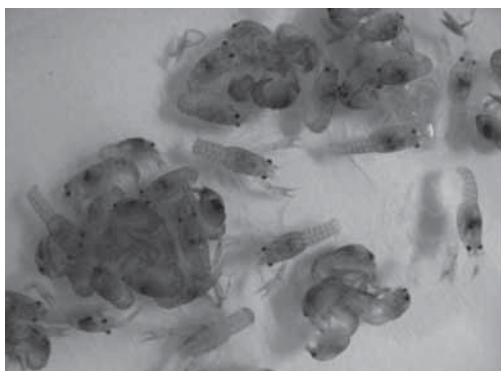
### **LABORATORY ACTIVITIES**

Laboratory activities are divided in several different tasks, particularly on: astacology, fish nutrition and meat quality, hydrobiology, impacts of piscivorous predators on pond aquaculture, and fish ethology.

### **ASTACOLOGY**

Currently solved directions of astacological research are mainly focused on following issues:

- *Reproduction biology – morphology of gonopods, mating, fecundity, embryonic and postembryonic development in crayfish.*
- *Risks dealing with occurrence of alien crayfish species – migratory activity, intra- and inter-specific interactions.*
- *Crayfish breeding – artificial incubation and antifungal treatments of incubated eggs, rearing and reintroductions of cultured crayfish.*
- *Monitoring and distribution of both native and non-native crayfish species.*
- *Native crayfish conservation and related PR activities.*



*Hatched crayfish juveniles obtained with a method of artificial incubation. Differing crayfish size caused by various composition of used diets.*

### ***Selected publications***

Buřič, M., Kozák, P., Kouba, A. Movement patterns and ranging behavior of the invasive spiny-cheek crayfish in a small reservoir tributary. *Fundamental and Applied Limnology*, 2009, volume 174, issue 4, pp. 329–337, ISSN 1863-9135.

- Buřič, M., Kouba, A., Kozák, P. Chelae regeneration in European alien crayfish *Orconectes limosus* (Rafinesque 1817). Knowledge and Management of Aquatic Ecosystems, 2009, volume 394–395, issue 1, pp. 04p1–04p10, ISSN 1961-9502.
- Buřič, M., Kočí, L., Petrušek, A., Kouba, A., Kozák, P. Invaders eating invaders: potential trophic interactions between amphipods *Dikerogammarus villosus* and juvenile crayfish *Orconectes limosus*. Knowledge and Management of Aquatic Ecosystems, 2009, volume 394–395, issue 1, pp. 05p1–05p8, ISSN 1961-9502.
- Buřič, M., Kouba, A., Kozák, P. Spring mating period in *Orconectes limosus*: the reason for movement. Aquatic Sciences, 2009, volume 71, issue 4, pp. 473–477, ISSN 1015-1621.
- Buřič, M., Kozák, P., Vích, P. Evaluation of different marking methods for spiny-cheek crayfish (*Orconectes limosus*). Knowledge and Management of Aquatic Ecosystems, 2008, volume 389, issue 1, pp. 1–8, ISSN 1961-9502.
- Kozák, P., Polícar, T., Fedotov, V., Kuznetsova, T., Buřič, M., Kholodkevich, S. Effect of chloride content in water on heart rate in narrow-clawed crayfish (*Astacus leptodactylus*). Knowledge and Management of Aquatic Ecosystems, 2009, volume 394–395, issue 1, pp. 08p1–08p9, ISSN 1961-9502.
- Polícar, T., Smyth, J., Flanigan, M., Kozák, P., Kouba, A. The effect of different cold period during maternal incubation on incubation efficiency and hatching term in *Austropotamobius pallipes*. Knowledge and Management of Aquatic Ecosystems, 2009, volume 394–395, issue 1, pp. 07p1–07p7, ISSN 1961-9502.
- Kouba, A., Hamáčková, J., Kozák, P. Decapsulation, hatching and rearing of brine shrimps belonging to genus *Artemia*. Edition of Methodics (Technological series), RIFCH USB Vodňany, 2009, No. 94, 35 pp.
- Kozák, P., Buřič, M., Kouba, A., Polícar, T. Methodology of noble crayfish breeding. Edition of Methodics (Technological series), RIFCH USB Vodňany, 2008, issue 83, 36 pp.
- Kozák, P., Polícar, T., Buřič, M., Kouba, A. Basic morphological characteristics of crayfish in the Czech Republic. Edition of Methodics (Technological series), RIFCH USB Vodňany, 2009, No. 92, 27 pp.

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## FISH NUTRITION AND MEAT QUALITY

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The main interest of the laboratory is a fish as the basic source of omega-3 fatty acids (especially EPA and DHA), which are known to play a key role in human nutrition. These fatty acids are essential part of nutrition necessary for the development of the nervous system and for prevention and therapy of various pathological diseases, especially cardiovascular and inflammatory diseases. An important area is the development of feeds using vegetable oils as a substitute of the traditional fish oil. The research is aimed at the improvement of aquaculture sustainability and improvement of nutritional value of fish for consumers. Fish fat contains a large quantity of polyunsaturated fatty acids and thus it is inclined for an oxidation. Therefore, another object of our interest is the optimization of antioxidant additives and storage protocol for decreasing of level of oxidative products.

### ***Selected publications***

- Mráz, J., Pícková, J. Differences between lipid content and composition of different parts of fillets from crossbred farmed carp (*Cyprinus carpio*). Fish Physiology and Biochemistry, 2009, volume 35, issue 4, pp. 615–623, ISSN 0920-1742.



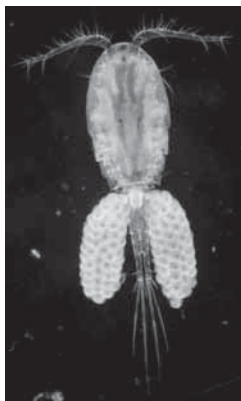
- Pettersson, A., Johnsson, L., Brannaas, E., Picková, J. Effects of rapeseed oil replacement in fish feed on lipid composition and self-selection by rainbow trout (*Oncorhynchus mykiss*). *Aquaculture nutrition*, 2009, volume 15, issue 6, pp. 577–586, ISSN 1353-5773.
- Picková, J. Importance of Knowledge on Lipid Composition of Foods to Support Development towards Consumption of Higher Levels of n-3 Fatty Acids via Freshwater Fish. *Physiological Research*, 2009, volume 58, issue S1, pp. S39–S45, ISSN 0862-8408.
- Trattner, S., Kamal-Eldin, A., Brannaas, E., Moazzami, A., Žlábek, V., Larsson, P., Ruyter, B., Gjøen, T., Picková, J. Sesamin Supplementation Increases White Muscle Docosahexaenoic Acid (DHA) Levels in Rainbow Trout (*Oncorhynchus mykiss*) Fed High Alpha-Linolenic Acid (ALA) Containing Vegetable Oil: Metabolic Actions. *Lipids*, 2008, volume 43, issue 11, pp. 989–997, ISSN 0024-4201.
- Trattner, S., Ruyter, B., Østbye, T., Žlábek, V., Kamal-Eldin, A., Picková, J. Sesamin Increases Alpha-Linolenic Acid Conversion to Docosahexaenoic Acid in Atlantic Salmon (*Salmo salar* L.) Hepatocytes: Role of Altered Gene Expression. *Lipids*, 2008, volume 43, issue 11, pp. 999–1008, ISSN 0024-4201.

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## HYDROBIOLOGY

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The laboratory is involved in monitoring of invertebrate communities both in still and running waters focused on their utilization for evaluation of various types of (not only) fisheries management. Studies in applied hydrobiology are targeted mainly on the description of food relationships in pond polycultures and natural water bodies. Special attention is given to the food habits of new and/or invasive fish species like e.g. topmouth gudgeon (*Pseudorasbora parva*), tubenose goby (*Proterorhinus marmoratus*) and other species of the *Gobiidae* family. In natural waters, the research is focused on the study of food biology of non-commercial cyprinids and their impact on environment quality development in the Hamry and Brno reservoirs. Two-year study was aimed at the feeding behaviour of hatchery reared rainbow trout after their stocking into trout and non-trout angling grounds. It was proved that stocked rainbow trout keep for a long time (in order of months) the ability of active ingestion of non-natural food items but on the other hand, they are able of reflexive ingestion of natural food (above all drifting macrozoobenthos) already since the first day of the release.



Coastal copepod *Acanthocyclops einslei* pictured in dark field

In cooperation with laboratory of molecular, cellular and quantitative genetics, we study relationship between morphological and genetic diversity in planktonic crustaceans using advanced morphological and molecular methods. In fact, we are assessing phylogenetic relationships within copepod genus *Acanthocyclops*. The study is aimed at exact species determination and revealing phylogenetic relationships within such a morphologically difficult copepod genus. Afterwards, these methods could be successfully applied to wider spectrum of planktonic crustaceans in order to determine exactly the particular species, since some of them suffer from high phenotypic plasticity and/or possible interspecific hybridization.

Based on genetic and morphological diversity we are able to presume general patterns of species dispersal or rate of relatedness.

Beside this, we analyze zooplankton community in ponds, i.e. abundance and species composition with special regards to carp feeding and its flesh quality, as well as feeding selectivity of fish including rare and endangered species (e.g. weather loach – *Misgurnus fossilis*). In running waters, biological evaluation of different localities is provided based on species composition of macroinvertebrates as well as fish community.

### ***Selected publications***

Šetlíková, I., Květ, J., Adámek, Z. Limnological changes in a pond ecosystem cause by grass carp (*Ctenopharyngodon idella* Val.) low stocking density. Czech Journal of Animal Science: Živočišná výroba, 2009, volume 54, issue 1, pp. 31–45, ISSN 1212-1819.

Jančula, D., Míkovcová, M., Adámek, Z., Maršálek, B. Changes in the photosynthetic activity of *Microcystis* colonies after gut passage through Nile tilapia (*Oreochromis niloticus*) and silver carp (*Hypophthalmichthys molitrix*). Aquaculture Research, 2008, volume 39, issue 3, pp. 311–314, ISSN 1355-557X.

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## **INFLUENCE OF FISH-EATING PREDATORS ON POND AQUACULTURE**

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The research is recently focused on great cormorant (*Phalacrocorax carbo sinensis*). Besides food spectrum, which has been studied all over the Europe and nowadays is well known, the main interest is focused on studying of influence of hunting cormorant on pond fish stock behaviour (stress reactions of fish, escapement into littoral zones of the pond and hiding) and fish condition (fish wounding and parasite infections). These secondary aspects cause significant economic losses to fish farmers; therefore, detailed studies dealing with indirect losses caused by cormorants are highly required.



Using of image analysis software to determine extent of injuries caused by great cormorant (A)  
And fish stock crowded into littoral vegetation of the pond by hunting cormorants (B).

### ***Selected publications***

Kortan, J., Adámek, Z., Flajšhans, M., Piačková, V. Indirect manifestation of cormorant (*Phalacrocorax carbo sinensis* (L.) predation on pond fish stock. Knowledge and Management of Aquatic Ecosystems, 2008, volume 389, issue 1, pp. 1–11, ISSN 1961-9502.

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## **FISH ETHOLOGY**

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Outcomes of this section are based on close collaboration with the **Laboratory of Fish Reproduction and Intensive Culture**. Our laboratory is specialized in ethological approaches in intensive fish culture, spawning and fry nursing of river fish species (barbel, vimba bream, dace, ide).

### ***Selected publications***

Relevant co-authored publications are listed in the section of the Laboratory of Fish Reproduction and Intensive Culture.



## INTERNATIONAL COOPERATION

The laboratory cooperates with several foreign institutions, i.e.:

- *Swedish University of Agricultural Sciences, Department of Food Science, Division: Meat and Fish Uppsala, Sweden (Prof. Jana Picková) – Fish meat quality.*
- *University of Florence, Department of Evolutionary Biology, Florence, Italy (Dr. Francesca Gherardi) – Crayfish ethology, ecology.*
- *Univerzita of Leon, Departamento de Producción Animal II, Facultad de Veterinaria, León, Spain (Carral Jose M.) – Artificial incubation of crayfish.*
- *University of Dublin, Dept of Zoology, Trinity College, Dublin, Ireland (Reynolds Julian) – Biology and crayfish breeding.*
- *Universita Poitiers, Génétique et Biologie des Populations de Crustacés, Poitiers, France (Souty-Grosset Catherine, Frédéric Grandjean) – Crayfish genetics, problems of management and protection of original crayfish species.*
- *University of Suleyman Demirel, Isparta, Turkey (Ibrahim Diler) – Crayfish breeding*

## APPLICATION OF SCIENTIFIC RESULTS IN PRACTICE AND OTHER ACTIVITIES OF THE LABORATORY

The laboratory closely cooperates with private bodies and other research organizations by a form of shared projects, contractual research or by applying of methodical or technological enterprises in practise. The institutions regularly cooperating with the laboratory are as follows:

- *The Faculty of Science of the University of Ostrava; the Faculty of Science of the Charles University in Prague; Mendel University in Brno; Institute of Vertebrate Biology, Academy of Sciences of the Czech Republic, v.v.i. in Brno; T. G. Masaryk Water Research Institute in Prague; Institute For Clinical and Experimental Medicine (ICEM) in Prague*
- *Blatná Fish Ltd.; Fisheries Mariánské Lázně Ltd.; Production of feed Ltd. Stříbrné Hory*
- *NP a PLA Šumava, town Písek; town Domažlice*
- *Jaroslav Vaniš – fish breeding, Czech Union for Nature Conservation*

Further, the laboratory's workers are engaged in the education of students of the Faculty of Fisheries and Protection of Waters, the University of South Bohemia in České Budějovice within the frame of following subjects:

- *Fundamentals of fisheries,*
- *Ichthyology a fundamentals of fisheries,*
- *Protection and culture of crustaceans and flaks,*
- *Crayfish breeding.*

# SCIENTIFIC-RESEARCH LABORATORIES OF RIFCH

## Laboratory of Fish Reproduction and Intensive Culture

<b>Assoc. Prof. Dipl.-Ing. Tomáš Polícar, Ph.D.</b> , Head of Laboratory <i>Intensive fish culture (barb, perch, pikeperch), biology and culture of crayfish</i>	<a href="mailto:policar@vurh.jcu.cz">policar@vurh.jcu.cz</a>	
<b>Assoc. Prof. Dipl.-Ing. Jan Kouřil, Ph.D.</b> Assistant manager <i>Hormonally induced ovulation in fish, intensive aquaculture, recirculation aquaculture systems, anaesthetics in aquaculture</i>	<a href="mailto:kouril@vurh.jcu.cz">kouril@vurh.jcu.cz</a>	
<b>Dipl.-Ing. Andrea Lepičová</b> (maternity leave) <i>Fish reproduction, incubation of eggs, culture of fingerlings in controlled conditions, feeding and nutrition of fingerlings</i>	<a href="mailto:lepicova@vurh.jcu.cz">lepicova@vurh.jcu.cz</a>	
<b>Dipl.-Ing. Vlastimil Stejskal, Ph.D.</b> (Ph.D. student till 2. 9. 2009) <i>Intensive fish culture (perch, pikeperch), recirculation aquaculture systems</i>	<a href="mailto:stejskal@vurh.jcu.cz">stejskal@vurh.jcu.cz</a>	
<b>MSc. Peter Podhorec, Ph.D. student</b> <i>Hormonal stimulation of fish reproduction, elimination of reproductive dysfunction, intensive aquaculture</i>	<a href="mailto:podhop01@vurh.jcu.cz">podhop01@vurh.jcu.cz</a>	
<b>MSc. Bořek Drozd, Ph.D. student</b> <i>Early ontogeny of fish, ploidy level, biology of protected species</i>	<a href="mailto:drozd@vurh.jcu.cz">drozd@vurh.jcu.cz</a>	
<b>MSc. Jiri Bossuyt, Ph.D. student</b> <i>Production of all-female populations and triploidization in percids</i>	<a href="mailto:bossuj00@frov.jcu.cz">bossuj00@frov.jcu.cz</a>	
<b>Dipl.-Ing. Viktor Viliam Švinger, Ph.D. student</b> <i>Artificial reproduction and culture of salmonids</i>	<a href="mailto:svingv00@frov.jcu.cz">svingv00@frov.jcu.cz</a>	
<b>Dipl.-Ing. Jiří Křišťan, Ph.D. student</b> <i>Reproduction and culture of percids</i>	<a href="mailto:kristj01@frov.jcu.cz">kristj01@frov.jcu.cz</a>	

### ***Undergraduates and bachelors***

Antonín Vavrečka  
Petr Trnka  
Pavel Benedikt

Tomáš Borkovec  
Karel Olbert  
Dagmar Jablonická

Miroslav Blecha  
Jiří Hájíček  
Jan Matoušek



*Members of Laboratory of Fish Reproduction and Intensive Culture – Vlastimil Stejskal, Jan Kouřil, Peter Podhorec, Bořek Drozd, Viktor Švinger, Tomáš Polícar and Jiří Kříšťan in the front*

## RESEARCH PRIORITIES

Laboratory is focused on research of culture technologies and patterns in aquaculture including intensive fish farming, recirculation aquaculture systems (RAS), fish reproduction (hormonal and environmental stimulation of spawning), rearing of early life stages of important and endangered fish species, optimization of rearing conditions and nutrition, applied hydrobiology and feeding biology of fish in ponds.

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### 1. CONTROLLED REPRODUCTION OF FISH

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The objective of this research is to optimise procedures of hormonal induction of spawners' ovulation for purposes of artificial (or semi-artificial) propagation in various original and introduced fish species. The range of fish species is wide. It includes traditional economically important fish species (common carp, sheatfish, tench, pike, pikeperch, grass carp, silver carp), species newly introduced into aquaculture (perch, African catfish, sturgeons), fish species from running and still waters (grayling, barbel, vimba, chub, asp, crucian carp) as well as ornamental fish species including tropical fish. We focus our efforts on gradual substitution of the prevailing method based on application of carp pituitary, containing gonadotropins, with synthetic preparations. Synthetic preparations based on gonadotropin releasing hormone (GnRH) or its functional analogues (GnRHa) with or without dopamine inhibitor are used. Both pure chemical substances and commercially offered preparations (Supergestran, Dagin, Ovipel, Gonazon) are tested. The research is focused also on the studying the impact of water temperature on the latency interval (time interval from injecting the hormonal substances to achieving the ovulation and possibility of artificial spawning). Basic assessed parameters are: percentage of ovulating spawners, fertility characteristics, fertilization and hatching rate of eggs, viability of hatched fingerlings, and survival of spawners and possibility of their repeated usage in reproduction process. Studies include in some cases also assessment of histological changes of gonads and fluctuation of levels of sex hormones in blood plasma.



Artificial spawning of channel catfish and pikeperch

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## 2. USAGE OF ANAESTHETICS IN AQUACULTURE

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This part of research experimentally determines optimal concentrations and exposure time to various anaesthetics (clove oil, Propiscin, MS-222 and 2-phenoxyethanol) for wide range of economically important fish species (about 30 species). The sensitivity of fish to selected anaesthetics in dependence on water temperature and fish weight is at the same time tested for some fish species. In some cases, effect of anesthetics on stress factors in blood plasma is studied.

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## 3. FISH CULTURE UNDER INTENSIVE CONDITIONS

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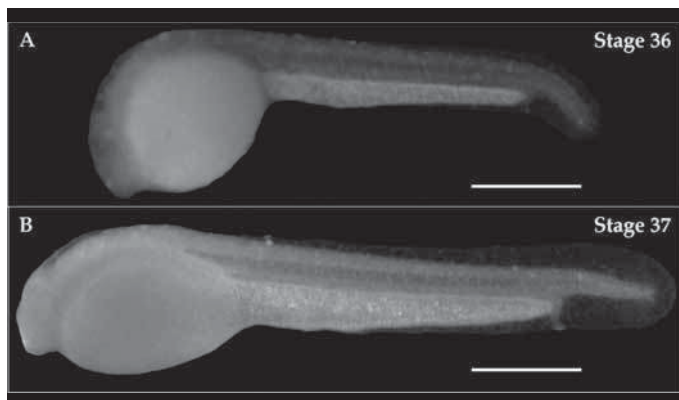
Attention is focused especially on introduction of non-traditional fish species into the intensive aquaculture (e.g.: perch, tench, pikeperch) and also on elaboration of technological procedures for thermophilic (e.g.: European catfish, African catfish, Nile tilapia) and cold-water (e.g.: rainbow trout, brook trout) fish species of economical importance. A part of the research concerns also the assessment of fish growth and conversion of nutrients in dependence on density of fish stocks, study of oxygen consumption and production of ammonia in various fish species in dependence on fish size, water temperature and intensity of feeding. This research also deals with assessment of effectivity of all-female or triploid stocks culture in selected fish species under specific rearing conditions. We also monitor efficiency of experimental and productional recirculation systems as a whole, including their water treatment part and cleaning technology, for intensive fish culture.

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## 4. PRODUCTION AND CULTURE OF EARLY DEVELOPMENTAL STAGES OF FISH

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The research is focused on optimising the nutrition and environmental conditions for culture of fingerlings (larval and juvenile developmental stages) of various economically important, ornamental, rheophilous and endangered fishes under controlled rearing conditions. Research activities are thus centred on the production of high-quality fish stock material designated for open waters. Presently, an attention is focused especially on culture of barbel *Barbus barbus* (L.), vimba *Vimba vimba* (L.), perch *Perca fluviatilis* L., pikeperch *Sander lucioperca* (L.) and various sturgeon species. The research activities also include studying the effect of abiotic environmental conditions (especially temperature, pH, oxygen) on early life history of selected fish species, e.g. weatherfish *M. fossilis* (L.), tench *Tinca tinca* (L.) and African catfish *Clarias gariepinus* (Burchell, 1822).



Early developmental stages of weatherfish, *Misgurnus fossilis*



Weatherfish, *M. fossilis* brood stock

## 5. STUDY OF WEATHERFISH BIOLOGY

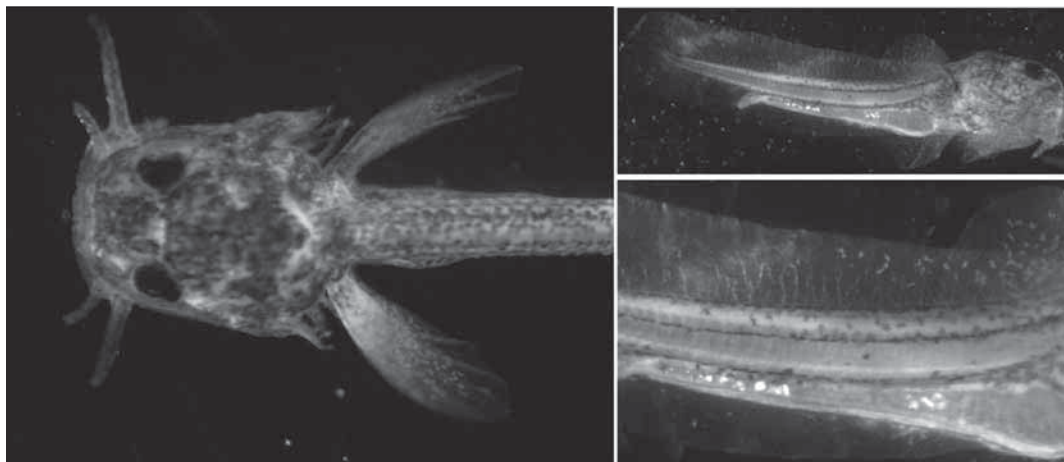
Weatherfish *Misgurnus fossilis* (L.) is hidden living cobitid fish inhabiting slowly flowing or stagnant waters heavily overgrown with water vegetation. *M. fossilis* belongs to endangered species in the Czech Republic as well as in European ichthyofauna (both, the fish itself and localities of its natural occurrence are involved into NATURA 2000 network). *M. fossilis* belongs to key fish species in terms of understanding and explanation of: (1) importance of the river flood-plain areas for fish reproduction and early developmental stages distribution, and (2) a specific populational dynamics in environments with unstable, periodically fluctuating living conditions. Research activities on *M. fossilis* are especially centred on studying the early life history with regard to selected abiotic environmental factors, and further to ploidy level of the fish and its relation to the dynamics of morphological characteristics.

## SELECTED PUBLICATIONS

### EFFECT OF TEMPERATURE ON EARLY LIFE HISTORY IN WEATHERFISH

Effect of incubation temperature (range: 9–36 °C; interval: 3 °C) on artificially propagated weatherfish *Misgurnus fossilis* (L.) early ontogeny (during interval from egg fertilization to the finish of hatching) was investigated in this study. Both, the amplitude of the incubation period (evaluated in four crucial moments) and the total hatching period duration were inversely proportional to the incubation temperature and ranged from 17.5 days at 9 °C to 1.8 days at 24 °C (expressed at H50) or from 137 hours at 9 °C to 9 hours at 24 °C, respectively. There was no influence of rising temperature on the total length of newly hatched larvae (TL = 4.23–4.67 mm), in contrast to negative correlation with developmental stage (9–18 °C: stage 37; 21–24 °C: stage 36), *i.e.* the length might determine the age at hatching, rather than the age at hatching determines the hatching length. The thermal tolerance range in term of survival lies between 9 and 24 °C (the thermal optimum 15–24 °C, *i.e.* weatherfish is a warm-mesothermic species). Temperatures above 24 °C (in our study 27–36 °C) are considered as lethal already during embryonic period. Temperatures in range 9–12 °C were suboptimal for the given ontogenic stages in our study. In order to test those temperatures for other stages of early ontogeny, appropriate experiments should be done.

Drozd, B., Kouřil, J., Bláha, M., Hamáčková, J. Effect of temperature on early life history in weatherfish, *Misgurnus fossilis* (L. 1758). Knowledge and Management of Aquatic Ecosystems, 2009, volume 392, issue 4, pp. 1–17, ISSN 1961-9502.



Detail of weatherfish (*Misgurnus fossilis*) larvae

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### **HORMONAL INDUCTION OF TENCH (*TINCA TINCA*) OVULATION OVER TWO CONSECUTIVE REPRODUCTIVE SEASONS**

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This study compared different protocols focused on inducing ovulation in tench over two consecutive spawning periods. The results showed that the Dagin preparation, containing GnRH $\alpha$  and a dopamine inhibitor, was the most efficient in terms of ovulation ratio and the amount of eggs stripped from the brood stock.

Kouřil, J., Mráz, J., Hamáčková, J., Barth, T. Hormonal induction of tench (*Tinca tinca* L.) ovulation with the same treatments over two consecutive reproductive seasons. *Cybium*, 2008, volume 32, issue 2, p. 61, ISSN 0399-0974.

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### **INDUCTION OF FINAL OOCYTE MATURATION IN CYPRINID FISH BY HYPOTHALAMIC FACTORS**

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This study reviewed present knowledge in induction of ovulation using hypothalamic factors. Gonadotropin-releasing hormone in *Cyprinidae*, as in other Vertebrates, functions as a brain signal, which stimulates the secretion of luteinizing hormone from the pituitary gland. Two forms of gonadotropin-releasing hormone have been identified in cyprinids, chicken gonadotropin-releasing hormone II and salmon gonadotropin-releasing hormone. Hypophysiotropic functions are fulfilled mainly by salmon gonadotropin-releasing hormone. Dopamin is the only known factor having an inhibitory effect on LH secretion in the family *Cyprinidae*. Most cyprinids reared under controlled conditions exhibit signs of reproductive dysfunction, which is manifested by failure to undergo final oocyte maturation and ovulation. In captivity a disruption of endogenous gonadotropin-releasing hormone stimulation occurs and sequentially that of the luteinizing hormone, which is indispensable for the final phases of gametogenesis. In addition to methods based on the application of exogenous gonadotropins, the usage of a method functioning on hypothalamic control of final oocyte maturation and ovulation has become popular recently. The replacement of natural gonadotropin-releasing hormones with chemically synthesized gonadotropin-releasing hormone analogues characterized by amino acid substitutions at positions sensitive to enzymatic degradation has resulted in a centuple increase of the effectiveness of luteinizing hormone secretion induction.

Combining gonadotropin-releasing hormone analogues with Dopamine inhibitory factors made possible to develop an extremely effective agent, which is necessary for the successful artificial reproduction of cyprinids.

Podhorec, P., Kouřil, J. Induction of final oocyte maturation in Cyprinidae fish by hypothalamic factors: a review. *Veterinární medicína*, 2009, volume 54, issue 3, pp. 97–110, ISSN 0375-8427.

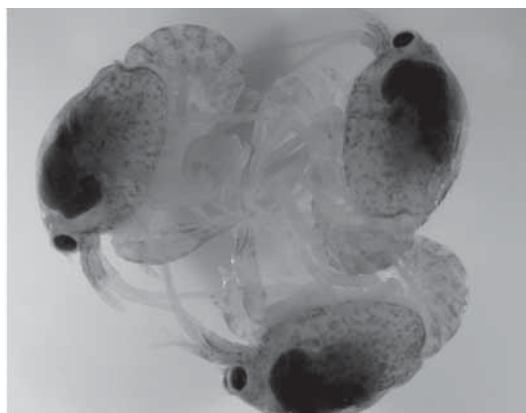
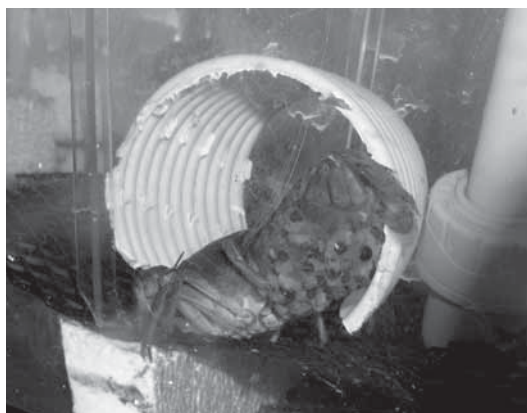
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#### **THE EFFECT OF DIFFERENT COLD PERIOD DURING MATERNAL INCUBATION ON INCUBATION EFFICIENCY AND HATCHING TERM IN AUSTROPOTAMOBIOUS (*AUSTROPOTAMOBIOUS PALLIPES*)**

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This study tested the effect of five different periods (duration: 45, 60, 75, 90 and 105 days) of decreased water temperature (below 5 °C) during maternal incubation of eggs in *Austropotamobius pallipes* on incubation efficiency (E in %) and hatching term. The experimental groups were compared with crayfish maintained under ambient Irish water temperatures. The six different durations of cold period, used in this study, caused six different terms of hatching from 16 March to 29 June. When compared to the group held under ambient Irish conditions with fluctuating water temperatures during the incubation period ( $E = 29.9 \pm 4.5\%$ ), higher incubation efficiency was found in all groups under the controlled conditions ( $E = 73.1 \pm 4.7\% - 41.3 \pm 2.7\%$ ). In groups under controlled conditions, a positive effect of shortened cold period on incubation efficiency was found, with the highest efficiency ( $E = 73.1 \pm 4.7\% - 68.8 \pm 5.2\%$ ) found after the shortest cold period, while the longest cold period led to the lowest efficiency ( $E = 41.3 \pm 2.7\%$ ).

Polícar, T., Smyth, J., Flanigan, M., Kozák, P., Kouba, A. The effect of different cold period during maternal incubation on incubation efficiency and hatching term in *Austropotamobius pallipes*. *Knowledge and Management of Aquatic Ecosystems*, 2009, volume 394–395, issue 1, pp. 07p1–07p7, ISSN 1961-9502.



*Austropotamobius pallipes* female and first developmental stage of their offspring

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## HORMONALLY INDUCED OVULATION IN EURASIAN PERCH (*PERCA FLUVIATILIS* L.) BY GNRH WITH AND WITHOUT METOCLOPRAMIDE

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Different doses of two hormonal preparations containing GnRHa for successful induction of ovulation in perch were tested in this study. In the group treated with Dagin, (GnRHa + metoclopramide) intermediate doses (12.5 µg GnRHa + 25 mg metoclopramide kg<sup>-1</sup> BW) provided successful results. In the group treated with Supergestran (without metoclopramide), higher doses (100 and 50 µg GnRHa kg<sup>-1</sup> BW) were optimal. No spawning was observed in the control group treated by saline solution. Higher doses of hormones led to shorter latency interval. No differences in fecundity were observed.

Polícar, T., Kouřil, J., Stejskal, V., Hamáčková, J. Induced ovulation of perch (*Perca fluviatilis* L.) by preparations containing GnRHa with and without metoclopramide. *Cybium*, 2008, volume 38, issue 2, pp. 308, ISSN 0399-0974.

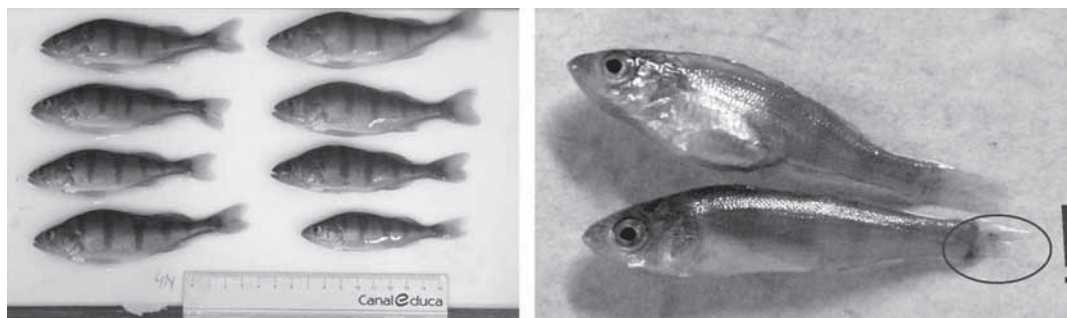
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## THE GROWTH PATTERN OF ALL-FEMALE PERCH (*PERCA FLUVIATILIS* L.) JUVENILES – IS MONOSEX PERCH STOCK BENEFICIAL?

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The objective of this study was to evaluate overall profitability of culture in monosex all-female stock (MS) compared to production characteristics of bisexual stock (BS) in Eurasian perch (*Perca fluviatilis* L.) under intensive conditions. Monosex all-female stock was produced by mating of masculinized females (neomales) with common females of a local strain, whereas bisexual stock was obtained from local strain perch broodstock. Duration of the experiment was 126 days, preceded by pond-nursing (60 days) and habituating (14 days) periods. Perch were held in 50 L aquaria connected to a recirculation system, with each group tested in triplicate. No significant differences ( $P = 0.07$ ) in total survival were observed after 126 days of rearing between all-female and bisexual stock, but MS gained 20% more ( $P = 0.04$ ) in total body weight, the final weight being ( $25.2 \pm 9.7$  g; mean  $\pm$  S.D.) compared to BS fish ( $21.0 \pm 7.5$  g). Therefore, it is suggested that the culture of monosex female perch might provide a significant economic benefit. Overall feed conversion ratio for tanks with BS ( $1.43 \pm 0.21$ ) was significantly ( $P = 0.02$ ) higher than in tanks with MS ( $1.30 \pm 0.11$ ) perch.

Stejskal, V., Kouřil, J., Musil, J., Hamáčková, J., Polícar, T. Growth pattern of all-female perch (*Perca fluviatilis* L.) juveniles – is monosex perch culture beneficial? *Journal of Applied Ichthyology*, 2009, volume 25, issue 4, pp. 432–437, ISSN 0175-8659.



Fish from all-female population of perch and habituated (above) and non-habituated (below) perch juveniles



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## SIZE-RELATED OXYGEN CONSUMPTION AND AMMONIA EXCRETION OF EURASIAN PERCH (*PERCA FLUVIATILIS* L.) REARED IN A RECIRCULATION SYSTEM

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This study was focused on metabolic rate of Eurasian perch. Therefore, oxygen consumption (OC) and ammonia excretion rates (AE) of perch were measured in semi-commercial conditions (temperature 23.3 °C) in both fed (F) and feed-deprived groups (D). Measurements of both groups with different mean body weight (range 44.8–336.2 g) were taken in six sized cohorts of perch in triplicate. Mean daily OC was 288.3–180.6 mg O<sub>2</sub> kg<sup>-1</sup> h<sup>-1</sup> for group F fish ranging in size from 44.8 to 279.4 g. Mean daily AE expressed as total ammonia nitrogen (TAN) was 13.8–5.2 mg TAN kg<sup>-1</sup> h<sup>-1</sup> in this group. Daily peaks of OC in the group F were observed 6 h after the onset of feeding for each size group with relatively stable values up to the end of feeding. Peaks of daily AE in perch group F were observed 10 h after the onset of feeding in each size group with a rapid decrease up to 16 h after onset. In the group D, OC was 181.1–110.5 mg O<sub>2</sub> kg<sup>-1</sup> h<sup>-1</sup> in the weight range 57.9–336.2 g. Daily mean AE was 1.7–0.5 mg TAN kg<sup>-1</sup> h<sup>-1</sup> in this group. No dramatic peaks of OC and AE in the group D were observed.

Stejskal, V., Kouřil, J., Valentová, O., Hamáčková, J., Polícar, T. Size-related oxygen consumption and ammonia excretion of Eurasian perch (*Perca fluviatilis* L.) reared in a recirculating system. *Aquaculture Research*, 2009, volume 41, issue 1, pp. 135–142, ISSN 1355-557X.

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## CULTURE OF SALMONIDS, GRAYLING AND WHITEFISHES

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Publication includes a short characterization of fish species such as rainbow trout, brook trout, brown trout, Arctic charr, grayling, Atlantic salmon, Pacific salmon and whitefish (coregonids). Ponds, flow-trough raceways, cages as well as closed recirculation system with different filters, foam separation, nitrification and denitrification units for the intensive culture of these fish species are described. Likewise, application of pure oxygen, degassing, ozonation and UV treatment is noted. Particular chapters describe stripping, manipulation with fish gametes, incubation of eggs, rearing of fingerlings, marketable and broodstock fish, feeding, sludge production, oxygen consumption, and ammonia excretion. The impact of intensive fish production upon the water quality is also discussed. Practical information including the harvesting, transport of the live fish, management and production of trout and grayling for the stocking, reintroduction of Atlantic salmon, anaesthesia are involved.

Kouřil, J., Mareš, J., Pokorný, J., Adámek, Z., Randák, T., Kolářová, J., Palíková, M. Salmonid, grayling and whitefish culture. Vodňany: University of South Bohemia in České Budějovice, Research Institute of Fish Culture and Hydrobiology, 2008. 141 pp. ISBN 978-80-85887-80-8.

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## FARMING OF EURASIAN PERCH: REPRODUCTION AND SPAWNING

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The team of authors from RIFCH with other colleagues from France, Ireland, Belgium and Denmark published a handbook about intensive culture of perch in 2008. The team of authors from RIFCH was responsible for chapter relevant to perch reproduction under controlled conditions, especially hormonal stimulated spawning, artificial fertilization, artificial egg incubation, hatching of larvae and effect of rearing conditions on the quality of egg, sperm and larvae within intensive culture.

Polícar, T., Toner, D., Alavi, S.M.H., Linhart, O., 2008. Reproduction and Spawning. In: Farming of Eurasian Perch Volume 1. Juvenile production (Rougeot C., Torner D. eds), Special publication BIM, No. 24, pp. 22–29.

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## **CONTROLLED REPRODUCTION AND LARVAL AND JUVENILE CULTURE IN RUDD (*SCARDINIUS ERYTHROPHthalmu*) AND GUDGEON (*Gobio Gobio*)**

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Within the framework focused on the optimization of spawning of our native cyprinids species a methodology describing methods of hormonally induced propagation, incubation of eggs and rearing of larvae and juveniles of rudd (*Scardinius erythrophthalmu*) and gudgeon (*Gobio gobio*) was published.

Kouřil, J., Hamáčková, J., Lepičová, A., Adámek, Z., Lepič, P., Kozák, P., Policar, T. Hormonally induced of propagation and rearing of alevins in rudd and gudgeon. Edition of Methodics (Technological series), RIFCH USB Vodňany, 2008, issue 69, 11 pp.

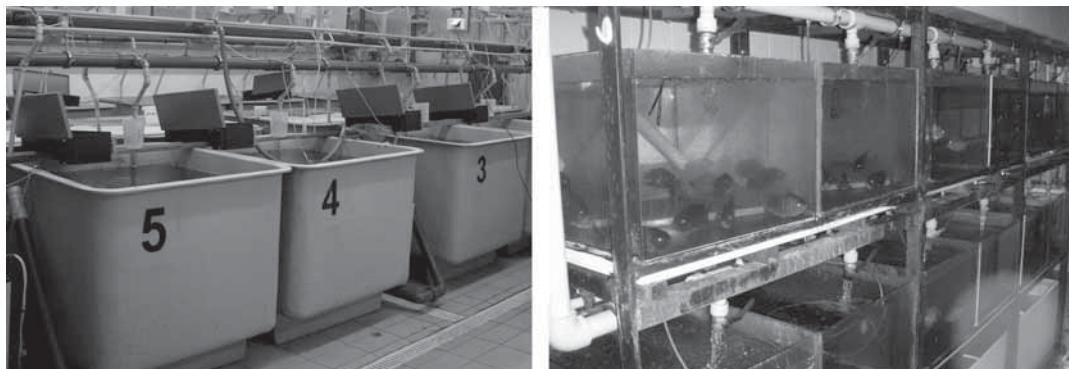
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## **RECIRCULATION AQUACULTURE SYSTEMS FOR FISH FARMING**

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The first publication, which describes the basic principals of recirculation systems for intensive rearing of fish; including mechanical and biological filtration of water; disinfection of water with UV or ozone, aeration and oxygenation of water, was published in the Czech Republic in 2009. The scheme, tables and colour pictures illustratively supplement part of text.

Kouřil, J., Hamáčková, J., Stejskal, V. Recirculating aquacultural systems for fish culture. Edition of Methodics (Technological series), RIFCH USB Vodňany, 2008, issue 85, 40 pp.



*View of experimental recirculation system and aquarium room*

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## **USE OF HEAT PUMPS IN AQUACULTURE**

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This work describes general overview and recommendations when using heat pumps in the intensive aquaculture systems in order to reduce the running costs in fish culture. The data were collected from three different recirculating aquaculture systems. There is a serious possibility to reach the heating factor in range from 2.2 to 3.2 leading to 55–69% reduction of energy demand. The publication includes also a different technical solutions, principles of heating pumps and pro-and-con of different kinds of heating pumps.

Kouřil, J., Matoušek, J. Using heatpumps in intensive aquaculture decrease volume of energy for optimisation of temperature conditions reared of fish. Edition of Methodics (Technological series), RIFCH USB Vodňany, 2008, issue 87, 20 pp.



*Intensive culture of rainbow trout in recirculation and cage systems*

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### **TECHNOLOGY OF INTENSIVE CULTURE OF EURASIAN PERCH (*PERCA FLUVIATILIS* L.)**

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This technology summarises recent knowledge in the field of intensive culture of Eurasian perch including geographical distribution, morphology and general biology. Publication includes many technical information and technological solution with relation to intensive aquaculture (recirculation aquaculture systems). Economic importance of this species in the Czech Republic and Europe is discussed too. Large space is provided to reproduction of this species in captivity. Culture techniques are described for larval, juvenile and marketable fish separately. A part of the work describes modern biotechnological principles for increasing of growth. Finally, there is a review of important diseases and veterinary risks, which caused losses.

Polícar, T., Stejskal, V., Bláha, M., Alavi, SMH., Kouřil, J. Technology of intensive culture of Eurasian perch (*Perca fluviatilis* L.). 2009. Edition of Methodics (Technological series), RIFCH USB Vodňany, 2009, No. 89, 51 pp.

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### **RECENT STATE, ARTIFICIAL REPRODUCTION AND REARING OF COMMON BARBEL (*BARBUS BARBUS* L.) FOR PRODUCTION OF SUITABLE STOCKING MATERIAL**

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A handbook describes current state of common barbel in running water in the Czech Republic and different methods of rearing and reproduction of this fish species in details. The aim of the handbook is to describe efficient technology for production of stocking material of common barbel, which will be stocked in flowing waters after its production. Chapters of the handbook describe: taxonomy, importance, occurrence and exposure of common barbel in flowing waters of the Czech Republic. Other chapters of the handbook describe: biology, reproduction, gamete quality, egg fertilization, egg incubation, hatching and quality of larvae, efficient rearing of juvenile and adult fish in common barbel.

Polícar, T., Drozd, B., Kouřil, J., Kozák, P., Hamáčková, J., Alavi, SMH., Vavřečka, A. Recent state, artificial reproduction and rearing of common barbel (*Barbus barbus* L.) for production of suitable stocking material. Edition of Methodics (Technological series), RIFCH USB Vodňany, 2009, No. 95, 39 pp.

# SCIENTIFIC-RESEARCH LABORATORIES OF RIFCH

## Laboratory of Fish Reproductive Physiology

<b>Prof. Dipl.-Ing. Otomar Linhart, DSc.,</b> Head of Laboratory <i>Reproduction and genetics of fish</i>	<i>linhart@vurh.jcu.cz</i>	
<b>Dipl.-Ing. Marek Rodina, PhD.</b> Assistant manager <i>Physiology of sperm, cryoconservation, reproduction of fish</i>	<i>rodina@vurh.jcu.cz</i>	
<b>MSc. Sayyed Mohammad Hadi Alavi, Ph.D.,</b> (Ph.D. student till 2. 9. 2009) <i>Physiology of sperm and fish reproduction</i>	<i>alavi@vurh.jcu.cz</i>	
<b>MSc. Boris Dzyuba, Ph.D.</b> <i>Cryoconservation of fish gametes</i>	<i>bdzyuba@vurh.jcu.cz</i>	
<b>MSc. Sergey Boryshpolets, Ph.D. student</b> <i>Cryoconservation and energetics of fish sperm</i>	<i>boryss00@vurh.jcu.cz</i>	
<b>MSc. Azadeh Hatef, Ph.D. student</b> <i>Endocrine disruptors in fish sperm</i>	<i>hatefa00@vurh.jcu.cz</i>	
<b>MSc. Anna Shaliutina, Ph.D. student</b> <i>Proteins in seminal plasma of fish</i>	<i>shalia00@vurh.jcu.cz</i>	
<b>Ivana Samková</b> Technician	<i>samkova@vurh.jcu.cz</i>	

### ***Undergraduate***

Tomáš Gavenda

Prof. Otomar Linhart has been a tutor of Ph.D. students, namely Dipl.-Ing. Vojtěch Kašpar, Dipl.-Ing. Martin Pšenička (defence in 2009), MSc. Ping Li, who are working in the Laboratory of Molecular, Cellular and Quantitative Genetics.



*The logo of the "First international workshop on Biology of fish sperm" organized by the laboratory in Vodňany at 2007*

## **THE RESEARCH PRIORITIES & THE LABORATORY ACTIVITIES**

The laboratory is besides the university education involved in both basic and applied research with focus on the study of spermiation of fresh water fish species, the diagnostics of maturity level of spawners and sex changes, the study of males competition during the reproduction process and its influence on the population of genetic variability. In other hand, the laboratory observes the endocrine effect on gametogenesis and quality of gametes for controlled reproduction with cryopreservation of sperm and fish embryos. For its scientific specialisation, the laboratory uses sophisticated technologies for microscopic analysis of fish sperm motility and velocity, including detailed identification of flagellum movement. The laboratory is able to demembranate the spermatozoa and to reactivate those spermatozoa of some fish species. The lab use techniques for ATP measurement and wide range of sperm freezing methods from simple to computer controlled. During experiments with fish, the laboratory used aquariums and service facilities mainly in the Genetic Fishery Centre and fish ponds. The laboratory also use the premises of other laboratories of RIFCH mainly the laboratory of molecular cellular and quantitative genetics for realization of experiments and cooperates with the workplace of the Czech Academy of Science and foreign laboratories from the USA to Japan, what is principally proved by international authors' collective in publications (see directly list of publications).

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### **THE CONTRIBUTIONS FROM THE FIRST INTERNATIONAL WORKSHOP ENTITLED "BIOLOGY OF FISH SPERM" WERE PUBLISHED IN JOURNAL OF APPLIED ICHTHYOLOGY**

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The laboratory with Ph.D. students of RIFCH focuses on the physiology of fish reproduction organized the first international workshop "Biology of fish sperm" at RIFCH in Vodnany in August 2007 with the participants from 13 countries of 4 continents. Some of the presented contributions were printed in the Journal of Applied Ichthyology under the editorial management of S.M.H. Alavi in 2008.

The next run of the international conference with our participation was held in Valencia, Spain in September 2009.

Alavi, SMH, Linhart, O., Rosenthal, H. The proceedings of the First International Workshop on the Biology of Fish Sperm. Journal of Applied Ichthyology, 2008, volume 24, issue 4, pp. 357–525, ISSN 0175-8659.

With the participation of O. Linhart, as a guest editor, a special issue of Fish Physiology and Biochemistry journal was published in 2009. The issue is composed of 17 research papers with the results in the field of fish physiology, biochemistry and toxicology monitoring obtained in the Central Europe.

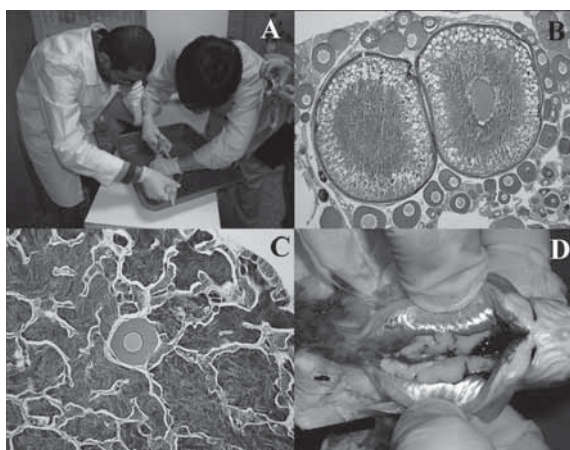
Linhart, O. Foreword for the special issue – Research on Fish in Central Europe: From Basic Science to Applied Approaches. Fish Physiology and Biochemistry, 2009, volume 35, issue 4, pp. 549–550, ISSN 0920-1742.

## **SELECTED RESEARCH RESULTS**

### **PRE-SPAWNING WATER TEMPERATURE AFFECTS SPERM RESPIRATION AND REACTIVATION PARAMETERS IN MALE CARPS**

Concentration, ability to motility, motility during the second activation (reactivation), and endogenous respiration were studied in sperm from two experimental groups of carp males. Group 1 was maintained for 7 days at 15 °C (cold water, CW group), whereas the second group was subjected to a temperature of 20 °C (warm water, WW group) before sperm sampling. Reactivation were achieved after incubation of firstly activated sperm in media with osmotic pressure adjusted up to 300 mOsm\*kg<sup>-1</sup> by increasing K<sup>+</sup> concentration. Statistically significant reduction of spermatozoa concentration in CW samples versus WW (46.0 ± 12.5 and C to 59.3 ± 7.0 · 10<sup>9</sup> spermatozoa /ml, respectively) was observed. The sperm of the CW group required a significantly longer incubation time (37 min) under isotonic conditions to achieve a maximum percentage of potent motility at repeated activation than the WW group (23 min). After activation of sperm motility, an increase of respiration rate up to maximum level has been found, this level remained the same under condition of recovering the potential to repeated activation. During the sperm movement respiration rate, in CW group (6.1 nmolO<sub>2</sub>/min/10<sup>9</sup> spermatozoa) and WW (3.9 nmolO<sub>2</sub>/min/10<sup>9</sup> spermatozoa), was significant higher compared to nonactivated sperm (2.4 nmolO<sub>2</sub>/min/10<sup>9</sup> for CW and 1.1 nmolO<sub>2</sub>/min/10<sup>9</sup> spermatozoa for WW). And keeping males for 7 days at 15A °C increase the respiration rate of sperm.

Boryshpolets, S., Dzyuba, B., Drokin, S. Pre-spawning water temperature affects sperm respiration and reactivation parameters in male carps. Fish Physiology and Biochemistry, 2009, volume 35, issue 4, pp. 661–668, ISSN 0920-1742.



A – collection of sterlet sperm, B – oocytes in common carp,  
C – hermafroditic gonad of common carp with spermatoocytes oocytes,  
D – gynogenetic common carp testes

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## **FREEZE-THAWING AS THE FACTOR OF SPONTANEOUS ACTIVATION OF SPERMATOZOA MOTILITY IN COMMON CARP (*CYPRINUS CARPIO* L.)**

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In the present study, we investigated the possibility of spontaneous carp spermatozoa activation by freeze-thawing. To evaluate this, the parameters of spermatozoa motility percentage, velocity, ATP content level and fertility rate of sperm were used. The motility and velocity of spermatozoa activated by freeze-thawing were characterized by motile spermatozoa with a median value of 16% and a velocity of 98  $\mu\text{m/s}$ . In addition, the motility and velocity of sperm from the thawed samples were significantly lower than in the control (median value of 100% for sperm motility and 175  $\mu\text{m/s}$  for sperm velocity). Furthermore, spontaneously activated spermatozoa motility terminated within five minutes post-thaw time. After freeze-thawing the ATP level significantly decreased with post-thaw time (46 nmol ATP/ $10^9$  and 10 nmol ATP/ $10^9$  at 25 s and 10 min after thawing, respectively). Fertility of spermatozoa was not significantly affected within 10 min post-thaw. On the other hand, the fertility of frozen-thawed sperm was significantly lower if compared to fresh sperm. We conclude that the freeze-thawing procedure spontaneously activated spermatozoa motility in common carp. However, this activation did not negatively affect the fertility of frozen-thawed sperm.

Boryshpolets, S., Dzyuba, B., Rodina, M., Li, P., Hulák, M., Gela, D., Linhart, O. Freeze-thawing as the factor of spontaneous activation of spermatozoa motility in common carp (*Cyprinus carpio* L.). *Cryobiology*, 2009, volume 59, issue 3, pp. 291–296, ISSN 0011-2240.

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## **DYNAMICS OF ATP AND MOVEMENT IN EURASIAN PERCH *PERCA FLUVIATILIS* L. SPERM IN CONDITIONS OF DECREASING OSMOLALITY**

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Repetitive activation of perch (*Perca fluviatilis* L.) sperm motility was investigated in this study. The first phase of sperm motility activation was initiated by dilution in a 260 mM glucose solution (75% motility). The second phase of motility was achieved by adding water to previously activated sperm, so that the glucose concentration dropped to 220 mM (24% motility). Finally, the third phase was obtained by further addition of water (down to 90 mM glucose) to the activated sperm suspension (15% motility). Parallel measurements of sperm ATP content were also made. The median value for nonactivated sperm was 43.9 nmol ATP/ $10^9$  spermatozoa. The ATP concentration decreased significantly from 35 to 7 nmol ATP/ $10^9$  spermatozoa after successive activations of motility in the above glucose solutions. Sperm velocity ranged in value from 25 to 330  $\mu\text{m/sec}$  at 10 sec postactivation, from 10 to 290  $\mu\text{m/sec}$  at 30 sec, and from 0 to 200  $\mu\text{m/sec}$  at 45 sec. A model postulating several classes in the population of spermatozoa is developed, tentatively accounting for such successive activation. Possible further application of multiple sperm activation is discussed.

Boryshpolets, S., Dzyuba, B., Stejskal, V., Linhart, O. Dynamics of ATP and movement in Eurasian perch (*Perca fluviatilis* L.) sperm in conditions of decreasing osmolality. *Theriogenology*, 2009, volume 72, issue 6, pp. 851–859, ISSN 0093-691X.

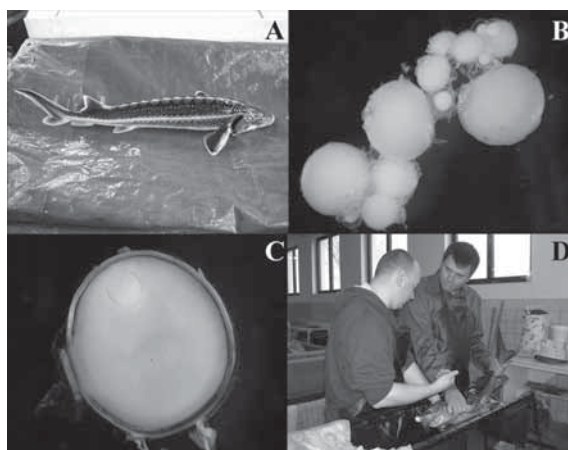
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## EFFECTS OF OSMOLALITY ON SPERM MORPHOLOGY, MOTILITY AND FLAGELLAR WAVE PARAMETERS IN NORTHERN PIKE (*ESOX LUCIUS* L.)

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Northern pike (*Esox lucius* L.) spermatozoa are uniflagellated cells differentiated into a head without acrosome, a midpiece and a flagellar tail region flanked by a fin structure. Total, flagellar, head and midpiece lengths of spermatozoa were measured and show mean values of 34.5, 32.0, 1.32, 1.17  $\mu\text{m}$ , respectively, with anterior and posterior widths of the midpiece measuring 0.8 and 0.6  $\mu\text{m}$ , respectively. The osmolality of seminal plasma ranged from 228 to 350 mOsmol  $\text{kg}^{-1}$  (average:  $283.88 \pm 33.05$ ). After triggering of sperm motility in very low osmolality medium (distilled water), blebs appeared along the flagellum. At later periods in the motility phase, the tip of the flagellum became curled into a loop shape, which resulted in a shortening of the flagellum and a restriction of wave development to the proximal part (close to head). Spermatozoa velocity and percentage of motile spermatozoa decreased rapidly as a function of time postactivation and depended on the osmolality of activation media ( $P < 0.05$ ). In general, the greatest percentage of motile spermatozoa and highest spermatozoa velocity were observed between 125 and 235 mOsmol  $\text{kg}^{-1}$ . Osmolality above 375 mOsmol  $\text{kg}^{-1}$  inhibited the motility of spermatozoa. After triggering of sperm motility in activation media, beating waves propagated along the full length of flagella, while waves appeared dampened during later periods in the motility phase, and were absent at the end of the motility phase. By increasing osmolality, the velocity of spermatozoa reached the highest value while wave length, amplitude, number of waves and curvatures also were at their highest values. This study showed that sperm morphology could be used for fish classification. Sperm morphology, in particular, the flagellar part showed several changes during activation in distilled water. Sperm motility of pike is inhibited due to high osmolality in the seminal plasma. Osmolality of activation medium affects the percentage of motile sperm and spermatozoa velocity due to changes in flagellar wave parameters.

Alavi, SMH., Rodina, M., Vivieros, A., Cosson, J., Gela, D., Boryshpolets, S., Linhart, O. Effects of osmolality on sperm morphology, motility and flagellar wave parameters in Northern pike (*Esox lucius* L.). *Theriogenology*, 2009, volume 72, issue 1, pp. 32–43, ISSN 0093-691X.



Laboratory focuses intensively to sturgeons: (A) – Russian sturgeon; (B) determines the sex of sturgeon by biopsy – sample of oocytes at different stages of growth; (C) determines the degree of maturity of oocytes – example of the oocyte of sturgeon with vesiculum in periphery; (D) – tissue samples taken for Siberian sturgeon population study

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## RELATIONSHIP BETWEEN SEMEN CHARACTERISTICS AND BODY SIZE IN *BARBUS BARBUS* L. (TELEOSTEI: CYPRINIDAE) AND EFFECTS OF IONS AND OSMOLALITY ON SPERM MOTILITY

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The objectives of the present study were to determine the relationships among length and weight of males, sperm volume, spermatozoa concentration, total number of spermatozoa, ionic contents and osmolality seminal plasma in barbel, *Barbus barbus*. The effect of osmolality on sperm motility parameters after activation in NaCl, KCl, or sucrose solutions was also examined. There were significant correlations between spermatozoa concentration – length ( $R = + 0.7$ ) and – weight ( $R = + 0.8$ ) of males.



No significant correlations were observed between the total number of spermatozoa, sperm volume, and length and weight of males. Seminal plasma osmolality was higher when the total number of spermatozoa ( $R = + 0.6$ ) and sperm volume ( $R = + 0.6$ ) were higher. Sperm motility and velocity was positively correlated with osmolality ( $R = + 0.5$ ). The correlation between sperm motility and  $K^+$  was negative ( $R = 0.5$ ), but positively correlated with  $Ca^{2+}$  ( $R = 0.8$ ),  $Na^+$  ( $R = 0.8$ ), and  $Cl^-$  ( $R = 0.8$ ). There was a rapid decrease ( $P < 0.05$ ) in sperm motility parameters after sperm activation. Just after sperm activation, beating waves propagated along the full length of flagella. At later stages post sperm activation, the waves appeared only in proximal part of the flagellum. The highest spermatozoa velocity and percentage of motility were observed at 215–235 mOsmol  $kg^{-1}$  in NaCl, KCl or sucrose. The tip of the flagellum became curled into a loop shape, which shortened the flagellum after activation of sperm in distilled water. *B. barbuis* sperm is very similar to that of other cyprinids in terms of ionic contents and osmolality of the seminal plasma, mechanism of sperm activation and behavior and motility of sperm during swimming period.

Alavi, SMH., Rodina, M., Policar, T., Linhart, O. Relationship between semen characteristics and body size in *Barbus barbuis* L. (Teleostei: Cyprinidae) and effects of ions and osmolality on sperm motility. Comparative biochemistry and physiology. Part A, Molecular & integrative physiology, 2009, volume 153, issue 3, pp. 430–437, ISSN 1095-6433.

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#### **SPERM QUALITY IN MALE *BARBUS BARBUS* L. FED DIFFERENT DIETS DURING THE SPAWNING SEASON**

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Sperm quality of *Barbus barbuis* L. was compared among the three following dietary regimes: Group A, fed 100% commercial diet (Karpico (TM) containing 33% crude protein and 6% fat), Group B, fed 78% commercial diet and 22% frozen chironomid (*Chironomus plumosus*) larvae, and Group C, fed 56% commercial diet and 44% frozen chironomid larvae. Concentrations of polyunsaturated fatty acids (PUFAs) in Group A, B, and C were 39.1, 42.0, and 44.6, respectively, as a percentage of total fatty acids. Sperm morphology, volume, concentration and motility, total number of spermatozoa, and osmolality of the seminal plasma were compared during the spawning season. Dietary regime did not influence sperm volume, concentration, or total number of spermatozoa, osmolality of seminal plasma, or the percentage of motile sperm, but significantly affected sperm morphology (except for anterior and posterior parts of the midpiece) and sperm velocity ( $P < 0.05$ ). Groups B and C showed similar sperm characteristics during the spawning season compared to Group A. Almost all parameters changed either among or within groups during the spawning season, suggesting differences in terms of the optimal time for sperm collection. The best time for sperm collection was March for Group A, but April for Groups B and C, when the osmolality of the seminal plasma measured 289 mOsmol  $kg^{-1}$  and sperm motility was maximal. Spermatogenesis, hydration, and cell decomposition were confirmed as the three major parameters controlling sperm characteristics during the spawning season. The possible correlation between sperm morphology and motility requires further study.

Alavi, SMH., Pšenička, M., Policar, T., Rodina, M., Hamáčková, J., Kozák, P., Linhart, O. Sperm quality in male *Barbus barbuis* L. fed different diets during the spawning season. Fish Physiology and Biochemistry, 2009, volume 35, issue 4, pp. 683–693, ISSN 0920-1742.

Alavi, SMH., Pšenička, M., Policar, T., Rodina, M., Kozák, P., Linhart, O. Sperm characteristic in *Barbus barbuis* as a function of nutrition throughout the reproductive season. Cybium, 2008, volume 32, issue 2, pp. 200–201, ISSN 0399-0974.

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## CHANGES OF SPERM MORPHOLOGY, VOLUME, DENSITY AND MOTILITY AND SEMINAL PLASMA COMPOSITION IN *BARBUS BARBUS* (TELEOSTEI: CYPRINIDAE) DURING THE REPRODUCTIVE SEASON

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Eighteen spermiating males were randomly selected from a hatchery-reared stock and electronically tagged to record changes in their sperm quality parameters (spermatozoa morphology, ultrastructure and motility, ionic composition and osmolality of the seminal plasma, and sperm volume and density) during the spawning season. Stripping was performed at the beginning of March, April and May. The *Barbus barbus* spermatozoon has a head without acrosome, a midpiece with 4–6 mitochondria and proximal and distal centrioles, and a flagellum with the typical 9 + 2 pairs of microtubules. Apart from posterior width of the midpiece, morphological and ultrastructural parameters changed significantly during the reproductive season; generally by decreasing toward the end of reproductive season. Sperm volume also decreased from 0.42 in March to 0.15 ml in May, and density from 18.81 in March to  $12.45 \times 10^9$  spz ml<sup>-1</sup> in May. Osmolality (mOsmol kg<sup>-1</sup>) was  $268 \pm 4$ ,  $276 \pm 2$  and  $268 \pm 2$  in March, April and May respectively. Chloride, sodium, calcium and potassium ion concentrations (mM) did not show significant differences between March and April (Cl<sup>-</sup>: 125.3 vs. 120.5, Na<sup>+</sup>: 75.7 vs. 69.7, Ca<sup>2+</sup>: 0.4 vs. 0.3 and K<sup>+</sup>: 84.7 vs. 84.0). The percentage of motile spermatozoa at 15 s post activation did not show a significant difference between dates, but the highest spermatozoa velocity at 15 s post activation was observed in April ( $91.4 \pm 3.2 \mu\text{m s}^{-1}$ ) and then decreased significantly towards the end of the reproductive season ( $80.6 \pm 1.9 \mu\text{m s}^{-1}$  in May). However, lowest spermatozoa velocity was measured in March ( $70.4 \pm 1.9 \mu\text{m s}^{-1}$ ). This study supports the hypothesis that longer spermatozoa swim faster. Within one stripping, velocity and percentage motility decreased significantly with time post activation. In conclusion, changes observed in *B. barbus* sperm parameters during the reproductive season, suggest there is association between such changes and spermatozoa aging processes.

Alavi, SMH., Pšenička, M., Rodina, M., Policar, T., Linhart, O. Changes of sperm morphology, volume, density and motility and seminal plasma composition in *Barbus barbus* (Teleostei: Cyprinidae) during the reproductive season. Aquatic Living Resources, 2008, volume 21, issue 1, pp. 75–80, ISSN 0990-7440.

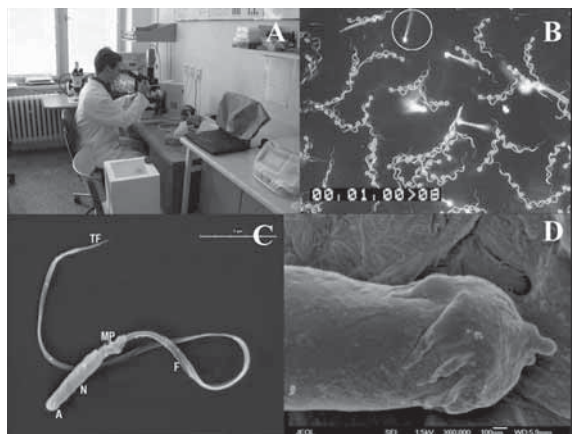
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## MORPHOLOGY AND FINE STRUCTURE OF *BARBUS BARBUS* (TELEOSTEI: CYPRINIDAE) SPERMATOZOA

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Morphology and fine structure of *Barbus barbus* L 1758 spermatozoa were studied using scanning (SEM) and transmission (TEM) electron microscopy. The results confirm that spermatozoa, exhibit morphological features typical to all teleost fishes. They are differentiated into a head, a midpiece and a flagellum with the typical, 9 + 2' pairs of microtubules. Both dynein arms are present in the flagellum. The spermatozoa have spherical nuclei, 4–6 mitochondria located in the postnuclear cytoplasmic region and centriolar complex (proximal and distal centrioles). Total length, head width, length of midpiece and length of flagellum were measured to be  $56.35 \pm 7.42$ ,  $1.80 \pm 0.06$ ,  $0.48 \pm 0.14$  and  $54.30 \pm 6.97 \mu\text{m}$ , respectively. Highly significant linear correlation was observed between posterior and anterior width of midpiece ( $P < 0.01$ ). Principal component analysis (PCA) was used to explore which parameters can explain the individual variation of sperm morphology. About 44% of the total accumulated variance was absorbed by the analysis of the two first components, distinguishing different groups of parameters related to head and midpiece. The lengths of flagellum and head are more isolated; indicating that the individual variation of sperm morphology depends on these two parameters. Comparing the results of this study with information on cyprinids spermatozoa reveals that the number of mitochondria and the length of the flagellum are good characters to characterize spermatozoa of the Cyprinidae in a phylogenetic arrangement.

## SPERM MOTILITY AND FERTILIZING ABILITY OF FROZEN SPERMATOZOA OF MALES (XY) AND NEOMALES (XX) OF PERCH (*PERCA FLUVIATILIS*)



Laboratory (A) – uses sophisticated techniques to analyze the microscopic movement of fish sperm; (B) – uses video images on motion analysis of sperm morphology and sperm of fish by electron microscopy; (C) – spermatozoa of sterlet; (D) – head of spermatozoa of Siberian sturgeon

The objective of this study was to freeze sperm of sex-reversed females (neomales) of perch and to test their fertilization ability. Sperm used was testicular (TSN), collected from females that have been inverted by means of externally administered 17-alpha methyltestosterone. Sperm collected from intact males (SSNM) of the same origin were used as control. Prior to freezing, both TSN and SSNM were diluted into 300 mM glucose solution at the ratio of 1:6 and DMSO was used as cryoprotectant (10% final concentration). Cryopreservation was performed in 0.5 ml straws placed into a polystyrene box, three cm above the liquid nitrogen level for 10 min and thereafter transferred fully into liquid nitrogen. Samples were thawed in 40 °C water bath

for 8 s and used for the fertilization experiments. Spermatozoa concentration of fresh TSN and SSNM were estimated with  $45.3 \times 10^9$  and  $37.8 \times 10^9$  spermatozoa.ml<sup>-1</sup>, respectively. Both sperm velocity and motility showed significant decreases in the TSN ( $134.6 \mu\text{m s}^{-1}$  and 12.8%) compared to the SSNM ( $203.2 \mu\text{m s}^{-1}$  and 94.7%) at 10 s after sperm activation. However, no differences were observed in terms of hatching rates between fresh TSN and SSNM (42.5 vs 49.3%) at fertilization densities of  $12 \times 10^5$  spermatozoa per egg. Frozen/thawed SSNM exhibited similar hatching rates at  $12 \times 10^5$  and  $2.4 \times 10^5$  spermatozoa per egg (37.2% vs 29.1%). Hatching rates for frozen/thawed TSN were about 7.3% with  $12 \times 10^5$  spermatozoa per egg and did not show any difference at  $2.4 \times 10^5$  spermatozoa per egg (6.6%). Stripped sperm of normal perch can be successfully frozen. Squeezing of the testes is not a good method for collection of testicular sperm resulting into low velocity, motility and hatching rate. To understand the influences of neomales on sperm quality on reproductive success further studies should be performed addressing a full assay of motility and fertility criteria when using stripped sperm from normal males and neomales. Additionally, the results indicate that many of sex reversed perch neomales are not able to release sperm and that for further studies some well spermiating neomales must to be selected.

Rodina, M., Policar, T., Linhart, O., Rougeot, C. Sperm motility and fertilizing ability of frozen spermatozoa of males (XY) and neomales (XX) of perch (*Perca fluviatilis*). Journal of Applied Ichthyology, 2008, volume 24, issue 4, pp. 438–442, ISSN 0175-8659.

Rodina, M., Policar, T., Linhart, O. Cryopreservation of sperm of testicular neomales and stripped normal males of European perch (*Perca fluviatilis* L.). Cybium, 2008, volume 32, issue 2, pp. 214–215, ISSN 0399-0974.

## COMPARISON OF SPERM VELOCITY, MOTILITY AND FERTILIZING ABILITY BETWEEN FIRSTLY AND SECONDLY ACTIVATED SPERMATOZOA OF COMMON CARP (*CYPRINUS CARPIO*)

The objective of the study was to compare carp sperm motility performances (sperm velocity and motility rates) from 10 males including fertilizing ability (hatching rates from 10 males and eight females) as a function of time elapsed after sperm exposure to activation medium in two situations: firstly activated sperm and sperm which had terminated swimming and was 're-activated' after incubation in a  $K^+$  rich (200 mM KCl) non-swimming solution. In case of both initial (first) and secondly activated spermatozoa, the motility was triggered in hatchery solution (HAS, 11.2 mOsmol) and in carp activation solution (CAS, 128.9 mOsmol) containing 45 mM NaCl, 5 mM KCl, 30 mM Tris-HCl while also adjusted to a pH of 8.0. First time activated sperm showed significantly higher relative motility, sperm velocity and fertilizing ability compared to re-activated sperm. The carp spermatozoa (in either first or second activation) rapidly lost their fertilizing ability as a function of exposure time of sperm to diluents prior to addition to eggs: this shows that spermatozoa must be in contact with eggs as soon as their motility is triggered. When sperm was firstly activated in CAS and then the second time in CAS (labeled CASCAS), the hatching rate was significantly higher at egg contact after 10, 20, 30, and 120 s of activation. Also at 20 s after the second activation of the sperm, higher sperm motility was observed compared to the first activation. This study showed that incubation of spermatozoa in a  $K^+$ -rich incubation medium could mitigate the effects of structural damages occurring in re-activated sperm, which may help spermatozoa to increase their motility and fertilization. To our knowledge, the results presented in this study document for the first time that fertilization can be achieved with sperm re-activated the second time while being exposed to an incubation medium that permits ATP reloading within the flagellum. Previous studies showed the potential for recovery of motility, however, the effect on possible fertilization is hitherto unknown.

Linhart, O., Alavi, SMH., Rodina, M., Gela, D., Cosson, J. Comparison of sperm velocity, motility and fertilizing ability between firstly and secondly activated spermatozoa of common carp (*Cyprinus carpio*). Journal of Applied Ichthyology, 2008, volume 24, issue 4, pp. 386–392, ISSN 0175-8659.

Linhart, O., Alavi, SMH., Rodina, M., Gela, D., Cosson, J. After finishing of motility, common carp (*Cyprinus carpio*) sperm is able to re-initiate a second motility period and to fertilize eggs. Cybium, 2008, volume 32, issue 2, pp. 187–188, ISSN 0399-0974.



Sperm and embryos of fish are frozen in the laboratory

(A) – work on the freezing machine for freezing sperm of carp;

(B) – the device to freeze cells to  $-196^{\circ}\text{C}$ ;

(C) – trays with individual boxes, heating, recirculation and UV water sterilization used for testing of fertilization and hatching

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## **ACTIVATION OF SPERM MOTILITY IN THE EURYHALINE TILAPIA *SAROTHERODON MELANOTHERON HEUDELOTII* (DUMERIL, 1859) ACCLIMATIZED TO FRESH, SEA AND HYPERSALINE WATERS**

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The effects of osmolality and ions on motility of sperm were examined in males of *Sarotherodon melanotheron heudelotii* acclimatized in tanks with salinities of 0, 35 and 70 g.l<sup>-1</sup>. The range of osmolality that enabled sperm activation shifted and broadened as the maintenance salinity of broodfish increased. The requirement of extracellular Ca<sup>2+</sup> for activation of sperm motility increased when the broodfish were exposed to higher salinity.

Legendre, M., Cosson, J., Alavi, SMH., Linhart, O. Activation of sperm motility in the euryhaline tilapia *Sarotherodon melanotheron heudelotii* (Dumeril, 1859) acclimatized to fresh, sea and hypersaline waters. *Cybium*, 2008, volume 32, issue 2, pp. 181–182, ISSN 0399-0974.

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## **DETERMINISM OF THE QUALITY OF REPRODUCTION IN MALE EURASIAN PERCH, *PERCA FLUVIATILIS*: A MULTIFACTORIAL STUDY**

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Sperm volume and density and total number of sperm per fish showed high variations among samples. In a medium containing 20 mM K<sup>+</sup>, sperm velocity and the percentage of motility were higher in stripped sperm compared to testicular sperm. Medium with Osmolality of 100 mOsmol kg<sup>-1</sup> showed a significant effect on velocity of stripped sperm ( $p < 0.05$ ).

Wang, N., Rodina, M., Gardeur, J., Vuillard, J., Policar, T., Henrotte, E., Mandiki, S., Kestemont, P., Linhart, O., Fontaine, P. Determinism of the quality of reproduction in Eurasian perch, *Perca fluviatilis*: a multifactorial study. *Cybium*, 2008, volume 32, issue 2, pp. 192–193, ISSN 0399-0974.

Alavi, SMH., Rodina, M., Policar, T., Cosson, J., Kozák, P., Pšenička, M., Linhart, O. Physiology and behavior of stripped and testicular sperm in *Perca fluviatilis* L. 1758. *Cybium*, 2008, volume 32, issue 2, pp. 162–163, ISSN 0399-0974.

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## **FISH SPERMATOLOGY: IMPACT ON THE MANAGEMENT IN AQUACULTURE**

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Alavi, S.M.H as the chief editor wrote a book *Fish spermatology* in 2008. The laboratory processed the impacts of management of artificial reproduction in aquaculture in the individual chapters of this book. Simple models and practical manuals in terms of the management of artificial reproduction are important tools for optimization and improvement of artificial reproduction at aquaculture farms. The fish species very much differ from each other from the spermatological point of view. The different methods of artificial reproduction also exist in terms of commercially important fish species reared in aquaculture. We discussed the effects of various aspects of spermatology on artificial reproduction including morphology of gonads and accessory organs, spermatogenesis and spawning induction, sperm density, physiology and biochemistry of sperm and artificial insemination.

Alavi, SMH., Linhart, O., Coward, K., Rodina, M. *Fish spermatology: Implication for aquaculture management*. In *Fish spermatology*. Oxford: Alpha Science Ltd, 2008, pp. 397–460. ISBN 978-1-84265-369-2.

# SCIENTIFIC-RESEARCH LABORATORIES OF RIFCH

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## RESEARCH PRIORITIES

The laboratory performs both fundamental and applied research and university education in genetics of freshwater fish, conservation of fish genetic resources and enhancement of genetic potential of commercially important species as e.g. common carp, tench, wels and sturgeons.

Research combines laboratory analyses and experiments with pilot testing in experimental ponds or indoor/outdoor tanks, and/or with regular performance testing in ponds on productive fish farms. Many results of our studies have wide implications for applied aquaculture.

There are five main programmes of research of the laboratory:

- *Genetic, biological, physiological and reproductive aspects of polyploid and unisexual fish populations.*
- *Breeding programmes based upon determination of heritability of performance traits and comparison of performance among different genetic groups (hybrids, breeds, lines).*
- *Determination of genetic variability and protection of variability of commercially important fish species, breeds and lines.*
- *Male competition during the fertilization process and its effects on population genetic variability.*
- *Sperm ultrastructure and characteristics of the fertilization procelození.*

## SELECTED RESEARCH RESULTS

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### STRUCTURAL ABNORMALITIES OF COMMON CARP *CYPRINUS CARPIO* SPERMATOZOA

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Spermatozoa of common carp *Cyprinus carpio* are typically consisted of a primitive head without acrosome, a midpiece with several mitochondria, a centriolar complex (proximal and distal centriole), and one flagellum. During an evaluation of the motility of common carp spermatozoa, we found spermatozoa with more than one flagellum and/or “double head” in three different individuals. This may be related to abnormal spermatogenesis. Ultrastructure and physiological parameters of spermatozoa were examined using light microscopy (dark field with stroboscopic illumination), transmission and scanning electron microscopy, and flow cytometry. The recorded pictures and videos were evaluated using Olympus MicroImage software. All spermatozoa with more than one flagellum had a larger head and shorter flagella. They occasionally demonstrated several cytoplasmic channels separating the flagella from the midpiece. Each flagellum was based upon its own centriolar complex, with the connection of the flagellum to the head always at a constant angle. The flagella always consisted of nine peripheral pairs and one central doublet of microtubules. Sperm exhibited a relative DNA content similar to that found in sperm from normal males, with higher coefficients of variation. Although similar abnormalities have been found in livestock, where they were described as a defect in spermiogenesis, no comparable results have been reported in fish. The frequency at which these abnormalities occurs, the fertilization ability of males with defects in spermiogenesis, the influence of these abnormalities on progeny in terms of ploidy level, and the occurrence of deformities warrant further investigation.

Pšenička, M., Rodina, M., Flajšhans, M., Kašpar, V., Linhart, O. Structural abnormalities of common carp *Cyprinus carpio* spermatozoa. *Fish Physiology and Biochemistry*, 2009, volume 35, issue 4, pp. 591–597, ISSN 0920-1742.

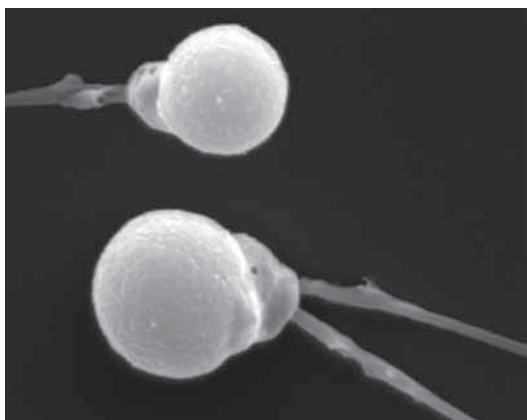
## A COMPARATIVE STUDY ON BIOLOGICAL ASPECT OF SPERM IN STERLET AND SIBERIAN STURGEON

Sperm morphology, biochemistry and physiology were compared between Siberian sturgeon *Acipenser baerii* and sterlet *A. ruthenus* in the present study. We observed wide morphological variations between spermatozoa of the two species. The average length of the spermatozoon head was 7.01 and 5.14  $\mu\text{m}$  in *A. baerii* and *A. ruthenus*, respectively. Significant differences were observed in terms of  $\text{Na}^+$ ,  $\text{K}^+$  and  $\text{Cl}^-$  concentrations in the seminal plasma as well sperm velocity.

Pšenička, M., Alavi, SMH., Rodina, M., Cosson, J., Nebesářová, J., Gela, D., Linhart, O. A comparative study on biological aspect of sperm in sterlet and Siberian sturgeon. *Cybium*, 2008, volume 32, issue 2, pp. 179–180, ISSN 0399-0974.

### MORPHOLOGY, CHEMICAL CONTENTS AND PHYSIOLOGY OF CHONDROSTEAN FISH SPERM: A COMPARATIVE STUDY BETWEEN SIBERIAN STURGEON (*ACIPENSER BAERII*) AND STERLET (*ACIPENSER RUTHENUS*)

The present study was carried out on two sturgeon species, Siberian sturgeon (*Acipenser baerii*) and sterlet (*A. ruthenus*) to compare some spermatological aspects for better understanding whether there is any inter-species difference. From morphological point of view, except for the length of midpiece, significant differences were observed in terms of acrosome length, acrosome width, head length, midpiece width and flagellar length. The sterlet has a shorter spermatozoon than Siberian sturgeon. Ultrastructural parameters vary significantly in terms of length of nucleus, diameter of endonuclear canals (ENCs), size of posterolateral projections (PPs) and diameter of flagellum. Mean values for density of sperm, seminal plasma pH, osmolality ( $\text{mOsmol Kg}^{-1}$ ), along with  $\text{Ca}^{2+}$ ,  $\text{Na}^+$ ,  $\text{K}^+$ ,  $\text{Cl}^-$  ions concentrations (mM), were measured to be  $0.61 \pm 0.37 \times 10^9$ ,  $8.16 \pm 0.18$ ,  $77.20 \pm 52.28$ ,  $0.24 \pm 0.06$ ,  $31.39 \pm 10.21$ ,  $3.51 \pm 1.10$ ,  $14.00 \pm 4.30$  in *A. baerii* and  $0.41 \pm 0.32 \times 10^9$ ,  $8.13 \pm 0.19$ ,  $50.74 \pm 6.27$ ,  $0.16 \pm 0.11$ ,  $20.11 \pm 3.78$ ,  $1.26 \pm 0.54$ ,  $6.11 \pm 0.60$  in *A. ruthenus*, respectively. Significant differences were observed in terms of  $\text{Na}^+$ ,  $\text{K}^+$  and  $\text{Cl}^-$  concentrations in the seminal plasma as well as sperm velocity. The percentage of motile sperm did not show significant difference between species. Comparison of the results of this study and literature published on sturgeon spermatozoa revealed that morphological and ultrastructural parameters of spermatozoa together with some parameters of the seminal fluid and sperm velocity could be considered in comparative spermatology among sturgeon species for better understanding inter-species differences. The present study revealed large inter- or intra-specific differences in terms of morphology, which could be valuable taxonomically. In addition, the observed biochemical and physiological differences should be considered for development of artificial reproduction and sperm cryopreservation.



Spermatozoa of common carp (*Cyprinus carpio*) with two flagella

Pšenička, M., Alavi, SMH., Rodina, M., Čičová, Z., Gela, D., Nebesářová, J., Linhart, O. Morphology, chemical contents and physiology of chondrostean fish sperm: A comparative study between Siberian sturgeon (*Acipenser baerii*) and sterlet (*Acipenser ruthenus*). *Journal of Applied Ichthyology*, 2008, volume 24, issue 4, pp. 371–377, ISSN 0175-8659.



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## FINE STRUCTURE AND MORPHOLOGY OF STERLET (*ACIPENSER RUTHENUS* L. 1758) SPERMATOOZOA AND ACROSIN LOCALIZATION

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Ultrastructure of sterlet *Acipenser ruthenus* L. 1758 spermatozoa was examined by scanning and transmission electron microscopy, which allowed us to use various methods for visualizations of different part of sterlet spermatozoa. Sperm-cells possess a head with a distinct acrosome, a mid-piece and a single flagellum surrounded by the flagellar plasma membrane. The average length of the head including the acrosome and the midpiece was estimated as  $5.14 \pm 0.42 \mu\text{m}$ . Nine to ten posterolateral projections were derived from the acrosome. Three intertwining endonuclear canals bounded by membranes traversed the nucleus in its whole length from the acrosom to the implantation fossa. Acrosin was located in all the three parts (acrosome, endonuclear canals and implantation fossa). The proximal and distal centrioles located in the midpiece compacted of nine peripheral triplets of microtubules. One cut of the midpiece contained from two to six mitochondria with area of  $215 \pm 85 \text{ nm}^2$  in average. The flagellum was  $42.47 \pm 1.89 \mu\text{m}$  in length with typical eukaryotic organization of one central pair and nine peripheral pairs of microtubules. It passed through a cytoplasmic channel in the midpiece, which was formed by an invagination at the plasmalemma. The flagellum gradually developed two lateral extensions of its plasma membrane, so-called "fins". Detected morphological variation can be described by four principal component axes corresponding to groups of individual morphometric characters defined on the sperm structures. Correlations among the characters indicate that the sperms are variable in their shape rather than size. Significant variation among examined fish individuals was found only in flagellum and nucleus length. Comparison between the present and previous studies of morphology of sturgeon spermatozoa confirmed large inter- and/or intra-specific differences that could be of substantial taxonomic value.

Pšenička, M., Vancová, M., Koubek, P., Těšitel, J., Linhart, O. Fine structure and morphology of sterlet (*Acipenser ruthenus* L. 1758) spermatozoa and acrosin localization. *Animal reproduction science*, 2009, volume 111, issue 1, pp. 3–16, ISSN 0378-4320.

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## SPERM PROTEINS IN TELEOSTEAN AND CHONDROSTEAN (STURGEON) FISHES

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Sperm proteins in the seminal plasma and spermatozoa of teleostean and chondrostean have evolved adaptations due to the changes in the reproductive environment. Analysis of the composition and functions of these proteins provides new insights into sperm motility and fertilising abilities, thereby creating possibilities for improving artificial reproduction and germplasm resource conservation technologies (e.g. cryopreservation). Seminal plasma proteins are involved in the protection of spermatozoa during storage in the reproductive system, whereas all spermatozoa proteins contribute to the swimming and fertilising abilities of sperm. Compared to mammalian species, little data are available on fish sperm proteins and their functions. We review here the current state of the art in this field and focus on relevant subjects that require attention. Future research should concentrate on protein functions and their mode of action in fish species, especially on the role of spermatozoa surface proteins during fertilisation and on a description of sturgeon sperm proteins.

Li, P., Hulák, M., Linhart, O. Sperm proteins in teleostean and chondrostean (sturgeon) fishes. *Fish Physiology and Biochemistry*, 2009, volume 35, issue 4, pp. 567–581, ISSN 0920-1742.

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## A QUANTITATIVE STUDY OF GERM CELL POPULATIONS AS RELATED TO 17 $\alpha$ -METHYL-TESTOSTERONE INDUCTION OF SEX INVERSION OF COMMON CARP (*CYPRINUS CARPIO* L.)

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The main objective of the present study was to investigate the effects of 17 $\alpha$ -methyltestosterone treatment upon the testicular germ cells of gynogenetic masculinized neomale common carp (*Cyprinus carpio* L.) in comparison with diploid carp. Gynogenetic common carp progeny (mean body weight, BW,  $2.6 \pm 0.3$  g; mean total length,  $10.4 \pm 0.5$  cm) were treated for a period of 40 days with 17 $\alpha$ -methyltestosterone (MT) at a dose of 100 mg kg<sup>-1</sup>. The oral administration of MT resulted in 61.5–100% of fish exhibiting male gonads. The masculinized neomales exhibited reduced ( $P < 0.05$ ) body weight (BW  $22.9 \pm 0.8$ ) but significantly increased ( $P < 0.05$ ) mean testis weight ( $2.1 \pm 0.3$ ) and mean gonadosomatic index (GSI  $9.5 \pm 0.2\%$ ) in comparison with fish not treated with MT (BW  $54.8 \pm 1.3$ ; GSI 0.61%). Furthermore, treatment with MT also resulted in an increased number of fish exhibiting abnormal gonads. However, neomales did not exhibit abnormalities in the development of sperm ducts. MT treatment significantly increased germ cell volume, nuclear diameter, nuclear volume and cyst volume ( $P < 0.01$  in all cases) in MT-treated fish compared to untreated fish. The area occupied by seminiferous tubules, the number of Sertoli cells and germ cells per cyst, and the number of Leydig cells were significantly ( $P < 0.05$ ) greater in fish treated with MT. The carp neomales exhibited approximately 20–60% more Sertoli cells per cyst ( $P < 0.05$ ). Leydig cell nuclear volume and Leydig cell individual volume were significantly reduced in MT-treated groups ( $P < 0.05$ ) compared with untreated groups. In conclusion, our study strongly suggests that the abnormal gonadal structure evident in masculinized neomales could be explained by a combination of MT-induced genetic (homozygosity) and anabolic effects (upon germ and somatic cells).

Hulák, M., Pšenička, M., Coward, K., Linhart, O. A Quantitative Study of Germ Cell Populations as Related to 17 $\alpha$ -methyltestosterone induction of Sex inversion of Common carp (*Cyprinus carpio* L.). Cell Biology International, 2008, volume 32, issue 5, pp. 515–524, ISSN 1065-6995.

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## CHARACTERISTICS OF STRIPPED AND TESTICULAR NORTHERN PIKE (*ESOX LUCIUS*) SPERM: SPERMATOZOA MOTILITY AND VELOCITY

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The effects of osmolality and accidental urine contamination on spermatozoa velocity and motility were studied, combined with an examination of the biological characteristics of stripped and testicular sperm. Analysis of Northern pike sperm showed higher ionic concentrations of Na<sup>+</sup> ( $123 \pm 9$  mM), Cl<sup>-</sup> ( $127 \pm 7$  mM), and K<sup>+</sup> ( $35 \pm 5$  mM) in the seminal fluid of testicular sperm (TS), than in that of stripped sperm (SS): Na<sup>+</sup> ( $116 \pm 9$  mM), Cl<sup>-</sup> ( $116 \pm 7$  mM) and K<sup>+</sup> ( $25 \pm 4$  mM). Highest osmolality of seminal fluid was observed in TS with a value of  $358 \pm 77$  mOsmol kg<sup>-1</sup> compared with  $273 \pm 21$  mOsmol kg<sup>-1</sup> for SS and  $68 \pm 36$  mOsmol kg<sup>-1</sup> for urine. A significantly higher spermatozoa concentration was observed in TS ( $34 \pm 5 \times 10^9$  ml<sup>-1</sup>) than in SS ( $23 \pm 4 \times 10^9$  ml<sup>-1</sup>). Spermatozoa concentration per male and per kg body weight was  $22 \pm 17 \times 10^9$  for TS and  $18 \pm 2 \times 10^9$  for SS, respectively. Both TS and SS showed significantly higher spermatozoa velocities and motilities after dilution in urine than after dilution in distilled water during the activity period. In conclusion, the results obtained from the present study provide information on northern pike sperm physiology that be used to improve sperm management efficiency for this species.

Hulák, M., Rodina, M., Linhart, O. Characteristics of stripped and testicular Northern pike (*Esox lucius*) sperm: spermatozoa motility and velocity. Aquatic Living Resources, 2008, volume 21, issue 2, pp. 207–212, ISSN 0990-7440.

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## EFFECTS OF THE HERBICIDE LASSO MTX (ALACHLOR 42% W/V) ON BIOMETRIC PARAMETERS AND LIVER BIOMARKERS IN THE COMMON CARP (*CYPRINUS CARPIO*)

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The aim of the study was to evaluate the effect of subchronic exposure to the herbicide LASSO MTX (alachlor 42% W/V) on biometric parameters and important liver biomarkers in the common carp (*Cyprinus carpio*). One-year-old fish were exposed for 28 days to LASSO MTX added to the tank water at concentrations of 240 and 2400  $\mu\text{g L}^{-1}$ . The exposure did not affect fish biometric parameters. Glutathione-S-transferase (GST) activity in liver (hepatopancreas) remained unchanged in exposed fish when compared to controls. However, significant induction of total cytochrome P 450 (CYP 450), ethoxyresorufin-O-deethylase (EROD) activity and elevated glutathione (GSH) in liver of exposed fish were detected.

Mikula, P., Blahová, J., Kružíková, K., Havelková, M., Némethová, D., Hulák, M., Svobodová, Z. Effects of the herbicide LASSO MTX (alachlor 42% W/V) on biometric parameters. Pesticide Biochemistry and Physiology, 2009, volume 93, issue 1, pp. 13–17, ISSN 0048-3575.

## APPLIED RESEARCH

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### GENETIC VARIATION FOR GROWTH AT ONE AND TWO SUMMERS OF AGE IN THE COMMON CARP (*CYPRINUS CARPIO* L.): HERITABILITY ESTIMATES AND RESPONSE TO SELECTION

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Heritability of growth-related traits (weight and length at ages one summer, first spring and two summers) was estimated in a synthetic mirror carp strain (HSM) reared under pond conditions of the Czech Republic. The four-generation pedigree was obtained from parentage assignment by using methods of molecular biology (microsatellite markers). The pedigree composed of 195 fish without phenotypes (48 inds. of  $G_0$ , 147 inds. of  $G_1$ ) and 1321 fish with phenotypes (674 inds. of  $G_2$ , 647 inds. of  $G_3$ ). Animal model heritability estimates over generations were in the range 0.21–0.33 for length and in the range 0.31–0.44 for weight. The genetic correlation between length and weight was high (0.97). The correlations between growth measurements in the first and in the second summer of age were moderate to low (0.34–0.67). Divergent selection for length at two summers of age was performed on  $G_2$  fish, and response to selection was evaluated by comparing the offspring of the selected sires in  $G_3$ , in a communal test (the same conditions of a single pond environment). The response to upwards selection was moderate and indicated a realized heritability value of 0.24 to 0.34. No response to downwards selection was observed. Presented results are in contrary to results found in Israel several tens years ago, but more supporting for further breeding work in common carp. It seems that individual selection for faster growth in common carp can be efficient. However, due to variability of environmental conditions in ponds and dependence on their natural productivity the visible results might be seen later on. Moreover, pond management will have to be altered in order to benefit fully from the improved genetic potential of fish.

Vandeputte, M., Kocour, M., Mauger, S., Rodina, M., Launay, A., Gela, D., Dupont-Nivet, M., Hulák, M., Linhart, O. Genetic variation for growth at one and two summers of age in the common carp (*Cyprinus carpio* L.): Heritability estimates and response to selection. Aquaculture, 2008, volume 277, issue 1–2, pp. 7–13, ISSN 0044-8486.

Breeding of common carp has had a long-term tradition in the Czech Republic. Thank to that, there has been bred many different carp breeds. Similar situation could be seen in other countries of Central and Eastern Europe. Therefore, an idea to summarize basic characteristics of existing carp breeds into a single publication appeared. One chapter was dedicated to the carp breeds of the Czech origin. Basic information to create this chapter was taken from atlas of carp breeds in the Czech Republic by Pokorný et al. (1996). The chapter summarizes most of the available data about origin of all 11 carp breeds included in the Czech national program of Ministry of Agriculture for protection of gene resources of farm animals. Information on living requests, present location and utilization, morphological and performance parameters is presented as well. Genetic variability and distances among breeds, estimated according to blood protein polymorphism, are not lacking. Aside the breeds of the Czech gene resources, three relatively new breeds are presented as well. The potential of their utilization for production of commercial stocks seems to be very high. Information presented in the chapter gives the most actual and comprehensive overview of existing carp breeds of the Czech origin. Much information presented in the chapter arose from research activities in this field at both institutions (FFWP USB, Vodňany and IAPG CAS, Liběchov) which the authors come from.

Kocour, M., Gela, D., Šlechtová, V., Kopecká, J., Šlechta, V., Rodina, M., Flajšhans, M., Carp Breeds of the Czech Republic. In Catalogue of Carp Breeds (*Cyprinus carpio* L.) of the Countries of the Central and Eastern Europe. Ministry of Agriculture of the Russian Federation, Moscow, 2008, pp. 13–46. ISBN 978-5-9974-0063-7.

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**A PROPOSAL AND CASE STUDY TOWARDS A CONCEPTUAL APPROACH OF VALIDATING SPERM COMPETITION IN COMMON CARP (*CYPRINUS CARPIO* L.) , WITH PRACTICAL IMPLICATIONS FOR HATCHERY PROCEDURES**

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Pooled sperms are used in hatcheries to reduce the impact of sperm of low quality and in an attempt to maintain genetic variability. This paper reviews sperm competition experiments that were conducted in common carp (*Cyprinus carpio* L.), and evaluates the genetic consequences of sperm competition under conditions of in vitro fertilization by variance in the effective number of males  $N_{em}$ . Whereas fertilization using equal volumes of sperm from each of five males resulted in 42.4% reduction in  $N_{em}$ , using pool of sperm with equal number of spermatozoa reduced the loss in  $N_{em}$  to 34.9%. Other two experiments implied only competition tests with equal numbers of spermatozoa per male - mean reduction in  $N_{em}$  of 28.4% was reported within 36 male-to-male competition challenges and four fertilizations by different sperm: egg ratios generated mean reduction in  $N_{em}$  of 42.2%. Lower number of males effectively represented in the hatchery progeny results in inbreeding and loss of genetic variability. Measures able to reduce these negative effects are discussed.

Kašpar, V., Vandeputte, M., Kohlmann, K., Hulák, M., Rodina, M., Gela, D., Kocour, M., Linhart, O. A proposal and case study towards a conceptual approach of validating sperm competition in common carp (*Cyprinus carpio* L.), with practical implications for hatchery procedures. Journal of Applied Ichthyology, 2008, volume 24, issue 4, pp. 406–409, ISSN 0175-8659.



Artificial reproduction of common carp (*Cyprinus carpio*)

## INTERNATIONAL COOPERATION

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### ACROSOME STAINING AND MOTILITY CHARACTERISTICS OF STERLET SPERMATOZOA AFTER CRYOPRESERVATION WITH USE OF METHANOL AND DMSO

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In this study we describe acrosome staining and motility characteristics of fresh and cryopreserved sterlet (*Acipenser ruthenus* L.) spermatozoa using soybean trypsin inhibitor-Alexa conjugate fluorescent staining and computer-aided sperm analysis (CASA), respectively. Methanol or dimethylsulfoxide (DMSO) were used as cryoprotectants. After cryopreservation, a decline in sperm motility characteristics occurred, but no differences between cryoprotectants were observed. Cryopreservation caused a significant increase of the percentage of spermatozoa with acrosome stained by SBTI-Alexa in samples with DMSO as cryoprotectant compared to methanol. The results indicate that the low usefulness of DMSO for cryopreservation of sturgeon spermatozoa is related to its harmful specific effect towards the acrosome, probably by causing its precocious triggering, before any egg contact.

Pšenička, M., Dietrich, G., Wojtczak, M., Nynca, J., Rodina, M., Linhart, O., Cosson, J., Ciereszko, A. Acrosome staining and motility characteristics of sterlet spermatozoa after cryopreservation with use of methanol and DMSO. *Cryobiology*, 2008, volume 56, issue 3, pp. 251–253, ISSN 0011-2240.

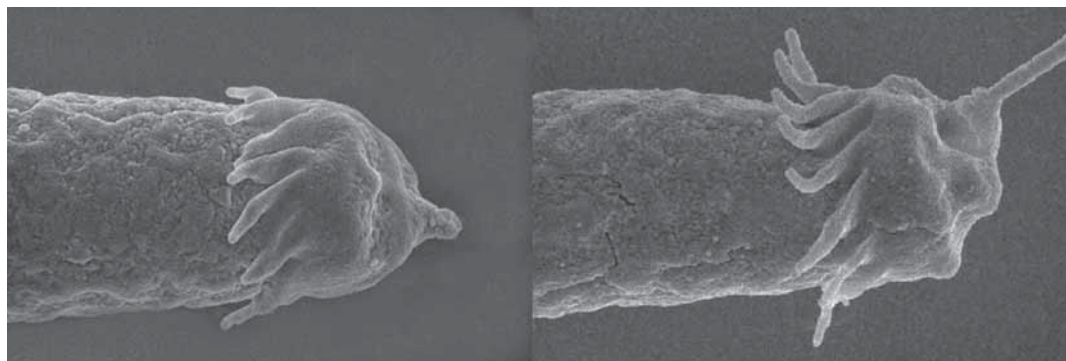
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### STAINING OF STURGEON SPERMATOZOA WITH TRYPSIN INHIBITOR FROM SOYBEAN, ALEXA FLUOR® 488 CONJUGATE FOR VISUALIZATION OF STURGEON ACROSOME

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Trypsin-like activity, similar to acrosin, is present in sturgeon spermatozoa and can be a potential target for trypsin inhibitors. The objective of this work was to use a fluorescent soybean trypsin inhibitor (SBTI) conjugate with the Alexa Fluor® 488 dye for visualization of sturgeon acrosome. After incubation with SBTI-Alexa, a strong signal was observed in both the acrosome and midpiece or implantation fossa regions. We have also found that SBTI-Alexa staining can be combined with live/dead staining. Close examination of staining pattern revealed that SBTI-Alexa could stain either acrosome or whole sperm. Staining of whole sperm correlated with live/dead staining ( $r^2 = 0.94$ ,  $p < 0.01$ ). However, in fresh semen most cells (93–97%) were not stained with SBTI-Alexa, probably due to intact acrosomes. Further studies should test if SBTI-Alexa can be applied to monitor the acrosome status during the acrosome reaction and cryopreservation.

Pšenička, M., Cosson, J., Alavi, SMH., Rodina, M., Kašpar, V., Gela, D., Linhart, O., Ciereszko, A. Staining of sturgeon spermatozoa with trypsin inhibitor from soybean, Alexa Fluor® 488 conjugate for visualization of sturgeon acrosome. *Journal of Applied Ichthyology*, 2008, volume 24, issue 4, pp. 514–516, ISSN 0175-8659.



*Detail of non-activated and activated acrosome of sperm of siberian sturgeon (Acipenser baerii)*

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## **POLYPLOID FISH AND SHELLFISH: PRODUCTION, BIOLOGY AND APPLICATIONS TO AQUACULTURE FOR PERFORMANCE IMPROVEMENT AND GENETIC CONTAINMENT**

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Polyploids can be defined as organisms with one or more additional chromosome sets with respect to the number most frequently found in nature for a given species. Triploids, organisms with three sets of homologous chromosomes, are found spontaneously in both wild and cultured populations and can be easily induced in many commercially relevant species of fish and shellfish. The major consequence of triploidy is gonadal sterility, which is of advantage in the aquaculture of molluscs since it can result in superior growth. In fish, the induction of triploidy is mainly used to avoid problems associated with sexual maturation such as lower growth rates, increased incidence of diseases and deterioration of the organoleptic properties. Triploidy can also be used to increase the viability of some hybrids, and is regarded as a potential method for the genetic containment of farmed shellfish and fish. This review focuses on some current issues related to the application of induced polyploidy in aquaculture, namely: 1) the artificial induction of polyploidy and the effectiveness of current triploidisation techniques, including the applicability of tetraploidy to generate auto- and allotriploids; 2) the performance capacity of triploids with respect to diploids; 3) the degree and permanence of gonadal sterility in triploids; and 4) the prospects for the potential future generalised use of triploids to avoid the genetic impact of escapees of farmed fish and shellfish on wild populations. Finally, directions for future research on triploids and their implementation are discussed.

Piferrer, F., Beaumont, A., Falguière, J., Flajšhans, M., Haffray, P., Colombo, L. Polyploid fish and shellfish: Production, biology and applications to aquaculture for performance improvement and genetic containment. *Aquaculture*, 2009, volume 293, issue 3–4, pp. 125–156, ISSN 0044-8486.



# SCIENTIFIC-RESEARCH LABORATORIES OF RIFCH

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Roman Blaszcok



# RESEARCH PRIORITIES AND SELECTED RESEARCH RESULTS

## ACTIVITIES OF THE LABORATORY

The laboratory activity is especially focused on monitoring of occurrence of extraneous substances in water ecosystems and research of their impact on exposed organisms. The attention is focused on impact assessment of selected sources of pollution on the water environment including the impact on water organisms. Pollutant contamination of fish in open waters as well as in aquaculture is assessed, too. The laboratory cooperates in national biomonitoring programs.

## LABORATORY TOXICOLOGICAL STUDIES

Laboratory toxicological studies, focused mainly on impact assessment of selected chemical compounds (currently especially pharmaceuticals and pesticides) on model organisms, are performed. Impact of extraneous substances occurring within the water environment on fish is determined especially by means of determination of selected biochemical parameters (so-called biochemical contamination markers) in fish tissue. The laboratory closely cooperates within the frame of its activities with other laboratories of the FFPW. Certain part of chemical analyses is made in cooperation with specialized analytical laboratories situated in other institutes both home and foreign. The scope of analyses includes not only pollutants limited by state legislation, but also so far virtually not monitored extraneous compounds representing, according to up-to-date scientific information, a potential risk for exposed organisms. The laboratory has reservoirs and experimental ponds for testing, keeping and manipulation with fish.



*Laboratory analyses*

### ***Selected publications***

- Li, Z., Randák, T. Residual pharmaceutically active compounds (PhACs) in aquatic environment – status, toxicity and kinetics: a review. *Veterinární medicína*, 2009, volume 52, issue 7, pp. 295–314, ISSN 0375-8427.
- Li, Z., Žlábek, V., Velíšek, J., Grabic, R., Máchová, J., Randák, T. Responses of antioxidant status and Na<sup>+</sup>-K<sup>+</sup>-ATPase activity in gill of rainbow trout, *Oncorhynchus mykiss*, chronically treated with carbamazepine. *Chemosphere*, 2009, volume 77, issue 11, pp. 1476–1481, ISSN 0045-6535.
- Žlábek, V., Randák, T., Kolářová, J., Svobodová, Z., Kroupová, H. Sex Differentiation and Vitellogenin and 11-Ketotestosterone Levels in Chub, *Leuciscus cephalus* L., Exposed to 17 β-Estradiol and Testosterone During Early Development. *Bulletin of Environmental Contamination and Toxicology*, 2009, volume 82, issue 3, pp. 280–284, ISSN 0007-4861.

Monitoring of water environment load by extraneous substances has been one of the laboratory activities already from the seventies of the last century. An extensive database of data on metal concentrations, persistent organochloric pollutants and other substances in bottom sediments, water plants, benthic organisms, biofilms and fish tissue has been established during this period. The results of mercury content determination from the year 1974 are the oldest. Thanks to this database it is possible to objectively assess, in a number of cases, the history of contamination at concrete sampling sites. The range of monitored substances is continuously changed and expanded. Laboratory employees perform field sampling for the monitoring purposes. The laboratory is appropriately equipped for this activity. There are cross-country cars available for field sampling, as well as equipment enabling sampling and freezing samples directly on site, there are several



Sampling in the field

types of efficient electro-hunting aggregates including a deep-water one, entangling nets and sampling boats. The laboratory has reservoirs and experimental ponds for testing, keeping and manipulation with fish. The FFPW cooperates in the field of determination of monitored pollutants with top equipped analytical workplaces (Umea University, Institute of Chemical Technology in Prague, National Veterinary Institute Prague, University of Veterinary and Pharmaceutical Sciences in Brno, Institute of Public Health in Ostrava). As far as the fish sampling itself concerns, the laboratory closely cooperates with fishing associations. With regard to assessment of water

environment contamination, the laboratory also cooperates with Czech Hydrometeorological Institute, Ministry of Agriculture of the Czech Republic, Ministry of Environment of the Czech Republic, institutions and organizations dealing with environmental protection, police, businesses dealing with ecological risks assessment, etc.

### ***Selected publications***

- Havelková, M., Slatinská, I., Šíroká, Z., Blahová, J., Krijt, J., Randák, T., Žlábek, V., Haruštiaková, D., Jarkovský, J., Svobodová, Z. Use of Biochemical Markers for the Assessment of Organic Pollutant Contamination. *Acta Veterinaria Brno*, 2009, volume 78, issue 3, pp. 513–524, ISSN 0001-7213.
- Havelková, M., Blahová, J., Kroupová, H., Randák, T., Slatinská, I., Leontovyčová, D., Grabic, R., Pospíšil, R., Svobodová, Z. Biomarkers of Contaminant Exposure in Chub (*Leuciscus cephalus* L.) – Biomonitoring of Major Rivers in the Czech Republic. *Sensors*, 2008, volume 8, issue 4, pp. 2589–2603, ISSN 1424-8220.
- Kružíková, K., Svobodová, Z., Valentová, O., Randák, T., Velíšek, J. Mercury and Methylmercury in Muscle Tissue of Chub from the Elbe River Main Tributaries. *Czech Journal of Food Sciences*, 2008, volume 26, issue 1, pp. 65–70, ISSN 1212-1800.
- Mácová, S., Haruštiaková, D., Kolářová, J., Máchová, J., Žlábek, V., Vykusová, B., Randák, T., Velíšek, J., Poleszczuk, G., Hajšlová, J., Pulkrabová, J., Svobodová, Z. Leeches as Sensor-bioindicators of River Contamination by PCBs. *Sensors*, 2009, volume 9, issue 3, pp. 1807–1820, ISSN 1424-8220.

Randák, T., Žlábek, V., Pulkrabová, J., Kolářová, J., Kroupová, H., Šíroká, Z., Velíšek, J., Svobodová, Z., Hajšlová, J. Effects of pollution on chub in the River Elbe, Czech Republic. *Ecotoxicology and Environmental Safety*, 2009, volume 72, issue 3, pp. 737–746, ISSN 0147-6513.

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## TROUT WATERS MANAGEMENT

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Laboratory employees also deal with issues of trout waters management. The brown trout (*Salmo trutta m. fario* L.) and grayling (*Thymallus thymallus* L.) belong to dominant and economically the most important species in so-called trout waters of the Czech Republic. However, there is currently a significant decrease of their populations in our rivers. The laboratory has been participating since the end of the nineties of the last century in cooperation with fishing associations in development of considerate methods of artificial breeding of various age categories of these species – including broodstocks. The purpose of this is to increase the number of spawners and subsequently the number of quality stock utilizable for strengthening freely living populations of the brown trout and grayling. The assessment of adaptability of cultured stocks in open water conditions and comparison of ecological demands of stocked and original free-living individuals provide very important information utilizable in the management of our trout waters. Experimental activity is largely applied in conditions of hatchery, pond management and protected fish reserve of the Local Organization of the Czech Fishing Association Husinec and in the purpose-built fishing ground of the USB RIFCH Vodňany. Based on the acquired knowledge, more efficient methods of trout grounds management, which support stabilization and development of trout and grayling populations in open waters, have been proposed and recommended for fishing practice.

### *Selected publications*

- Randák, T., Turek, J., Kolářová, J., Kocour, M., Kouřil, J., Hanák, R., Velíšek, J., Žlábek, V. Technology of brown trout culture in control conditions for running waters stocks production. Edition of Methodics (Technological series), RIFCH USB Vodňany, 2009, No. 97, 24 pp. • Verification 2009, Using in Czech Fishing Union, Fishing Club Husinec •
- Randák, T., Turek, J., Kolářová, J., Kocour, M., Hanák, R., Velíšek, J., Žlábek, V. Technology of European grayling broodfish culture in control conditions for sustainable running waters stocks production. Edition of Methodics (Technological series), RIFCH USB Vodňany, 2009, No. 96, 20 pp. • Verification 2009, Using in Czech Fishing Union, Fishing Club Husinec •
- Turek, J., Randák, T., Velíšek, J., Hanák, R., Sudová, E. Comparison of fish abundance and biomass in parts of small brook with different morphological and discharge conditions. *Bulletin*, 2009, volume 45, issue 1, pp. 18–24, ISSN 0007-389X.



*Electrofishing using backpack electrofishing equipment*

## INTERNATIONAL COOPERATION

The laboratory cooperates with two abroad universities (joint publications from 2008–2009 mentioned):

- *Umea University, Department of Chemistry, Sweden.*
- *Swedish University of Agricultural Sciences, Department of Food Science, Uppsala, Sweden.*

### ***Selected publications***

Zamaratskaia, G., Žlábek, V. EROD and MROD as Markers of Cytochrome P450 1A Activities in Hepatic Microsomes from Entire and Castrated Male Pigs. *Sensors*, 2009, volume 9, issue 3, pp. 2134–2147, ISSN 1424-8220.

Zamaratskaia, G., Žlábek, V., Chen, G., Madej, A., Modulation of porcine cytochrome P450 enzyme activities by surgical castration and immunocastration. *Animal*, 2009, volume 9, issue 3, pp. 1124–1132, ISSN 1751-7311.

Trattner, S., Kamal-Eldin, A., Brannaas, E., Moazzami, A., Žlábek, V., Larsson, P., Ruyter, B., Gjøen, T., Picková, J. Sesamin Supplementation Increases White Muscle Docosahexaenoic Acid (DHA) Levels in Rainbow Trout (*Oncorhynchus mykiss*) Fed High Alpha-Linolenic Acid (ALA) Containing Vegetable Oil: Metabolic Actions. *Lipids*, 2008, volume 43, issue 11, pp. 989–997, ISSN 0024-4201.

Trattner, S., Ruyter, B., Østbye, T., Žlábek, V., Kamal-Eldin, A., Picková, J. Sesamin Increases Alpha-Linolenic Acid Conversion to Docosahexaenoic Acid in Atlantic Salmon (*Salmo salar* L.) Hepatocytes: Role of Altered Gene Expression. *Lipids*, 2008, volume 43, issue 11, pp. 999–1008, ISSN 0024-4201.



*Grayling, Thymallus thymallus L.*

# APPLICATION OF SCIENTIFIC RESULTS IN PRACTICE AND OTHER LABORATORY ACTIVITIES

The laboratory activity for practice is focused on:

- *ment of contamination of selected localities (rivers, reservoirs) and assessment of effect of contamination on fish;*
- *analyses of a wide range of biochemical indicators in fish tissue;*
- *passive sampling;*
- *chemical analyses of environmental samples;*
- *toxicological studies focused on determination of impact of selected extraneous substances on fish conducted under laboratory conditions;*
- *biomonitoring for research purposes and for state administration;*
- *fish capture by means of electric aggregates;*
- *assessment of hygienic quality of fish meat;*
- *fishery management in fishing grounds;*
- *consultancy in the area of technologies of the brown trout and grayling culture;*
- *administration of purpose-built fishing ground of the RIFCH Blanice vodňanská 4B – sale of permits;*
- *proposals and service activities in the field of biomonitoring systems using fish as bioindicators;*
- *consultancy and advisory activity in the field of toxicology and fish management of open wat.*

Laboratory employees also participate in education of FFPW students studying the bachelor, master and also doctoral study programs.

# SCIENTIFIC-RESEARCH LABORATORIES OF RIFCH

## Laboratory of Aquatic Toxicology and Ichthyopathology

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Martin Podlesný

## **RESEARCH PRIORITIES**

The laboratory carries out fundamental and applied research under laboratory (lab experiments and tests), pilot plant (in experimental ponds) and field conditions. The research is focused on following topics:

- *Determination of effects of selected environmental and anthropogenic factors on fish.*
- *Prevention and elimination of health risks in fish culture – application of the principles of pharmacovigilancy in aquaculture in the Czech Republic. Protection of common carp (*Cyprinus carpio* L.) from KHV disease.*
- *Assessment of the toxicity and genotoxicity of substances and wastes for aquatic organisms.*
- *Study of fish physiology.*
- *Assessment of effects of fish culture intensity on quality of water and fish products (aiming at the composition of polyunsaturated fatty acids – PUFA, EPA, DHA).*
- *Analysis of the waste production by fish reared under different condition.*
- *Searching for causes of accidental fish kills.*

## **SELECTED RESEARCH RESULTS**

### **THE EFFECT OF SELECTED ENVIRONMENTAL AND ANTHROPOGENIC FACTORS ON FISH**

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#### **THE EFFECTS OF TESTED SUBSTANCES AND PREPARATIONS ON EARLY LIFE STAGES OF COMMON CARP (*CYPRINUS CARPIO*)**

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The effects of tested substances and preparations (organic solvent DMSO, PAX-18) on early life stages of common carp (*Cyprinus carpio* L.) were assessed on the basis of the results of the embryo-larval tests carried out on the eggs, embryos and larvae according to the OECD guideline no. 210. In the embryo-larval test, fish from egg to onset of the juvenile stage are continually exposed to a concentration series of a toxicant. The test starts 24 hours after eggs fertilization and takes about 30 days depending on water temperature (the test is concluded when the majority of fish in the control group reach juvenile stage).

1) Dimethyl sulfoxide (DMSO) is an important polar solvent, broadly used in chemical industry and as an auxiliary substance in toxicity tests on aquatic organisms. In the present study, fish were continually exposed to DMSO at the concentrations of 0.2, 0.5, 1.0 and 5.0 ml·l<sup>-1</sup> from fertilized egg to the end of the larval stage. DMSO exposure at all the tested concentrations did not result in any lethal effects or abnormalities compared to the control over a whole test period (29 days). Growth parameters were similar in DMSO treated (at concentrations of 0.2, 0.5 and 1.0 ml·l<sup>-1</sup>) and control groups. However, mean body weight (35 ± 9 mg) of larvae exposed to the highest DMSO concentration (5 ml·l<sup>-1</sup>) tested was significantly lower compared to the control (45 ± 14 mg).

2) The preparation PAX-18, with its active ingredient polyaluminium chloride (9% of Al), is a coagulation agent that is used mainly to precipitate phosphates, to prevent surface water eutrophication and occurrence of cyanobacteria. As it is applied to the water environment, and thus could present a potential risk to fish, it was necessary to test its toxicity to fish.

Effect on early developmental stages of common carp expressed as the no observed effect concentration was  $10 \text{ mg.l}^{-1}$  ( $0.9 \text{ mg.l}^{-1} \text{ Al}$ ), the lowest observed effect concentration was  $50 \text{ mg.l}^{-1}$  ( $4.5 \text{ mg.l}^{-1} \text{ Al}$ ). No significant effects of the preparation PAX-18 at the concentrations of  $50 \text{ mg.l}^{-1}$  of PAX-18 and lower were found on hatching, length and weight parameters, morphology and histopathology. Fish in eutrophicated water sources are exposed to PAX-18 concentrations corresponding to the lowest observed effect concentration, calculated in the present study, only for a short time, therefore, the effect on them can be considered as minimal.

Máchová, J., Prokeš, M., Kroupová, H., Svobodová, Z., Máčová, S., Doleželová, P., Velíšek, J. Early Ontogeny, Growth and Mortality of Common Carp (*Cyprinus carpio*) at Low Concentrations of Dimethyl Sulfoxide. Acta Veterinaria Brno, 2009, volume 78, issue 3, pp. 505–512, ISSN 0001-7213.

Máčová, S., Máchová, J., Prokeš, S., Plhalová, L., Šíroková, Z., Dlesková, K., Doleželová, K., Svobodová, Z. Polyaluminium chloride (PAX-18) – acute toxicity and toxicity for early development stages of common carp (*Cyprinus carpio*). Neuroendocrinology Letters, 2009, volume 30, issue 1, pp. 192–198, ISSN 0172-780X.

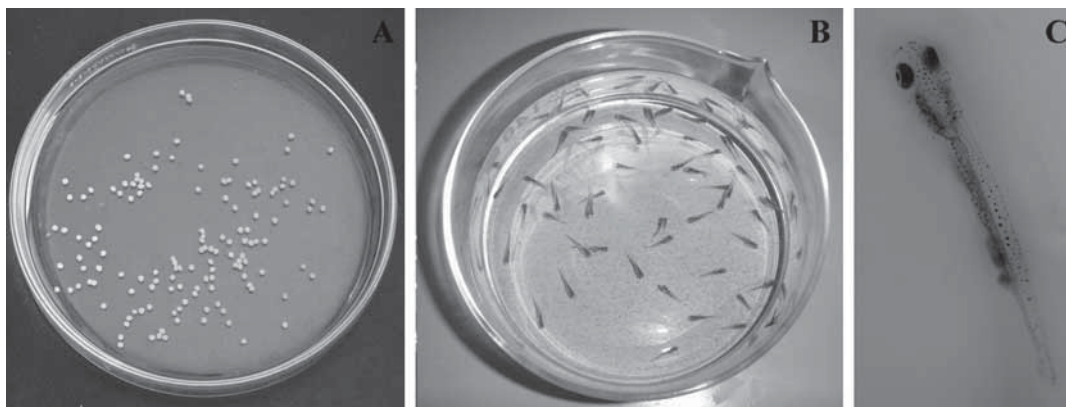


Fig. A: Common carp eggs before the beginning of the embryo-larval test

Fig. B: Common carp larvae before conclusion of the embryo-larval test

Fig. C: Common carp larvae before conclusion of the embryo-larval test – a detail

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## SUBCHRONIC TOXICITY OF NITRITE TO FISH

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Subchronic toxicity of nitrite in rainbow trout (*Oncorhynchus mykiss*; mean mass  $\pm$  S.D.,  $18.9 \pm 1.3 \text{ g}$ ) was assessed in a 28-day trial. The influence of nitrite on fish mortality, growth rate, haematology, blood biochemistry, and gill histology was observed. Survival was not affected by exposures up to  $1 \text{ mg.l}^{-1} \text{ NO}_2^-$  (at  $10 \text{ mg.l}^{-1} \text{ Cl}_2$ ). On the basis of growth rate inhibition data, the values of NOEC (28 d LC0) and LOEC (28 d LC10) were estimated at  $0.01$  and  $0.2 \text{ mg.l}^{-1} \text{ NO}_2^-$ , respectively. At  $0.01 \text{ mg.l}^{-1} \text{ NO}_2^-$  (the lowest concentration tested), there was segmental hyperplasia of the respiratory epithelium of secondary lamellae and elevated glucose and decreased potassium. Elevated nitrite concentrations were found in blood plasma of fish exposed to concentrations of  $1.0 \text{ mg.l}^{-1} \text{ NO}_2^-$  and higher, and in muscle tissue at the highest concentration  $3.0 \text{ mg.l}^{-1} \text{ NO}_2^-$ . Plasma and muscle nitrite levels were lower than those in the ambient water in all experimental groups.

Therefore, according to our observations, the strict water quality criteria declared in the EU Council directive 78/659/EEC are substantiated ( $0.01 \text{ mg.l}^{-1} \text{ NO}_2^-$  for salmonid waters).



Kroupová, H., Máčková, J., Piačková, V., Blahová, J., Dobšíková, R., Novotný, L., Svobodová, Z. Effects of subchronic nitrite exposure on rainbow trout (*Oncorhynchus mykiss*). *Ecotoxicology and Environmental Safety*, 2008, volume 73, issue 3, pp. 813–820, ISSN 0147-6513.



Rainbow trout (*Oncorhynchus mykiss*) in the test aquarium

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## THE TOXIC EFFECT OF PESTICIDE ON FISH

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The assessment of the toxic effect of two pesticide preparations Sencor 70 WG (active substance metribuzine), and Talstar EC 10 (active substance bifenthrin), was performed on common carp (*Cyprinus carpio* L.) and rainbow trout (*Oncorhynchus mykiss*). The effect was assessed on the basis of acute toxicity tests and effects of pesticide on haematological, biochemical blood plasma profile and histological examination of tissues.

Examination of haematological and biochemical profile and histological tissue examination was performed on the control group and experimental group after exposure to 96hLC50. The indices used to evaluate the haematological profile included the erythrocyte count (Er), haemoglobin concentration (Hb), haematocrit (PCV), mean erythrocyte volume (MCV), mean corpuscular haemoglobin concentration (MCHC), mean corpuscular haemoglobin content (MCH), leukocyte count (Leuko) and the differential leukocyte count (Leukogram). Biochemical indices determined in blood plasma included glucose (GLU), total protein (TP), albumins (ALB), total globulins (GLOB), ammonia (NH<sub>3</sub>), triacylglycerols (TRIG), aspartate aminotransferase (AST), alanin aminotransferase (ALT), lactate dehydrogenase (LDH), creatin kinase (CK), calcium (Ca<sup>2+</sup>), inorganic phosphate (PHOS) and glutathione S-transferase. Samples of gills, skin, liver, cranial and caudal kidney and spleen were histologically examined. Results of the examinations suggest that the pesticide preparation Talstar EC 10 was classified as highly toxic and pesticide preparation Sencor 70 WG was classified as harmful to fish.

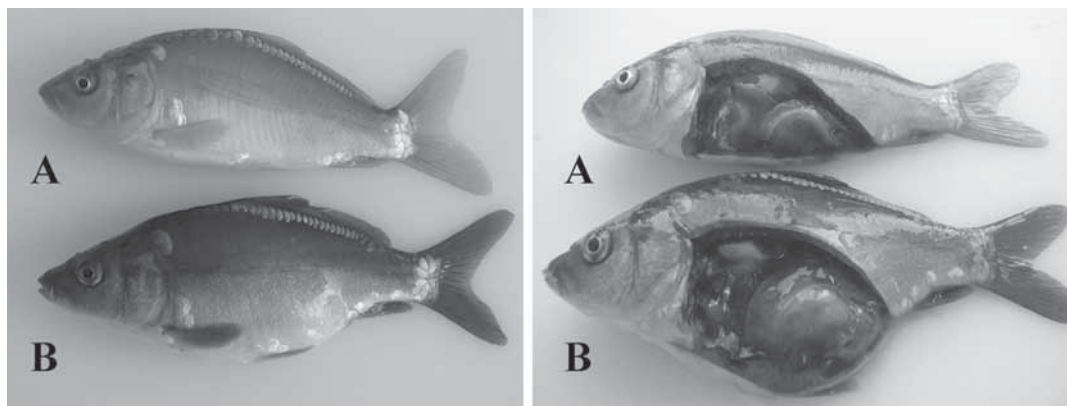


Fig. A – control common carp; B – experimental common carp after acute exposure to metribuzin – dark colour body, transudate in the body cavity

The next study assessed the subchronic effects of a triazine compound, simazine, on common carp (*Cyprinus carpio* L.) by means of biometric, biochemical, haematological, and histological examination. One-year-old fish were exposed to simazine at four concentrations, 0.06 (reported concentration in Czech rivers), 4, 20, and 50  $\mu\text{g/l}$  for 28 days and compared to carp in a non-treated control group. Our data suggest that simazine in the recorded environmental concentration 0.06  $\mu\text{g/l}$  had no effect on common carp. Subchronic exposure to 4, 20, and 50  $\mu\text{g/l}$  of simazine was associated with alterations in biochemical and haematological indices and in fish organ tissues.

Velíšek, J., Svobodová, Z., Piačková, V., Novotný, L., Blahová, J., Sudová, E., Malý, V. Effects of metribuzin on rainbow trout (*Oncorhynchus mykiss*). Veterinární medicína, 2008, volume 53, issue 6, pp. 324–332, ISSN 0375-8427.

Velíšek, J., Svobodová, Z., Piačková, V., Sudová, E. Effects of Acute Exposure to Metribuzin on Some Hematological, Biochemical and Histopathological Parameters of Common Carp (*Cyprinus carpio* L.). Bulletin of Environmental Contamination and Toxicology, 2009, volume 82, issue 4, pp. 492–495, ISSN 0007-4861.

Velíšek, J., Svobodová, Z., Piačková, V. Effects of Acute Exposure to Bifenthrin on Some Haematological, Biochemical and Histopathological Parameters of Rainbow Trout (*Oncorhynchus mykiss*). Veterinární medicína, 2009, volume 54, issue 3, pp. 131–137, ISSN 0375-8427.

Velíšek, J., Svobodová, Z., Máchová, J. Effects of bifenthrin on some haematological, biochemical and histopathological parameters of common carp (*Cyprinus carpio* L.). Fish Physiology and Biochemistry, 2009, volume 35, issue 4, pp. 583–590, ISSN 0920-1742.

Velíšek, J., Šťastná, K., Sudová, E., Turek, J., Svobodová, Z. Effects of subchronic simazine exposure on some biometric, biochemical, hematological and histopathological parameters of common carp (*Cyprinus carpio* L.). Neuroendocrinology Letters, 2009, volume 30, issue 1, pp. 236–241, ISSN 0172-780X.

# ASSESSMENT OF TOXICITY AND GENTOXICITY OF SUBSTANCES AND WASTE FOR AQUATIC ORGANISMS

## THE EFFECTS OF SEDIMENTS BURDENED BY SEWERAGE WATER ORIGINATING IN CAR BATTERIES PRODUCTION IN THE KLENICE RIVER (CZ)

The thesis is aimed at testing of genotoxicity of river sediment samples from the locality burdened with car industry (the production of car batteries) and at comparing the results with chemical analysis from different locality of the Klenice River (CZ). Genotoxicity has been tested by means of two kinds of genotoxicity tests: SOS chromotest and Escherichia coli WP2 assay. Toxicity of the samples was determined by an acute toxicity test on an aquatic crustacean *Daphnia magna*. Concurrently, sampling of juvenile cyprinids, of biofilm and benthos for the purpose of chemical analysis (assessment of lead concentration) was performed. Qualitative and quantitative analysis of benthos samples were carried out. A strong toxic effect on benthic organisms due to the pollution of the Klenice River (CZ) by sewage and runoff waters from the area of car industry was revealed. In a similar manner, the content of lead has been growing in biofilm, in sediments and in bodies of juvenile fish. In the line with growing charge of the localities the genotoxic potential of the sediment samples was growing. The work represents the first study of the burdening of the stream receiving sewerage and flush water from the car industry area.

## IMPACT OF SEDIMENT EXTRACTION'S METHOD ON RESULTS OF ECOTOXICOLOGICAL TESTS

This study was directed on sediment extraction and its impact on results of ecotoxicological tests. Preparations of aqueous leach (dry sediment's shaking to distilled water) and extraction by organic solvents (e. g. dichloromethane, hexane, methanol and so on, eventually their compounds) are the most used extraction's methods. Water belongs to polar solvents and therefore we can assume that polar substances would be leached to it preferentially. On the other hand, dichloromethane is non-polar solvent and therefore non-polar substances should dissolve in it in preference. Biological impact of polar and non-polar substances could be very different.

Two tests of toxicology were chosen as examples of ecotoxicological methods - Acute immobilization test on water crustacean (*Daphnia magna*) and Test of root growth's inhibition of white mustard (*Sinapis alba*). Also one test of genotoxicity was chosen (SOS-chromotest).

Strong toxicological effect was proved by aqueous leach as well as organic extract in the Acute immobilization test on *Daphnia magna* (mortality and immobility was 100% in all tested treatments versus 0 and 0.3% in negative controls). Vice versa, all tested samples showed negative effect in the Test of root growth's inhibition of *Sinapis alba* (stimulation/inhibition of growth did not differ from negative controls more than 30% which is considered to be a negative result of this test by Methodological direction of Ministry of Environment of the Czech Republic for evaluation of waste's ecotoxicology). In SOS-chromotest, different effects of aqueous leach (effect was comparable with effects of negative controls) and organic extract (effect got over induction factor 1.5 which means strong genotoxicological effect of tested sample) was examined.

Differences in results of these separate tests confirm hypothesis about diverse effect of sediment extracts obtained by different extraction methods. In consequence, more experiments will be done and they will be completed by detailed chemical analyses. Gained information will be used for optimalization of environment monitoring in the Czech Republic.

Beránková, P., Schramm, K., Bláha, M., Rosmus, J., Čupr, P. The Effects of Sediments Burdened by Sewerage Water Originating in Car Batteries Production in the Klenice River (CZ). *Acta Veterinaria Brno*, 2009, volume 78, issue 3, pp. 535–548, ISSN 0001-7213.

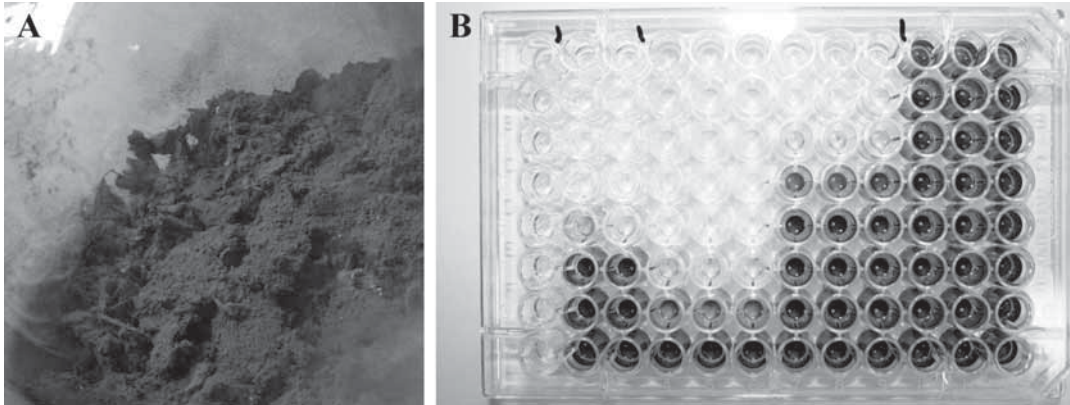


Fig. A: a dry sediment before extraction; Fig. B: a plate of SOS-chromotest

## PREVENTION AND MINIMISATION OF HEALTH HAZARD IN FISH CULTURE

### THERAPEUTIC EFFECT OF PERSTERIL

The use of chemicals for treatment of fish and fish diseases prevention is very complicated. Substances or drugs have to fulfill criteria of effectiveness and safety standards for fish organisms and criteria for hygienic quality of flesh of treated fish and legislative limits for protection of water quality (non-target organisms and water quality can not be influenced).

There is only limited number of substances that are allowed to be used in fisheries practise. Persteril seems to be very prospective for practical use. This substance is based on peroxyacetic acid ( $\text{CH}_3\text{CO}_3\text{H}$ ), hydrogen peroxide ( $\text{H}_2\text{O}_2$ ) and acetic acid ( $\text{CH}_3\text{CO}_2\text{H}$ ). The mechanism of therapeutic effect is seen in activity of elemental oxygen. Water and acetic acid are easily biodegradable products of dissociation. Accumulation of these substances in environment is not supposed.

Therapeutic effect of persteril was tested in a five days dynamic exposure of carps aimed at *Ichthyophthirius multifiliis*. This parasitic ciliate *Ichthyophthirius multifiliis* infests all species of freshwater fish and can cause severe economic losses in fish culture. The most effective treatment, malachite green, has been banned in Europe and North America for use in food-fish production. Peracetic acid (PAA) was found to be toxic to *I. multifiliis* theronts at low concentrations. *I. multifiliis*-infested carp were exposed to 1 mg/l PAA in a dynamic exposure by means of peristaltic pumps. Five days after infestation, gills, tail fins and skin below the dorsal fin were observed microscopically for *I. multifiliis* abundance. After PAA exposure, PAA-treated fish showed lower infestation of *I. multifiliis* in all investigated tissues than the unexposed control fish. The infestation increased in the control group whereas the infestation in the PAA-exposed groups significantly decreased ( $p = 0.0083$ , Bonferroni correction). The fish in the two exposure groups showed a slight reinfestation with *I. multifiliis*. This might be caused by a peroxide degradation (hydrolysis) and/or reduction of the delivered PAA concentration. Thus, PAA concentrations were possibly too low to be effective on the released trophonts and/or the infective theronts. This hypothesis is corroborated by the fact that the *I. multifiliis* in the gills, skin, and fins of the PAA-exposed carp were in an early developmental stage.

### KOI HERPES VIRUS (KHV)

Since 1998, the disease causing serious loses in common carp and koi carp breeds has spread around the world. Koi herpes virus (KHV) was designated as etiological agent of this disease.

In 2004, the Department of water toxicology and fish diseases joined the research activities in the field of KHV by means of the grant project of The National Agency for Agriculture Research. The first project (2004–2006) was focused mainly on the implementation of routine PCR diagnostic of KHV at the Department of virology Veterinary research institute in Brno and on the monitoring of presence of KHV in Czech stocks of common carp and koi carp. Since 2007, the second project has been under way. The aim of this project is except of the field monitoring also to determine sensitivity of various breeds and hybrids of common carp to KHV in laboratory and, if possible, also in the field conditions.

In 2008 samples from eight localities were checked, sixty six samples in total. Examinations were performed by PCR method by using two different methods of DNA extraction. Experiments testing sensitivity of individual strains to KHV were also started. Four groups of fish (pure strains and hybrids) were used. Koi carp was used as the positive control.

The monitoring of the presence of KHV in Czech carp stocks continued in 2009. Samples from six fish farms were taken and checked. According to the fact that the monitoring of KHV was implemented to the Czech veterinary legislation since august 2009, there wasn't any reason to continue in monitoring in the frame of the project.

Testing of sensitivity individual strains and hybrids to KHV were carried out in two phases: in the first, fish of K<sub>1</sub> category obtained from the spring harvests of ponds were used. In the second, fingerlings which were bred especially for purposes of the project were used. Eleven groups of fish were tested in total in 2009. Some of them were the same as in 2008. Groups, which will be submitted to another testing, are going to be chosen on the basis of the laboratory experiments.

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## **STUDY OF FISH PHYSIOLOGY – BIOCHEMICAL AND HAEMATOLOGICAL PROFILE OF COMMON CARP BREEDS**

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The goal of this study was to determine the basic biochemical and haematological profile of common carp (*Cyprinus carpio* L.) spawners of eight breeds reared under identical conditions and sampled in spring after overwintering. The breeds compared were: Amur wild carp (AS), Ropsha scaly carp (ROP), Ukraine scaly carp (US), Northern mirror carp (M72), South Bohemian mirror carp (BV), Israeli mirror carp (Dor 70), Hungarian mirror carp (M2) and Tata scaly carp (TAT).

Significant differences were found among breeds in glucose concentration (GLU), total protein concentration (TP), triacylglycerols concentration (TAG), and calcium (Ca) and phosphorus (Pi) concentration. No differences were observed in aspartate transaminase activity (AST) or alanine aminotransferase activity (ALT). The highest glucose, total protein, and calcium (Ca) concentrations were found in AS (GLU  $8.3 \pm 1.2$  mmol.L<sup>-1</sup>, TP  $32 \pm 3$  gL<sup>-1</sup>, Ca  $2.42 \pm 0.22$  mmol.L<sup>-1</sup>). High values of triacylglycerol concentration (TAG) were found in ROP ( $1.94 \pm 0.52$  mmol.L<sup>-1</sup>). Phosphorus (Pi) concentration was the highest in M2 ( $3.82 \pm 1.34$  mmol.L<sup>-1</sup>). Amur wild carp and breeds originating from there (ROP, US, and M72) had significantly higher values of TP ( $P < 0.05$ ), TAG ( $P < 0.05$ ), and Ca ( $P < 0.01$ ) and significantly lower values of Pi ( $P < 0.05$ ) than did the other breeds. Scaly breeds had higher values of glucose ( $P < 0.01$ ), TP ( $P < 0.01$ ), ALT ( $P < 0.01$ ), and Ca ( $P < 0.01$ ) and significantly lower values of Pi ( $P < 0.01$ ) than did mirror carp. Significant ( $P < 0.01$ ) sex-related differences were found in GLU, TAG and Ca concentrations.

Significant differences were found among the breeds for haemoglobin level (Hb), haematocrit value (PCV), mean corpuscular volume (MCV) and mean corpuscular haemoglobin (MCH) values. The number of red blood cells (RBC), mean corpuscular haemoglobin concentration (MCHC), number of leukocytes (WBC) and leukocyte differential count (WBC DIFF) did not differ significantly among the respective breeds. The highest Hb, PCV and MCH values were found for Ropsha scaly carp (ROP) and Amur wild carp (AS) (Hb  $109 \pm 17$  and  $106 \pm 15$  g l<sup>-1</sup>; PCV  $0.40 \pm 0.06$  and  $0.40 \pm 0.06$  l l<sup>-1</sup>; MCH  $69 \pm 7$  and  $69 \pm 9$  pg, respectively).

The AS specimens and breeds that originated [ROP, Ukraine scaly carp (US), and Northern mirror carp (M72)] showed significantly higher values of Hb ( $P < 0.01$ ), PCV ( $P < 0.01$ ), MCV ( $P < 0.05$ ) and MCH ( $P < 0.05$ ), compared to the other four breeds: Hungarian mirror carp (M2), Israeli mirror carp (Dor 70), South Bohemian mirror carp (BV) and Tata scaly carp (TAT). Males showed significantly higher PCV, Hb and RBC values within individual breeds. This study demonstrated that Amur wild carp and breeds originating from it had significantly higher values of erythrocyte profile in comparison with the other breeds studied.

Svobodová, Z., Kroupová, H., Modrá, H., Flajšhans, M., Randák, T., Savina, L., Gela, D. Haematological profile of common carp spawners of various breeds. *Journal of Applied Ichthyology*, 2008, volume 24, issue 1, pp. 55–59, ISSN 0175-8659.

Svobodová, Z., Smutná, M., Flajšhans, M., Gela, D., Kocour, M., Máchová, J., Kroupová, H. Differences in biochemical profiles among spawners of eight common carp breeds. *Journal of Applied Ichthyology*, 2009, volume 25, issue 6, pp. 734–739, ISSN 0175-8659.

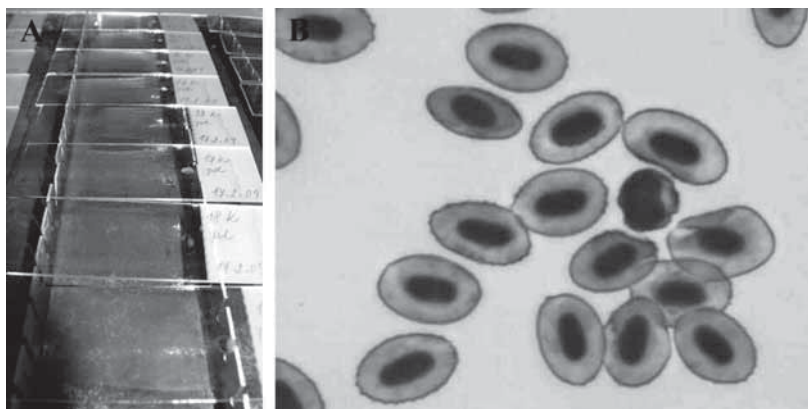


Fig. A: Blood smears for estimating of differential cell count

Fig. B: Erythrocytes of common carp *Cyprinus carpio* L.

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## THE IMPACT OF A POND MANAGEMENT ON WATER AND FISH FLESH QUALITY

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The impact of a pond management on water and fish flesh quality was studied from April to September 2008 in 6 experimental ponds (0.16 ha each) at the Research Institute of Fish Culture and Hydrobiology in Vodňany (Czech Republic). The extensive carp production system (stocking density: 50 individuals per pond, 300 g mean weight, fish was not fed by supplemental feed) and the semi-intensive carp production system (stocking density: 200 individuals per pond, 300 g mean weight, fish was supplemented by wheat) were carried out in three experimental ponds each. During the experiment, the water quality was analyzed and compared with the emission standards (Governmental order nr. 229/2007 for carp waters). There were no differences in water quality parameters among the ponds. However, the emission standards of pH, oxygen level,  $\text{CHSK}_{\text{Cr}}$ ,  $\text{BSK}_5$  and total phosphorus exceeded repeatedly even in the pond with extensive carp production system. The unsuitable values were approximately 10 to 30% higher in the semi-intensive system than in the extensive system. The supplemental cereal feeding in the semi-intensive system doubled lipid content in carp muscle and increased the ratio of n-6/n-3 polyunsaturated fatty acids (2.7:1 supplemented fish; 0.55:1 fish with no supplemental feed). Despite n-6/n-3 ratio reduction, the ratio is still very favourable compared to usual so called western diet.



Fig. A: Degustation of carp meat from fish fed on different diet

Fig. B: Experimental pond for fish fed on natural diet

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## WATER POLLUTION BY CARP ORIGINATING FROM DIFFERENT POND MANAGEMENT SYSTEMS

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Water pollution by carp excretion was evaluated in short term aquarium experiments. Effects of the three different feeding treatments of carp were tested (extensive without supplemental feeding; semi-intensive with supplemental feeding by either wheat or feed pellets). Two fish from each pond with different treatment were placed into 100 l tanks filled with tap water, with two replicates per treatment. Fish were removed into aquarium with clean water after 24 hours; all prior water was filtered through a sieve with 40  $\mu\text{m}$  mesh size. Both, filtered water and solids were analysed. The same sampling was repeated after next 24 hours. Pollution detected in solids and in filtered water was related to live weight of fish per day. Solids were analysed for a content of dry matter, total phosphorus (P) and nitrogen (N). Filtered water was analysed for a concentration of total nitrogen, total phosphorus,  $\text{COD}_{\text{Mn}}$ ,  $\text{COD}_{\text{Cr}}$  and  $\text{BOD}_5$ . Fish fed on pellets showed the highest excretion of solids given in dry matter ( $1003 \text{ mg}\cdot\text{day}^{-1}\cdot\text{kg}^{-1}$  of fish) compared to values 557 and  $638 \text{ mg}\cdot\text{day}^{-1}\cdot\text{kg}^{-1}$  of fish fed with wheat or without supplemental feeding, respectively. All these values decreased markedly during the second day of the experiment. The highest values of  $\text{COD}_{\text{Mn}}$  ( $609 \text{ mg}\cdot\text{day}^{-1}\cdot\text{kg}^{-1}$ ),  $\text{COD}_{\text{Cr}}$  ( $1620 \text{ mg}\cdot\text{day}^{-1}\cdot\text{kg}^{-1}$ ),  $\text{BOD}_5$  ( $1053 \text{ mg}\cdot\text{day}^{-1}\cdot\text{kg}^{-1}$ ) and total N ( $24 \text{ mg}\cdot\text{day}^{-1}\cdot\text{kg}^{-1}$ ) in filtered water were detected in the group fed on pellets, whereas unfed group presented the highest concentration of total P ( $15.4 \text{ mg}\cdot\text{day}^{-1}\cdot\text{kg}^{-1}$ ).

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## ANAESTHETICS

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Assessment of the effect of anaesthetics (eugenol and MS 222) was performed on Siberian sturgeon (*Acipenser baeri Brand*). The effect was assessed on the basis of the effects of anaesthetics on haematological, biochemical blood plasma profile and histological examination of tissues. The haematological and biochemical indices were assessed in fish immediately and 24 h after anaesthesia. The experiment results showed that despite no mortality after anaesthesia in both 125 mg/l of MS-222 and 0.075 ml/l of eugenol, these chemicals severely influenced blood parameters of Siberian sturgeon and resulted in some histological changes in gills and liver. Eugenol and MS-222 anaesthesia caused erythrocytes swelling and haemolysis. The severe depletion of leukocyte number occurred 24 hours after both eugenol and MS-222 anaesthesia (mainly due to depletion of lymphocyte, neutrophils segments and eosinophiles fractions). Total protein, total globulin, triacylglycerols concentration and alanine aminotransferase activity in blood plasma was significantly elevated ( $p < 0.01$ ) after both eugenol and MS-222 anaesthesia. The concentration of  $\text{Ca}^{2+}$ , inorganic phosphate,  $\text{NH}_3$  and alkaline phosphatase activity were significantly decreased ( $p < 0.01$ ) compared to control.

The next study assessed the effects of four anaesthetics (MS 222, clove oil, 2-phenoxyethanol and Propiscin) on biochemical profile of perch (*Perca fluviatilis*). This study investigated the feasibility of using of clove oil, 2-phenoxyethanol, or Propiscin as an alternative to tricaine methane sulphonate (MS 222) as a fish anaesthetic, particularly with regard to reducing fish stress. Biochemical profiles were determined from blood samples collected prior to treatment in controls, immediately after 10 min anaesthesia and 24 h after 10 min anaesthesia. The values determined in the present study suggested that internal organs and tissues of perch were slightly altered by MS 222 (100 mg/l), clove oil (33 mg/l), and 2-phenoxyethanol (0.40 ml/l), anaesthesia, but not by Propiscin (1.0 ml/l) anaesthesia. Therefore, it is possible to recommend Propiscin as suitable anaesthetic for perch.

Gomulka, P., Wlasow, T., Velíšek, J., Svobodová, Z., Chmielinska, E. Effects of Eugenol and MS-222 Anaesthesia on Siberian Sturgeon *Acipenser baerii* Brandt. *Acta Veterinaria Brno*, 2008, volume 77, issue 3, pp. 447–453, ISSN 0001-7213.

Velíšek, J., Stejskal, V., Kouřil, J., Svobodová, Z. Comparison of the effects of four anaesthetics on biochemical blood profiles of perch. *Aquaculture Research*, 2009, volume 40, issue 3, pp. 354–361, ISSN 1355-557X.

## INTERNATIONAL COOPERATION

The Laboratory cooperates with following foreign workplaces:

- *Faculty of Environmental Science and Fisheries, University of Warmia and Mazury Olsztyn, Poland (T. Wlasow and P. Gomulka) – Anaesthetics.*
- *Department of Physiology and Ecotoxicology, John Paul II Catholic University of Lublin, Poland (A. Sierosławska, A. Rymuszka) – Microcystins.*
- **Szczecin University, Szczecin, Poland (G. Poleszczuk) – Nitrite toxicity to fish.**
- *Leibniz-Institute of Freshwater Ecology and Inland Fisheries, Berlin, Germany (W. Kloas, I. Lutz, T. Meinelt) – Effect of environmental and anthropogenic factors on fish, Prevention and elimination of health risks in fish culture.*

## APPLICATION OF RESEARCH RESULTS AND OTHER ACTIVITIES

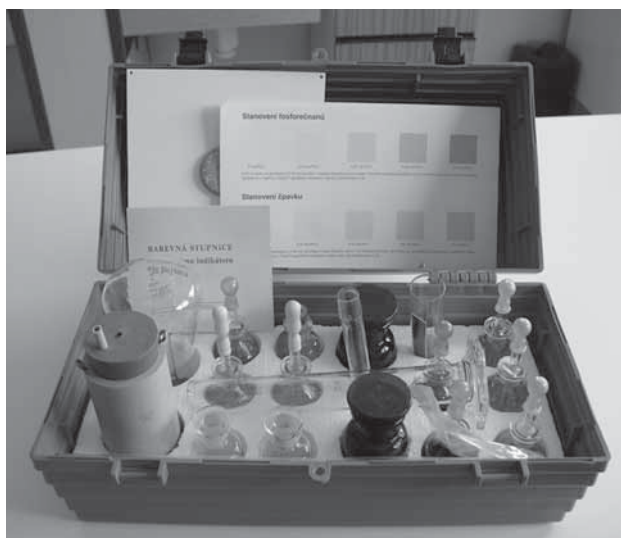
Further laboratory activity is focused on:

- *Eco-toxicological assessment of preparations, substances, and wastes in toxicological laboratory accredited by the Czech Institute of Accreditation registered under No. 1052 (Head – Dipl.-Ing. J. Máchová, Quality manager – Dipl.-Ing. O. Valentová). Acute toxicity test are carried out on fish (guppy *Poecilia reticulata*, zebra fish *Brachydanio rerio*, common carp *Cyprinus carpio*, and rainbow trout *Oncorhynchus mykiss*), green chlorococcal algae *Scenedesmus subspicatus*, aquatic arthropod *Daphnia magna* and plant *Sinapis alba*. (Dipl.-Ing. J. Máchová).*
- *Chronic toxicity tests on fish – common carp (*Cyprinus carpio*) and rainbow trout (*Oncorhynchus mykiss*). (Dipl.-Ing. J. Velíšek, Ph.D., Dipl.-Ing. J. Máchová).*
- *Basic chemical analysis of drinking, surface, waste waters and determination of total mercury in biological materials. Production and service of field kits for quick basic chemical analysis of water (Dipl.-Ing. O. Valentová).*
- *Parasitological, pathological, biochemical and haematological examination of fish (E. Sudová, DVM, Ph.D.; V. Piačková, DVM, Ph.D.; Dipl.-Ing. J. Velíšek, Ph.D., and Prof. Z. Svobodová, DVM, DSc.).*



- Consulting service in the field of aquatic toxicology, fish diseases and aquatic chemistry (The following methodology was issued for fishery practice: Valentová, O., Máchová, J., Faina, R., Kroupová, H., Svobodová, Z. COMBI set – field water analyses. 2009. Edition of Methodics (Technological series), FFPW USB Vodňany, 2009, No. 90, 28 pp.
- Teaching of the subjects Aquatic Chemistry, Ecotoxicology, Aquatic Toxicology and Fish Diseases at the Faculty of Fisheries and Protection of Waters, the University of South Bohemia in České Budějovice.
- Teaching of Ecotoxicology at Higher Professional School of Water Management and Ecology by Fishery High School in Vodňany.

The Combi – set is widely used by Czech fishermen for analyses of basic water parameters under field conditions. The methodology called “COMBI set – field water analyses” was prepared to help fishermen to better interpret results of water analysis obtained by using this set. Moreover, the methodology provides detailed instruction for use of the set and gives also basic information about the significance of selected water quality parameters.



Valentová, O., Máchová, J., Faina, R., Kroupová, H., Svobodová, Z. COMBI set – field water analyses. 2009. Edition of Methodics (Technological series), RIFCH USB Vodňany, 2009, No. 90, 28 pp.

Prof. Zdeňka Svobodová, MVD, DSc. edited a book Veterinary Toxicology for clinical praxis. H. Kroupová and J. Máchová cooperated on the chapter dealing with fish toxicology.

Svobodová, Z., Máchová, J., Kroupová, H., Suchý, P. Fish Toxicology. In Toxicology for clinical praxis. Prague the Czech Republic: Profi Press, 2008, pp. 201–217. ISBN 978-80-86726-27-4.



# SCIENTIFIC-RESEARCH LABORATORY OF IA

**Laboratory of Aquaculture** – The lab was established on the 1st September 2009

<b>Dipl.-Ing. Pavel Vejsada, Ph.D.</b> Head of Laboratory <i>Fish nutrition (the influence of nutrition on fish flesh), fish processing, new technological processes in fish processing, gastronomy of fish products</i>	<a href="mailto:vejsada@frov.jcu.cz">vejsada@frov.jcu.cz</a>	
<b>Dipl.-Ing. Petr Dvořák, Ph.D.</b> Assistant manager <i>Fish anatomy and physiology, ichthyology, sport fishing, hunting, research on fish migration and the possibilities of their protection, the impact of revitalization interventions in the water streams to changes in fish communities</i>	<a href="mailto:dvorakp@frov.jcu.cz">dvorakp@frov.jcu.cz</a>	
<b>Assoc. Prof. Dipl.-Ing. Petr Hartvich, CSc.</b> <i>Fish farming in pond aquaculture, semi-intensive rearing of carp with complementary diets, revitalization of migration penetrability in water systems. Biodiversity and ecological stability of ichthyofauna in protected areas</i>	<a href="mailto:hartvich@frov.jcu.cz">hartvich@frov.jcu.cz</a>	
<b>Assoc. Prof. Dipl.-Ing. František Vácha, CSc.</b> <i>Fish processing, fish nutrition, meat nutritional and technological quality, marketing of fish products with a link to the profile of textural properties, sensory evaluation of fish, advisory and consulting approach to international activities (in relation to the FEAP - Federation of European Aquaculture Producers)</i>	<a href="mailto:vacha@frov.jcu.cz">vacha@frov.jcu.cz</a>	
<b>Dipl.-Ing. Tomáš Zajíc, Ph.D. student</b> <i>Fish flesh quality</i>	<a href="mailto:zajict00@frov.jcu.cz">zajict00@frov.jcu.cz</a>	
<b>Dipl.-Ing. Jan Másilko, Ph.D. student</b> <i>Fish nutrition</i>	<a href="mailto:masilj00@frov.jcu.cz">masilj00@frov.jcu.cz</a>	
<b>Dipl.-Ing. Vítězslav Plička</b> Technician	<a href="mailto:plickv00@frov.jcu.cz">plickv00@frov.jcu.cz</a>	

## ***Undergraduates and bachelors***

Bc. Ondřej Tomeček  
Pavel Brož  
Jan Toms  
Bc. Josef Příborský  
Tomáš Marek  
Petr Antonín  
Hynek Zikmund

Lenka Jirušková  
Lukáš Bíro  
David Jánošík  
Dalibor Koutník  
Petr Nádvorník  
František Salon  
Petr Svačina

Michal Sedlák  
Bc. Michal Vodárek  
Miloš Petr  
Bc. David Hlaváč  
Jiří Toncar  
Bc. Pavel Šmíd  
Jakub Zrostlák

## RESEARCH PRIORITIES AND SELECTED RESEARCH RESULTS

The laboratory guarantees and coordinates bachelor and master study in fisheries under South Bohemian University in České Budějovice, Faculty of Fisheries and Protection of Waters. The laboratory cooperates with significant fish farmers in the Czech Republic and abroad where students undergo their practical training. The laboratory also cooperates with nature and land protection organisations and participates in selected projects of water ecosystems.



The laboratory is involved in several activities dealing with assessment and characterisation of fish as entering raw material for further commercial utilization. Changes in fish flesh after killing and impact on quality and nutritional value of fish flesh are evaluated. Other part of laboratory activity is the finalisation of fish production, possibilities of effective evaluation of fish products on domestic and international market, and also culinary treatment of fish flesh and use of additive substances in new product development.

The laboratory is also involved in migration penetrability of watercourses in CZ, participates in migration of fish in newly built passages in the Vltava river basin and in chosen localities in Liberec region. In cooperation with management of protected areas the laboratory monitors ichthyofauna and evaluates ecological stability of fish communities in watercourses and installations in protected areas.



It evaluates methods of fish management, suggests and creates new methods in fishery management promoting biodiversity and ecological stability. It also participates in research of new methods in supplementary feeding in economically important fish species, deals with stabilisation of financial expenses for feeding in semi intensive fish culture, efficiency of feed digestibility and ways of feed treatment.

In the field of the applied research, the laboratory is involved in nutritional and qualitative values of fish flesh in relation to different fish feed sources, fish products auditing, microbial and chemical assessment of fish product quality. Post mortem changes in fish flesh, flesh autolysis and their influence on quality and nutritional value at fish flesh in connection to organoleptic assessment and food safety are dealt with. The other field activity is in the field of sanitation and hygiene of processing plants, hygiene regulations in connection to system of quality control (HACCP) at fish products in CZ.





The research is focused on the influence of nutritional parameters of fish flesh from the point of aminoacids in flesh and fatty acids of fat in consumed fish body parts. Two projects on biological potential, determination and characteristics of “Czech carp” profile and common carp welfare in pond aquaculture and trade are solved at the time.

## SELECTED PUBLICATIONS

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### **EFFECTIVE SUPPLEMENTARY FEEDING BY MECHANICALLY MODIFIED CEREALS FOR MARKET CARP CULTURE IN TŘEBOŇ HLD.**

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In storage ponds and earth ponds at Fishery Třeboň Hld., pilot experiments in carp farming with supplementation of mechanically modified cereals were carried out in 2006–2009. For supplementary feeding pressed and crushed triticale, barley and rye were used. Lower feed conversion was found in treated cereals in 11.06% than with cereals without any modifications. Effective supplementary feeding with the modified cereals will be reflected in the overall reduction of feed costs in market carp culture.

Másilko, J., Urbánek, M., Hartvich, P., Hůda, J. Efficient additional feeding with mechanically treated cereals in the breed of market carp in fisheries Rybářství Třeboň Hld. a.s. Edition of Methodics (Technological series), RIFCH USB Vodňany, 2009, No. 98, 11 pp. • Verification 2009, Using Třeboň, Hld. Fishery •

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### **TEXTURE PROFILE ANALYSE IN COMMON CARP FLESH**

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Evaluation of various parameters in texture is based on the relationship between the chemical composition of meat, its structure and physical properties of the product. The methodology deals with the texture profile in common carp measured by instrumental methods. The procedure allows detection of textural properties at lower cost and shorter timeframe. The results are independent on the evaluator, are not affected by different experiences of evaluators. Methodology can serve farmers and processors to keep their products in good quality and help them to find new methods of farming and processing at lower cost. It will serve for further development of new processing technologies and adjustment of products based on raw fish, or in the choice of new suitable additives (emulsifiers, stabilizers, etc.).

Cepák, M., Vácha, F., Vejsada, P. Texture profile analyse in common carp flesh using TA.XTPlus analyse. Edition of Methodics (Technological series), RIFCH USB Vodňany, 2009, No. 93, 22 pp.

## INTERNATIONAL COOPERATION

The laboratory has a partnership with the Institute of Aquaculture, Fischbiologie TU München – Weißenstephan, the Bavarian Institut für Fischerei – Außenstelle für Karpfenwirtschaft Höchststadt/Aisch and Ökologisch Station Waldviertel in Lower Austria in the postgradual doctoral studies through internships, teaching and research work

**International cooperation** is complemented by negotiations and dealings with FEAP (Federation of European Aquaculture Producers), cooperation with the Fisheries Faculty, Egirdir, Süleyman Demirel University, Isparta, Turkey (A. Diler) and arrangement the Czech version of the European Project WAVE (Working in Aquaculture Validation of Experience) (C. Pons).

## APPLICATION OF SCIENTIFIC RESULTS IN PRACTICE AND OTHER LABORATORY ACTIVITIES

The laboratory cooperates with Fishery Třeboň, Hld.; LYCKEY Culinar Inc.; and Institute of Chemical Technology in Prague (ICT) in research and evaluation of fish processing technology. Area of international contacts is accompanied by acting with the Federation of European Aquaculture Producers. The laboratory also collaborates with the protected landscape area of Jizerské hory region on ichthyomonitoring of selected streams. The laboratory participates in the repatriation and spreading of protected species fathead minnow, *Phoxinus phoxinus*, in Jizerské hory. In cooperation with other agencies, it monitors EVL with the occurrence of bullheads, *Cottus gobio* in the area of Karlovy Vary region.

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[lepic@vurh.jcu.cz](mailto:lepic@vurh.jcu.cz)



It includes a complex of 51 experimental fish ponds in the total area of nearly 7 ha and a fish culture object using both flowing and recirculating system for rearing of various fish and crayfish species mainly in early stages.

The workplace is used for realization of experiments mainly focused on the research of rearing technologies in aquaculture and considerable attention is devoted mainly to these areas: intensive methods of aquaculture including recirculation system, fish reproduction including hormonal and environmental stimulation, rearing of commercial and endangered fish species including optimization of living conditions and nutrition, applied fishing hydrobiology, feeding biology of fish in fish ponds and wild waters, activity of predatory fish in fish objects, biology and monitoring of native and introduced crayfish species, crayfish breeding including the reproduction research and reintroduction.



# SERVICE UNITS OF FACULTY

## Genetic Fisheries Center

**Dipl.-Ing. David Gela, Ph.D.**  
*Fish breeding*

Head of Unit

[gela@vurh.jcu.cz](mailto:gela@vurh.jcu.cz)



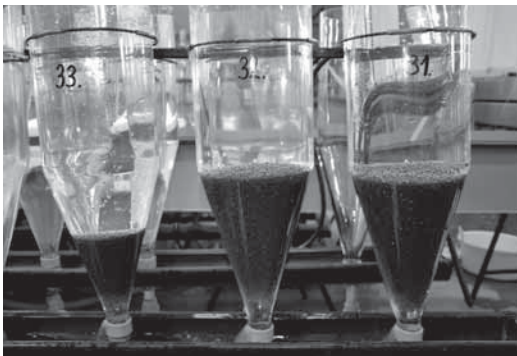
The purpose of the Genetic Fisheries Center (GFC) is to preserve genetic sources of existing stocks and populations of carp, tench, European catfish and sturgeon. This Center has been entrusted by leading of the breeding and testing program of carp and tench performance in the Czech Republic since 1982.

The GFC also provides a functional basis for laboratories of the faculty dealing with e.g. study of colours heritability of tench, genome manipulations of selected fish species (carp, tench, silver carp, sturgeon species – see Laboratory of Molecular, Cellular and quantitative genetics), fish gametes (see Laboratory of Reproduction Physiology) and for subsequent application of obtained results in aquaculture.

This Center has also been serving since 1996 for education of fish breeding for USB students in form of field and block training.

The GFC has a modern and multi-purpose equipped fish hatchery (the hatchery itself with possibility of farming early fish stages, trough room for final preparation of broodstocks for controlled reproduction, execution of experiments in special troughs and for work with young broodfish) with total area of 220 m<sup>2</sup>. River water, necessary for egg incubation and farming of fingerlings, is cleaned through a micro-screen filter, ozonizer and is sterilized by UV radiation. The system can be supplied, in the case of need, with water from water pipeline system with recirculation through biofilters. Water for broodfish, eggs and fingerlings is heated to required temperature in three mutually independent reservoirs. Water levels, water temperatures and oxygen saturation are monitored in the whole system with control of preparation of technological flow-through or recirculating water and reporting of current states of GSM technologies.

The GFC has a pond fund with total area of 25 ha and 65 m<sup>2</sup> of indoor and outdoor breeding pools with either flow-through or recirculation system.



*Egg incubation*



*Control of egg incubation*





*Spawning of Siberian sturgeon (Acipenser baerii)*

Our hatchery was again flooded in the summer of 2009. The water overflowed the incubation room and the trough room till 35 cm (see photos below) but this time, the flood did not have so devastating consequences as that one in 2002 thanks to the hard-work of the workers to secure the object.



# INTERNATIONAL ACTIVITIES OF FFWP

## Cooperation

International co-operation runs on several levels:

Cooperation in mutual exchange of publications, experience, results and short-term stays aiming at resolving related research subjects. This co-operation is based on signed contracts between USB FFWP and specific foreign institution. In the period 2008–2009 we had valid agreements with following institutions:

- *Institute of Ichthyobiology Polish Academy of Science, Golysz, Poland*
- *International Centre of Ecology Polish Academy of Science, Dziekanów Leceny, Poland*
- *Kaliningrads State technical University, Kaliningrad, Russia*
- *Shimoda Marine Research Centre, University of Tsukuba, Shimoda, Japan*
- *Department of Genetics, Developmental and Molecular Biology, Aristotle University of Thessaloniki, Thessaloniki, Greece*
- *GDR INRA-IFRINRA-IFREMER Amélioration génétique des poissons; Chemin de Maguelone, Palavas les Flots, France*
- *Szent István University of Gödöllő, Faculty of Agricultural and Environmental Sciences, Department of Fish Culture, Gödöllő, Hungary*
- *Research Institution of Fisheries, Aquaculture and Irrigation, Szarvas, Hungary*
- *University of Florence, Department of Animal Biology and Genetics, Florence, Italy*
- *National Research Center for Environment and Health, Institute of Ecological Chemistry, Neuherberg, Germany*
- *Russian Federal Research Institute of Fisheries and Oceanography, Moscow, Russia*
- *Institute of Animal Reproduction and Food Research of the Polish Academy of Sciences, Olsztyn, Poland*
- *University of Exteremadura, Department of Vegetal Biology, Ecology & Earth Sciences, Badajoz, Spain*
- *National Centre of Scientific Research, Station of Zoology and Cellular Marine Biology, Villefranche-sur-Mer, France*
- *Institute for Problems of Cryobiology and Cryomedicine, Kharkov, Ukraine*
- *The University of New Orleans, New Orleans, USA*
- *Russian Academy of Sciences Scientific Research Center for Ecological Safety, Saint Petersburg, Russia*
- *The University of Michoacana de San Nicolás de Hidalgo, Michoacana, Mexico*
- *Fisheries and Oceans Canada, Biological Station, New Brunswick, Canada*
- *York University, Toronto, Canada*
- *University of Johannesburg, Johannesburg, South Africa*
- *Aquaculture initiative EEIG, Dundalk, Ireland*
- *Hellenic Centre for Marine Research, Crete Institute of Aquaculture, Heraklion, Greece*
- *Bundesamt für Wasserwirtschaft Oekologische Station Waldviertel, Schrems, Austria*
- *The University Nancy, Nancy, France*
- *Estonian University of Life Sciences, Institute of Veterinary Medicine and Animal Science, Tartu, Estonia*
- *Universidad Politécnica de Valencia, Valencia, Spain*
- *The University Udine, Pagnacco, Italy*
- *The University Umea, Umea, Sweden*
- *V.N. Karazin Kharkiv National University, Department of Biological and Medical Physics, Kharkiv, Ukraine*
- *Chinese Academy of Fishery Science, Jingzhou City, China*

Bilateral cooperation in scope of countries, which signed contracts on governmental level regarding mutual co-operation in research and development. These programmes are available through the Ministry of Education, Youth and Sports of the Czech Republic (see chapter “Research projects”)

Direct cooperation with several partners from European countries concentrating on research and development in scope of the programmes of the European Union (see chapter “Research projects”).

## **INTERNATIONAL SCIENTIFIC MEETINGS ORGANIZED BY FFPW (TILL THE 1ST SEPTEMBER 2009 RIFCH)**

### **THE 1ST INTERNATIONAL WORKSHOP “AQUATIC TOXICOLOGY AND BIOMONITORING”**



A number of experts working in water toxicology and biomonitoring of exogenous substances in water environment met in Vodňany between 27.–29. August 2008. The Research Institute of Fish Culture and Hydrobiology of the University of South Bohemia prepared the first international workshop called Aquatic Toxicology and Biomonitoring. The organizers welcomed more than 60 participants from four continents represented by 18 countries (South Africa, Nigeria, Egypt, Mexico, South Korea, China, Iran, Germany, Portugal, France, Turkey, Poland, Moldavia, Serbia, Lithuania, Italy, Sweden and the Czech Republic).

24 lectures were presented during the workshop and nearly 50 contributions in poster section. Main themes of the workshop included the problems of influence of exogenous substances and pharmaceuticals on water organisms, monitoring of pollutants in water environment, and the methods of detecting these substances. The whole workshop was characterized by an active attitude of the participants; problems were discussed in the workshop room, by posters and during social activities. The official language was English but it was often possible to hear discussions in German, Russian or Spanish. The visit of the Institute’s laboratories and its experimental workplaces (fish hatcheries and experimental farming) was also involved in the programme. Although the expert programme was time-consuming, it was managed to find some time also for a visit of Holašovice and Český Krumlov, which was very much appreciated mainly by the participants from farther countries. For the last evening, organizers prepared besides classical forms of refreshment also grilling of pork; a big success had also culinary fish specialities prepared by chef Stupka and also cymbal music Šariš had well-deserved applause.

#### XIV. TOXICOLOGICAL CONFERENCE

XIV. National conference "Toxicity and biodegradability of wastes and substances important in aquatic environment" took place in Vodňany on 26–27 August 2009. It was traditionally organized by the employees of USB RIFCH. Nearly 40 people attended the conference, 30 expert contributions in the field of toxicology and ecotoxicology of substances, monitoring and biomonitoring and protection of water environment were presented. A competition for the best student's contribution – the award of Prof. MSc. Vladimír Sládeček, DSc. was also an integral part of the conference. In total, 15 lectures met competition conditions. They were assessed by a 5-member committee composed of following experts: Prof. Dipl.-Ing. Pavel Pitter, DSc., Prof. Zdeňka Svobodová, DVM, DSc., Prof. Dipl.-Ing. Jiří Matoušek, DSc., Prof. Miriam Smutná, DVM, CSc., MSc. Libuše Rauscherová. Awarded students of bachelor, master and doctoral programmes obtained a diploma and a material prize.

#### REGIONAL EUROPEAN CRAYFISH WORKSHOP: FUTURE OF NATIVE CRAYFISH IN EUROPE



International workshop "Regional European Crayfish Workshop: Future of native crayfish in Europe" organized by the Faculty of Fisheries and Protection of Waters took place in Písek on 7–10 September 2009. More than 50 experts (astacologists) from 15 European countries participated in this workshop. Separate sections of this workshop were focused on expansion and protection, ecology and morphology, genetics and crayfish illnesses. Actual problems connected to protection and management of former crayfish species, monitoring and limiting of occurrence of non-indigenous crayfish species and new methods and processes of detection of crucial crayfish illness (crayfish plague) were discussed at "Round tables". Within the conference, the meeting of European Inland Fisheries Advisory Commission (EIFAC) was also held. Four employees of the faculty presented their contributions: Pavel Kozák (Effect of chloride content in water to heart rate in narrow-clawed crayfish), Tomáš Polícar (Egg incubation in white-clawed crayfish (*Austropotamobius pallipes*) under controlled temperature conditions), Antonín Kouba (The use of formaldehyde for antifungal treatment of noble crayfish (*Astacus astacus*) eggs in a partial recirculating system) and Miloš Buřič (Chelae regeneration in European alien crayfish *Orconectes limosus*, Rafinesque 1817).

## **PARTICIPATION IN INTERNATIONAL CONFERENCES AND SYMPOSIUMS BY FFPW EMPLOYEES AND STUDENTS**

### **Year 2008**

- *25th session of EIFAC and symposium on interactions between social economic and ecological objectives of inland commercial and recreational fisheries and aquaculture, Antalya, Turkey, 20–28 May 2008*
- *International Association of Astacology (IAA), 17th Symposium, August 4–8, 2008, Kuopio, Finland*
- *International conference of Genetics, selection, hybridization, breeding activities and fish reproduction was organized for 100th anniversary of birth of Prof. Kirpičnikov, took place in St. Petersburg, Russia, 10.–12. 9. 2008*
- *Aquaculture Europe 2008, Krakow, Poland, 15.–18. 9. 2008*
- *5th International Workshop on Biology and Culture of tench (Tinca tinca L.), Ceresore d'Alba, Italy, 29. 9. – 3. 10. 2008*
- *45th Congress of the European Societies of Toxicology, Rhodes, Greece*
- *Conference EAFP (European Association of Fish Pathologists) Jena (Germany) called "The way to healthy fish", 8.–10. 10. 2008*
- *NACEE's 5th Director's meeting in Lviv, Ukraine 15.–17. 10. 2008*
- *NACA-NACEE Meeting in Research Institute for Aquaculture No. 2 (RIA 2) Ho Chi Minh city, Vietnam, 3.–4. 12. 2008*
- *Scientific conference called "Problems and perspectives of usage of water resources in Siberia in 21st century", Krasnoyarsk, Russia, 8.–12. 12. 2008*

### **Year 2009**

- *International Meeting on freshwater aquaculture, Vukovar, Croatia, 16.–17. 4. 2009*
- *Conference in Aquaculture, Timisoara, Romania, 27.–29. 4. 2009*
- *5th Meeting of German Expert board for water genetic recourses, Baden-Württemberg in Lange-nargen, Germany, 29.–30. 4. 2009*
- *13th volume of conference Hygiene Alimentorum XXX, Štrbské pleso, The Slovak Republic, 13.–15. 5. 2009*
- *14th Interdisciplinary Toxicology Conference in Brno, Czech Republic, 1.–3. 6. 2009*
- *10th International Symposium on Genetics in Aquaculture, Bangkok, Thailand, 22.–26. 6. 2009*
- *Aquaculture Europe 2009, Trondheim, Norway, 14.–17. 8. 2009*
- *XIII. European Congress of Ichthyology, Klaipėdė, Lithuania, 4.–13. 9. 2009*
- *Second International Workshop on Biology of Fish Gametes, Valencia, Spain, 9.–11. 9. 2009*
- *14th EAFP International Conference "Diseases of Fish and Shellfish", Prague, the Czech Republic, 14.–19. 9. 2009*
- *16th specialized conference with international participation "Animal Protection and Welfare 2009", Brno, the Czech Republic, 22.–23. 9. 2009*
- *6th International Symposium on Sturgeon, Wuhan, China, 25.–30. 10. 2009.*

## **MEMBERSHIPS OF FFPW IN INTERNATIONAL NETWORKS AND ORGANISATIONS**

- *NACEE (Network of Aquaculture Centres in Central Eastern Europe)*
- *AQUA-TNET (European thematic network in the field of aquaculture, fisheries and aquatic resources management)*
- *EAS (European Aquaculture Society)*
- *W.S.C.S. (World Sturgeon)*
- *Crustacean society*
- *Society for Cryobiology*

## **MEMBERSHIPS OF FFPW EMPLOYEES AND STUDENTS IN INTERNATIONAL ORGANISATIONS**

Assoc. Prof. Dipl.-Ing. Martin Flajšhans, Dr.rer.agr.	Network of Tropical Aquaculture Scientists
Assoc. Prof. Dipl.-Ing. Pavel Kozák, Ph.D.	International Association of Astacology Crustacean society
Assoc. Prof. Dipl.-Ing. Jan Kouřil, Ph.D.	European Aquaculture Society
Prof. Dipl.-Ing. Otomar Linhart, DSc.	European Aquaculture Society International Society of Cryobiology World Sturgeon Conservation Society
Prof. Zdeňka Svobodová, DVM, DSc.	European Association of Fish Pathologists OECD-Ecotoxicology

## **MEMBERSHIPS OF FFPW EMPLOYEES IN EDITORIAL BOARDS**

Assoc. Prof. MSc. Zdeněk Adámek, CSc.	Aquaculture International Ribarstvo Zagreb Agriculture Consetus Scientificus Zagreb
Assoc. Prof. Dipl.-Ing. Martin Flajšhans, Dr.rer.agr. Zuzana Dvořáková	Bulletin RIFCH Vodňany Bulletin RIFCH Vodňany
MSc. Roman Grabic, Ph.D.	Bulletin RIFCH Vodňany
Assoc. Prof. Dipl.-Ing. Pavel Kozák, Ph.D.	Bulletin RIFCH Vodňany
Assoc. Prof. Dipl.-Ing. Tomáš Polícar, Ph.D.	Bulletin RIFCH Vodňany
Dipl.-Ing. Tomáš Randák, Ph.D.	Bulletin RIFCH Vodňany
Prof. Dipl.-Ing. Otomar Linhart, DSc.	Bulletin RIFCH Vodňany Journal of Applied Ichthyology Czech Journal of Animal Science
Prof. Zdeňka Svobodová, DVM, DSc.	Acta Veterinaria Bulletin RIFCH Vodňany



# FACULTY OF FISHERIES AND PROTECTION OF WATERS

## Education and Teaching Activities

The Faculty of Fisheries and Protection of Waters was established on the 1st September 2009 by merging the Research Institute of Fish Culture and Hydrobiology and former Department of Fisheries of the Faculty of Agriculture USB.

The fields of study Fisheries (bachelor and master studies) and Aquaculture (master studies) were reaccredited together with the Faculty's accreditation. These fields of study were taken over from the Faculty of Agriculture USB (bachelor and master studies) and the field of study Fisheries (doctoral studies) from the Research Institute of Fish Culture and Hydrobiology USB. The students of above-mentioned fields of study were signed over to USB FFPW.

### PROFILE OF BACHELOR STUDIES

Bachelor studies offer a range of professional knowledge in the field of freshwater fisheries, quality of water environment, finalization of fish products and water management utilization in the landscape. These studies also introduce students to related fields; they contain an overview of science basics, enable mastering of computer techniques and methods of informatics, expand and improve knowledge of the English language. Thus, these studies interconnect theoretical general fields with specialized ones and practical technological focus of the field Fisheries.

### PROFILE OF TWO-YEAR MASTER STUDIES

In master studies of the fields of Fisheries and Aquaculture, students are educated to become professionals and specialists in the scope of aquaculture, productive fisheries, water management, revitalization processes, management systems and many other areas. These studies increase the level of knowledge, for instance in corporate management, technological water treatment and management of open waters. These studies currently implement also knowledge from the sphere of breeding activities, business, aquaristics, fish diseases and toxicology. Graduates of the master studies will be able to apply systematic approaches as expert and qualified workers on both national and European level.

### Reaccredited fields of study together with Faculty's accreditation

Code of SP	Study programme (SP)	Field of Study	Type of SP	Form of study	Standard length of study (years)	Language	Accredited to
B4103	Zootecnics	Fishery	Bachelor	Present	3 years	Czech	1. 3. 2016
M4101	Agricultural Ingeneering	Fishery	Master	Present	5 years	Czech	31. 10. 2013*
N4103	Zootecnics	Fishery	Master	Present	2 years	Czech	1. 3. 2016
N4103	Zootecnics	Aquaculture	Master	Present	2 years	English	31. 10. 2011
P4103	Zootecnics	Fishery	Doctoral	Present and combined	4 years	Czech	1. 3. 2016
P4103	Zootecnics	Fishery	Doctoral	Present and combined	4 years	English	1. 3. 2016

\* accredited only for graduation of current students



## MATRICULATION OF STUDENTS OF THE FIRST YEAR

The historically first celebratory matriculation of students of the 1st year of the field Fisheries (study programme Zootechnics) took place on 6th October 2009. The celebratory matriculation was held in a large boardroom of the municipality in Vodňany. The celebratory collegium consisted of following significant members and the faculty friends:

Vice-Rector for Development:	Prof. MSc. Pavel Tlustý, CSc.
Dean of the Faculty:	Prof. Dipl.-Ing. Otomar Linhart, DSc.
Vice-Dean for External Affairs:	Assoc. Prof. Dipl.-Ing. Pavel Kozák, Ph.D.
Vice-Dean for Study Affairs:	Dipl.-Ing. Pavel Vejsada, Ph.D.
Mayor of the Town Vodňany:	Václav Heřman
Registrar:	Dipl.-Ing. Vladimír Nedopil
Bedel:	Dipl.-Ing. Václav Nebeský



Celebratory matriculation of students of the 1st year of bachelor studies. In the 1st picture from the left: P. Tlustý, V. Nedopil, P. Vejsada, P. Kozák, V. Heřman, O. Linhart. In the 2nd picture – celebratory vow.

## Number of students signed over from the Faculty of Agriculture, the RIFCH

Type of study programme (SP)	Code of FS	Field of study (FS)	Form of study	Year					Total
				2.	3.	4.	5.	6.	
Bachelor	4103R003	Fishery	Present	18	24	9	4	0	55
Master – 5 years	4103T003	Fishery	Present	0	0	0	0	2	2
Master – 2 years	4103T003	Fishery	Present	11	–	–	–	–	11
Master – 2 years	4103T017	Aquaculture	Present	It was not open.					
Doctoral	4103V003	Fishery	Present	2	6	6	1	0	15
Doctoral	4103V003	Fishery	Combined	0	3	0	0	0	3
Doctoral	4103V003	Fishery	Present	It was not open.					
Doctoral	4103V003	Fishery	Combined	It was not open.					
<b>Total</b>									<b>86</b>

## Number of students accepted to the 1st year

Type of SP	Code of FS	Field of study (FS)	Form of study	Number of students in 1st year
Bachelor	4103R003	Fishery	Present	36
Master – 2 years	4103T003	Fishery	Present	10
Master – 2 years	4103T017	Aquaculture	Present	Not open
Doctoral	4103V003	Fishery	Present	9
Doctoral	4103V003	Fishery	Combined	1
Doctoral	4103V003	Fishery	Present	Not open
Doctoral	4103V003	Fishery	Combined	Not open
<b>Total</b>				<b>56</b>

## PROFILE OF DOCTORAL STUDIES

Doctoral studies of the field Fisheries can be studied either in a daily form or in a combined form, in Czech or English languages for a standard period of four years.

The aim of the doctoral studies is a research-oriented education of specialists in the field of fisheries. The field of study involves thorough training in ecology, reproduction, physiology, genetics, ecotoxicology, diseases, and fish breeding. Students acquire knowledge in various fishery segments and elaborate a doctoral thesis in English focused on a specific segment within the study field. The subjects of a final state examination are Ichthyology and fish taxonomy, Fish aquaculture and Applied hydrobiology.

The graduates of the Fisheries doctoral study programme possess general knowledge of fish, i.e. of the taxonomy, morphology and physiology of fish. They have a good basis of the general fisheries, agricultural, and biological subjects (ecology, genetics, cell and molecular biology) and are able to use the theoretical background for the environmental management in the area of fisheries and water management.

## Number of students in single academic years

Academic year	Total number	4th year of study	3rd year of study	2nd year of study	1st year of study	Completed study	Aborted study	Interrupted study
2006/07	15		2	6	7	2	1C	1
2007/08	21	–	5	7	6+3C			
2008/09	23	5	7	6+3C	2	5		
2009/10	28	6	6+3C	2	10			1

*C – number of students in the combined form of study*

## GRADUATION CEREMONY OF THE GRADUATES OF DOCTORAL STUDIES WHO DEFENDED THEIR PH.D. THESES ON THE 3RD SEPTEMBER 2009

The historically first graduation ceremony of the graduates of doctoral studies in the Fisheries, study programme Zootechnics, took place on 6th October 2009. The graduation was held in a large boardroom of the municipality in Vodňany. The celebratory collegium consisted of following significant members and the faculty friends:

Vice-Rector for Development:  
 Dean of the Faculty:  
 Vice-Dean for External Affairs:  
 Vice-Dean for Study Affairs:  
 Mayor of the Town Vodňany:  
 Registrar:  
 Bedel:

Prof. MSc. Pavel Tlustý, CSc.  
 Prof. Dipl.-Ing. Otomar Linhart, DSc.  
 Assoc. Prof. Dipl.-Ing. Pavel Kozák, Ph.D.  
 Dipl.-Ing. Pavel Vejsada, Ph.D.  
 Václav Heřman  
 Dipl.-Ing. Vladimír Nedopil  
 Dipl.-Ing. Václav Nebeský



The dean of the faculty prof. O. Linhart, DSc. with E. Sudová, DVM to whom a title Ph.D. was granted.

## Topics of the Ph.D. theses of the graduates of the Fisheries at FFPW (2009)

Supervisor	Ph.D. student	Doctoral thesis
Prof. Dipl.-Ing. Otomar Linhart, DSc.	MSc. S. M. Hadi Alavi	Sperm behavior and competition in models of teleostean and chondrosteian fish
Prof. Dipl.-Ing. Otomar Linhart, DSc.	Dipl.-Ing. Martin Pšenička	Ultrastructure of fish spermatozoa and fertilization process with a view to sturgeons
Assoc. Prof. Dipl.-Ing. Jan Kouřil, Ph.D	Dipl.-Ing. Vlastimil Stejskal	Intensive culture and nutrition of Eurasian perch ( <i>Perca fluviatilis</i> L.) fingerlings
Prof. Zdeňka Svobodová, DVM, DSc.	Eliška Sudová, DMV	Pharmacovigilance in aquaculture with attention to antibiotics and antiparasitics
Assoc. Prof. Dipl.-Ing. Pavel Kozák, Ph.D	Dipl.-Ing. Miloš Buřič	Biology of spiny-cheek crayfish <i>Orconectes limosus</i> (Rafinesque, 1817) in conditions of Czech Republic and the study factors influencing its invasive spread

## Current Ph.D. students of the Fisheries and topics of their doctoral theses

Supervisor	Ph.D. student	Doctoral thesis
Assoc. Prof. MSc. Zdeněk Adámek, CSc.	Dipl.-Ing. Jiří Kortan	Evaluating of secondary losses on fish stock caused by feeding activity of great cormorant ( <i>Phalacrocorax carbo sinensis</i> ) on the ponds
Prof. MSc. Zdeněk Brandl, DSc.	Dipl.-Ing. Martin Bláha	Ecology and biology of three species <i>Acanthocyclops vernalis</i> – <i>robustus</i> group and their differentiation using molecular methods
MSc. Boris Dzyuba, Ph.D.	MSc. Anna Shaliutina	The study of total proteins profiles in seminal plasma during maturation

↓ The table continues on the next page

Assoc. Prof. Dipl.-Ing. Martin Flajšhans, Dr.rer.agr.	MSc. Dmytro Bytyutsyy	The phenomenon of polyploidy in fish: applied aspects in fish artificial reproduction and conservation
	Dipl.-Ing. Miloš Havelka	Molecular aspect of interspecific hybridization of sturgeon related to polyploidy and in situ conservation
MSc. Roman Grabic, Ph.D.	MSc. Ganna Fedorova	The fate of polar organic pollutants in aquatic environment
Assoc. Prof. Dipl.-Ing. Petr Hartvich, CSc.	Dipl.-Ing. Jan Másilko	Production efficiency of mechanical modified cekals in market carp farming
Assoc. Prof. Dipl.-Ing. Jan Kouřil, Ph.D.	MSc. Bořek Drozd	Critical population parameters in weatherfish ( <i>Misgurnus fossilis</i> L.)
	MSc. Peter Podhorec	Artificial reproduction of barbel ( <i>Barbus barbus</i> L.)
	Dipl.-Ing. Viktor William Švinger	Hormonally induced artificial reproduction of fish
Assoc. Prof. Dipl.-Ing. Pavel Kozák, Ph.D.	Dipl.-Ing. Antonín Kouba	Optimalization of noble crayfish breeding and estimation of adaptability and migration of crayfish after reintroduction
Prof. Dipl.-Ing. Otomar Linhart, DSc.	Dipl.-Ing. Vojtěch Kašpar	Sperm competition in common carp ( <i>Cyprinus carpio</i> )
	MSc. Sergey Boryshpolets	Energetics and motility of fresh and frozen thawed spermatozoa in models of teleost and chondrosteian fish
	MSc. Ping Li	Characterisation of the protein in seminal plasma of fresh and frozen fish spermatozoa
	MSc. Ivo Příklad	Correlation between nutrients and species composition of fishpond zooplankton
	MSc. Azadeh Hatef	Effect of Selected Endocrine Disruptors on Reproductive Parameters in Fish
Assoc. Prof. Dr. Jana Picková	Dipl.-Ing. Jan Mráz	Enrichment of fatty acid composition of common carp ( <i>Cyprinus carpio</i> )
Assoc. Prof. Dipl.-Ing. Tomáš Polícar, Ph.D.	MSc. Jiri Bossuyt	Optimalisation of percid culture under controlled conditions
Assoc. Prof. Dipl.-Ing. Tomáš Polícar, Ph.D.	Dipl.-Ing. Jiří Kříšťan	Distribution, reproduction and eggs quality of pikeperch ( <i>Sander liciopeca</i> )
Assoc. Prof. Dipl.-Ing. Petr Ráb, DSc.	Dipl.-Ing. Jan Kohout	Population genetic structure of brown trout ( <i>Salmo trutta</i> ) in the Czech republic and Slovakia
Dipl.-Ing. Tomáš Randák, Ph.D.	Dipl.-Ing. Radek Hanák	Interactions between wild and hatchery fish in salmonid waters
	MSc. Zhiua Li	Effect of extraneous substances present in aquatic environment on fish
Prof. Zdeňka Svobodová, DVM, DSc.	Dipl.-Ing. Jan Turek	Adaptability of hatchery – reared brown trout ( <i>Salmo trutta m. fario</i> L.) and European grayling ( <i>Thymallus thymallus</i> L.) in natural watters
	MSc. Petra Beránková	Genotoxic potential of extraneous substances in surface water ecosystems
	Dipl.-Ing. Jana Máčková	Prevention of fish mortality in highly eutrophic ponds
Assoc. Prof. Dipl.-Ing. František Vácha, CSc.	Dipl.-Ing. Tomáš Zajíc	Qualitative characteristics of common carp ( <i>Cyprinus Carpio</i> L.) flesh in term of rearing technology
	Dipl.-Ing. Antonín Vavříčka	The welfare parameters of market carp ( <i>Cyprinus Carpio</i> L.) in pond aquaculture

## Undergraduates who worked at the Institute/Faculty or were supervised by the Institute's (Faculty's) fellows in years 2008–2009

Supervisor	Student	Type of SP	2008	2009	Defence	University/Faculty
Assoc. Prof. MSc. Zdeněk Adámek, CSc.	J. Síkora	MSc.	+		2008	FA
	J. Ťuk	MSc.	+		2008	FA
	J. Zeman	MSc.	+	+	2010	FA*
	D. Hercig	MSc.	+		2009	FA
	K. Němec	MSc.	+		2008	FA
	J. Strapina	MSc.	+	+	2009	FA
	J. Šampalík	MSc.	+	+	2010	FA*
	P. Čtrnáct	Bc.	+	+	2010	FA*
	J. Mačej	Bc.	+	+	2010	FA*
	M. Pavlíček	Bc.	+	+	2010	FA*
	P. Hulan	Bc.	+	+	2010	FA*
	J. Opatřil	MSc.		+		FA*
Ch. Kemigabo	MSc.		+	2010	IHE Delft (NL)	
Dipl.-Ing. Martin Bláha	J. Brož	Bc.		+		FFPW
Dipl.-Ing. Petr Dvořák, Ph.D.	L. Bečák	Bc.		+		FA*
	D. Janošik	Bc.		+		FA*
	D. Koutník	Bc.	+	+		FA*
	J. Šrámek	Bc.	+	+		FA*
	P. Antonín	MSc.		+		FA*
	R. Mráz	MSc.		+		FA*
	L. Jirušková	MSc.		+		FFPW
	L. Bíro	Bc.		+		FFPW
	H. Zikmund	Bc.		+		FFPW
	L. Bečák	Bc.		+		FFPW
	P. Nádvořník	Bc.		+		FFPW
	F. Salon	Bc.		+		FFPW
	P. Svačina	Bc.		+		FFPW
	M. Sedlák	MSc.	+	+		FA*
Assoc. Prof. Dipl.-Ing. Martin Flajšhans, Dr.rer.agr.	M. Marek	Bc.	+	+	2010	FA*
	J. Srp	Bc.	+	+		FA*
	J. Kašpar	MSc.		+		FA*
	O. Fořt	MSc.	+	+	2009	FA*
Assoc. Prof. Dipl.-Ing. Petr Hartvich, CSc.	P. Brož	Bc.	+	+		FA*
	T. Marek	Bc.	+	+		FA*
	M. Petr	Bc.	+	+		FA*
	J. Toncar	Bc.	+	+		FA*
	J. Zrostlík	Bc.	+	+		FA*
	O. Flokovič	Bc.		+		FFPW
	P. Šmíd	MSc.		+		FFPW
	M. Vodárek	MSc.		+		FFPW
D. Hlaváč	MSc.		+		FFPW	

Dipl.-Ing. Martin Kocour, Ph.D.	M. Kříž	MSc.	+	+	2009	FA
	M. Prchal	Bc.		+		FFPW
Assoc. Prof. Dipl.-Ing. Jan Kouřil, Ph.D.	K. Raška	Bc.		+		FA*
	T. Borkovec	MSc.	+	+		FA*
	M. Flokovič	MSc.				FFPW
	R. Pavlišta	Bc.		+		FFPW
	J. Sládeček	Bc.		+		FFPW
Assoc. Prof. Dipl.-Ing. Pavel Kozák, Ph.D.	I. Machovská	Bc.	+	+		FA*
	J. Šabata	Bc.	+	+		FA*
	J. Watzek	Bc.	+	+		FA*
	L. Kočí	MSc.	+	+	2009	FA
	P. Vích	MSc.	+		2008	FA
	P. Eliášek	Bc.		+		FFPW
Prof. Dipl.-Ing. Otomar Linhart, DSc.	T. Gavenda	Bc.	+	+		FA*
Dipl.-Ing. Jana Máchová	J. Mecko	Bc.		+		FA*
Assoc. Prof. Dipl.-Ing. Tomáš Policar, Ph.D.	P. Trnka	MSc.	+	+	2009	FA
	P. Benedikt	MSc.		+	2010	FA*
	J. Matoušek	Bc.	+	+	2010	FA*
	D. Jablonická	Bc.	+	+	2010	FA*
	M. Blecha	Bc.	+	+	2010	FA*
	J. Hájiček	Bc.	+	+	2010	FA*
Dipl.-Ing. Martin Pšenička, Ph.D.	M. Dvořák	Bc.		+		FFPW
	F. Ložek	Bc.		+		FFPW
Dipl.-Ing. Tomáš Randák, Ph.D.	V. Šantra	Bc.	+	+	2010	FA*
	J. Mandeliček	Bc.	+	+	2010	FA*
	D. Červený	Bc.		+	2010	FA*
	R. Kubín	Bc.		+	2010	FA*
	J. Bartoň	Bc.		+	2011	FA*
	T. Blinky	Bc.	+	+		FFPW
	R. Blaszczyk	MSc.		+	2011	FA*
Prof. Zdeňka Svobodová, DVM, DSc.	M. Gřunděl	MSc.	+	+	2009	FA
	M. Podlesný	MSc.	+	+	2009	FA
	H. Dort	MSc.	+	+	2009	FA
	P. Schneiner	MSc.	+	+		FA*
Assoc. Prof. Dipl.-Ing. František Vácha, CSc.	P. Janoušek	Bc.		+		FA*
	A. Kólbl	Bc.		+		FA*
	J. Macek	Bc.	+	+		FA*
	P. Moravec	Bc.		+		FA*
	M. Johánek	MSc.		+		FFPW
Dipl.-Ing. Olga Valentová	J. Škramovský	Bc.		+		FFPW
Dipl.-Ing. Pavel Vejsada, Ph.D.	J. Příborský	MSc.		+		FA*
	O. Tomeček	MSc.		+		FA*
Dipl.-Ing. Josef Velišek, Ph.D.	V. Malý	MSc.	+		2008	FA
	H. Dort	MSc.	+	+	2009	FA
<b>Total</b>			<b>47</b>	<b>77</b>		

\*All students from FA were signed over to newly established faculty FFPW on 1st September 2009.

## Ph.D. students from other universities or USB faculties with supervisors from FFPW in years 2008 and 2009

Supervisor	Student	2008	2009	Defence	University/Faculty
Assoc. Prof. MSc. Zdeněk Adámek, CSc.	D. Kortan	+	+	2010	FFPW
	J. Sychra	+	+		MU FS Brno
	L. Chaloupková	+	+		MU FS Brno
<b>Total</b>	<b>3</b>	<b>3</b>	<b>2</b>		

## Lecturing at universities

Supervisor	Subject	2008 hours	2009 hours	University/Faculty
Assoc. Prof. MSc. Zdeněk Adámek, CSc.	Fundamentals of Fisheries	28		MU FS Brno
	Ichthyology and Fundamentals of Fisheries		28	PU FS Olomouc
Assoc. Prof. Dipl.-Ing. Martin Flajšhans, Dr.rer.agr.	Fish Breeding	56	56	FA, FFPW
Assoc. Prof. Dipl.-Ing. Jan Kouřil, Ph.D.	Recirculation Systems in Aquaculture		56	FA
	Salmonoid Fish Breeding	56	56	FA, FFPW
Assoc. Prof. Dipl.-Ing. Pavel Kozák, Ph.D.	Protection and Culture of Crustaceans and Flaks		56	FA, FFPW
Prof. Dipl.-Ing. Otomar Linhart, DSc., Dipl.-Ing. Marek Rodina, Ph.D. Dipl.-Ing. Martin Hulák, Ph.D.	Controlled Reproduction in Fish	56	56	FA, FFPW
Assoc. Prof. Dipl.-Ing. Tomáš Policar, Ph.D.	Aquaristics	48	48	FA, FFPW
Prof. Zdeňka Svobodová, DVM, DSc.	Fish Diseases	56	56	UVPS Brno
	Toxicology	72	72	UVPS Brno
	Food Toxicology	48	48	UVPS Brno
	<b>Total</b>	<b>420</b>	<b>588</b>	

Processed by: Dipl.-Ing. Jitka Kotová, Dipl.-Ing. Eva Bezchlebová

# LIFELONG LEARNING

## Educational seminars, courses and studies co-financed by the EU and the Czech state budget:

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### **ADVISORY, INFORMATION AND TRAINING FISHERY CENTER AT USB RIFCH VODŇANY (CZ.04.1.03/3.3.03.3/0002)**

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*project leader: Dipl.-Ing. Blanka Vykusová, CSc., administrator: Dipl.-Ing. Petra Plachtová,  
provider: South Bohemian Regional Authority*

**The cycle of the last two thematic seminars** (2007–2008) was held during the final year of the project. Seminars were especially designed for applicants among consultants, educators, tutors and methodists of fishing companies, fishing organizations, schools and state institutions.

**5th seminar** (11.–12. 3. 2008)

Genetics and fish breeding

**6th seminar** (15.–16. 5. 2008)

Perspectives of the Czech fishery

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### **INTRODUCTION OF THE COMBINED TWO-SEMESTER SPECIALIZED STUDY IN THE FIELD OF FISHERIES AT THE UNIVERSITY OF SOUTH BOHEMIA (CZ.04.1.03/3.2.15.2/0358)**

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*project leader: Assoc. Prof. Dipl.-Ing. Jan Kouřil, Ph.D., administrator: Zuzana Dvořáková  
project provider: the Ministry of Education, Youth and Sports of the Czech Republic, Prague*

Two-semester specialized study of fisheries ran in the academic year 2007–2008. It was dedicated to employees of fishing production companies, professional employees of fishing sport associations, employees of state administration and other applicants. The study was organized as a block of lectures and seminars of 150 tuition hours in total. The lectures, performed by foremost Czech experts, were targeted to following topics: traditional and non-traditional fish rearing technologies, fish genetics and breeding, controlled reproduction in fish, fish nutrition and feeding, intensive aquaculture, technical news, fish processing, fishery marketing, preparation of applications to national and European grant agencies in fisheries, the Czech and European legislative regarding fishing, water management and protection of the environment or other up-to-date subjects.

Four blocks of this study ran in 2008 (4–8 February 2008, 4–7 March 2008, 21–24 April 2008 and 15–16 June 2008). The last block was reserved for the defence of study thesis.

Many publications were issued within the solution of the project (Fish Genetics and Breeding; Applied Hydrobiology; Controlled reproduction and rearing fingerling orfe (*Leuciscus idus*); Recirculating aquacultural systems for fish culture; Intensive methods for breeding nase fry and stock (*Chondrostoma nasus* L.); Hormonally induced of propagation and rearing of alevins in rudd and gudgeon; Anaesthesia in fishes; Rearing technology of african catfish (*Clarias gariepinus*).



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## **IMPROVEMENT OF THE BACHELOR, MASTER AND DOCTORAL STUDY IN THE FIELD OF FISHERIES AT THE UNIVERSITY OF SOUTH BOHEMIA (CZ.04.1.03/3.2.15.3/0427)**

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*project leader: Assoc. Prof. Dipl.-Ing. Jan Kouřil, Ph.D., administrator: Zuzana Dvořáková  
project provider: the Ministry of Education, Youth and Sports of the Czech Republic, Prague*

The first and the second degree (bachelor – three years; master – two years) were provided by the Faculty of Agriculture, České Budějovice; the doctoral degree is then performed at the Research Institute of Fish Culture and Hydrobiology in Vodňany. The lecturing was shared by both mentioned parts of the University of South Bohemia. The aim of the project was to improve both the theoretical and applied training of students. Various teaching materials were issued: 1) textbooks (Principles of molecular biology and genetics in fisheries; Salmonid, grayling and whitefish culture), 2) compendiums and/or methodics (Artificial reproduction and rearing stocking material *Vimba bream*; The artificial reproduction of the sturgeons; Methodology of crayfish catching; Methodology of noble crayfish breeding; Using heatpumps in intensive aquaculture decrease volume of energy for optimisation of temperature conditions reared of fish; The use of Diazinon 60 EC in pond fishery to suppress excessive propagation of large daphnian zooplankton.) and 3) DVD films (Fish processing and Breeding brook trout), and laboratory equipment was improved. A part of the project included innovation of selected subjects and introduction of new ones (Fish feeding, Fish culture in recirculation systems). Lectures of several foreign experts were arranged to enrich common educational program.

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## **THE NETWORK OF INFORMATION AND ENVIRONMENTAL CENTERS FOR THE CARE OF WETLANDS AND LAND WATER (CZ.04.1.03/4.2.16.4/0016)**

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*project leader: MSc. Ivo Přikryl, ENKI Třeboň, RIFCH; solver: Dip.-Ing. Blanka Vykusová, CSc., provider: the Ministry of the Environment of the Czech Republic, Prague*

The project aim was to increase the knowledge of people who affect the status of wetlands and the water circulation/function in the landscape in various ways. A special attention was devoted to ponds and their reasonable and regardful management, renewal of wetland biotopes and the way of applying the General directive on waters (Directive 2000/60/ES). The aim was realized by organizing series of courses and seminars focused on the requirements of particular target groups. Employees of public offices (ministries, regional offices and municipalities), employees of Protected landscape areas, National Parks, Czech environmental inspection, and hygienists, owners of ponds as well as subjects managing them; members and employees of nongovernmental non-profit organizations, designers of small waterworks and water revitalizations etc. were the target groups of the project. Fifteen various courses and seminars were organized in 2008.

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## **ORGANIZING OF SPECIAL FISHING SEMINARS (OP Fisheries, CZ.1.25/3.1.00/08/00288)**

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*Project leader: Dipl.-Ing. Blanka Vykusová, CSc.  
Provider: The Ministry of Agriculture of the Czech Republic*

**1st seminar** (18.–19. 3. 2009)

**2nd seminar** (14.–15. 5. 2009)

**3rd seminar** (10.–11. 11. 2009)

**4th seminar** (8.–9. 12. 2009)

Present and perspectives of farming in trout waters

Biology and culture of predatory fish species + grant policy

New technologies in fish culture I.

New technologies in fish culture II.

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## FIRST SUMMER FISHERY SCHOOL

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The first Summer fishery school for talented secondary school students started in RIFCH Vodňany on Monday 7th July 2008. Ten students from Prachatice, Praha, Strážnice, Příbram, Havlíčkův Brod, Karviná, Podbořany and Vodňany participated in a number of theoretical lectures focused on: fish breeding, hydrobiology, hydrochemistry, astacology, biochemistry, etc. The lectures were enriched by the work in laboratories and the field. An excursion to a fishery facility was also a part of the programme. The summer school was financed by the Development project of USB (programme no. 6).

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## SECOND SUMMER FISHERY SCHOOL

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The workers of the Research Institute of Fish Culture and Hydrobiology prepared the second run of Summer fishery school in the frame of the project "With education towards improvement of competitive ability of South Bohemian research and development" (OP VK, CZ.1.07/2.3.00/09.0203). Unlike the first run, which was focused on the secondary school students only, a possibility to participate was also given to university students and the programme was extended from two to three weeks. Main emphasis was given to the individual work of participants of the summer school on the projects and grants of RIFCH. At the end, the summer school participants presented and defended obtained results.

Twenty secondary and university students from the whole Czech Republic met in Vodňany on 7–30 July 2009. At first, they attended a practical excursion at fishery companies in South Bohemia regions (the Třeboň region, the Hluboká region, the Nové Hradky region), got acquainted with the workplace of RIFCH Vodňany (fish hatchery, experimental farming and fishery facility) and then they fully participated in the work on „their projects“. The organizers prepared nearly 20 professional lectures and practical trainings focused on fish culture, hydrobiology, aquatic chemistry, astacology, genetics, etc.



*Participants of the second Summer fishery school*

*Processed by: Dipl.-Ing. Blanka Vykusová, CSc.*



## EDITORIAL ACTIVITIES

### FOLLOWING *METODICS* TITLES WERE PUBLISHED IN 2008–2009:

- Gela, D., Rodina, M., Linhart, O. *The artificial reproduction of the sturgeons (Acipenser)*. Edition of Methodics (Technological series), RIFCH USB Vodňany, 2008, No. 78, 24 pp.
- Hamáčková, J., Kozák, P., Lepič, P., Kouřil, J. *Artificial reproduction and rearing stocking material vimba bream*. Edition of Methodics (Technological series), RIFCH USB Vodňany, 2008, No. 82, 14 pp.
- Kozák, P., Buřič, M., Kouba, A., Policar, T. *Methodology of noble crayfish breeding*. Edition of Methodics (Technological series), RIFCH USB Vodňany, 2008, No. 83, 36 pp.
- Hamáčková, J., Kouřil, J., Adámek, Z. *Controlled reproduction and rearing fingerling orfe (Leuciscus idus)*. Edition of Methodics (Technological series), RIFCH USB Vodňany, 2008, No. 84, 12 pp.
- Kouřil, J., Hamáčková, J., Stejskal, V. *Recirculating aquacultural systems for fish culture*. Edition of Methodics (Technological series), RIFCH USB Vodňany, 2008, No. 85, 40 pp.
- Fiala, J., Spurný, P., Tichý, F. *Intensive methods for breeding nase fry and stock (Chondrostoma nasus L.)*. Edition of Methodics (Technological series), RIFCH USB Vodňany, 2008, No. 86, 12 pp.
- Kouřil, J., Matoušek, J. *Using heatpumps in intensive aquaculture decrease volume of energy for optimisation of temperature conditions reared of fish*. Edition of Methodics (Technological series), RIFCH USB Vodňany, 2008, No. 87, 20 pp.
- Kolářová, J., Svobodová, Z. *Therapeutical procedures in fishculture*. Edition of Methodics (Technological series), RIFCH USB Vodňany, 2009, No. 88, 30 pp.
- Policar, T., Stejskal, V., Bláha, M., Alavi, SMH., Kouřil, J. *Technology of intensive culture of Eurasian perch (Perca fluviatilis L.)*. 2009. Edition of Methodics (Technological series), RIFCH USB Vodňany, 2009, No. 89, 51 pp.
- Valentová, O., Máchová, J., Faina, R., Kroupová, H., Svobodová, Z. *COMBI set – field water analyses*. 2009. Edition of Methodics (Technological series), RIFCH USB Vodňany, 2009, No. 90, 28 pp.
- Flajšhans, M., Hulák, M., Kašpar, V., Rodina, M., Kocour, M. *Methodology of conservation of fish genetic resources in a live gene bank*. Edition of Methodics (Technological series), RIFCH USB Vodňany, 2009, No. 91, 25 pp.
- Kozák, P., Policar, T., Buřič, M., Kouba, A. *Basic morphological characteristics of crayfish in the Czech Republic*. Edition of Methodics (Technological series), RIFCH USB Vodňany, 2009, No. 92, 27 pp.
- Cepák, M., Vácha, F., Vejsada, P. *Texture profile analyse in common carp flesh using TA.XTPlus analyser*. Edition of Methodics (Technological series), RIFCH USB Vodňany, 2009, No. 93, 22 pp.
- Kouba, A., Hamáčková, J., Kozák, P. *Decapsulation, hatching and rearing of brine shrimps belonging to genus Artemia*. Edition of Methodics (Technological series), RIFCH USB Vodňany, 2009, No. 94, 35 pp.
- Policar, T., Drozd, B., Kouřil, J., Kozák, P., Hamáčková, J., Alavi, SMH., Vavřečka, A. *Recent state, artificial reproduction and rearing of common barbel (Barbus barbus L.) for production of suitable stocking material*. Edition of Methodics (Technological series), RIFCH USB Vodňany, 2009, No. 95, 39 pp.
- Randák, T., Turek, J., Kolářová, J., Kocour, M., Hanák, R., Velíšek, J., Žlábek, V. *Technology of brown trout culture in control conditions for running waters stocks production*. Edition of Methodics (Technological series), RIFCH USB Vodňany, 2009, No. 96, 20 pp.

Randák, T., Turek, J., Kolářová, J., Kocour, M., Kouřil, J., Hanák, R., Velišek, J., Žlábek, V. *Technology of european grayling broodfish culture in control conditions for sustainable running waters stocks production*. Edition of Methodics (Technological series), RIFCH USB Vodňany, 2009, No. 97, 24 pp.

Másilko, J., Urbánek, M., Hartvich, P., Hůda, J. *Efficient additional feeding with mechanically treated cereals in the breed of market carp in fisheries Rybářství Třeboň Hld. a.s.* Edition of Methodics (Technological series), RIFCH USB Vodňany, 2009, No. 98, 11 pp.

Gela, D., Kocour, M., Rodina, M., Flajšhans, M., Beránková, P., Linhart, O. *The artificial reproduction of common carp*. Edition of Methodics (Technological series), RIFCH USB Vodňany, 2009, No. 99, 43 pp.

## BULLETIN OF RIFCH VODŇANY

The professional quarterly has been published since 1965. Fortyfourth and 45th editions were published in 2008 and 2009. The 45th edition was financed from the EU resources and the European fisheries fund, project: „Preparation and publishing of 45th edition of the special quarterly Bulletin of RIFCH Vodňany (CZ.1.25/3.1.00/08.00290)“.

## FURTHER PUBLICATIONS, AUDIOVISUAL WORKS

### SPECIAL MONOGRAPHS

Adámek, Z., Helešic, J., Maršálek, B., Rulík, M. *Applied Hydrobiology*. Vodňany: University of South Bohemia in České Budějovice, Research Institute of Fish Culture and Hydrobiology, 2008. 256 pp. ISBN 978-80-85887-79-2.

Flajšhans, M., Kocour, M., Ráb, P., Hulák, M., Šlechta, M., Linhart, O. *Fish Genetics and Breeding*. Vodňany: University of South Bohemia in České Budějovice, Research Institute of Fish Culture and Hydrobiology, 2008. 232 pp. ISBN 978-80-85887-82-2.

Hulák, M. *Principles of molecular biology and genetics in fisheries*. Vodňany: University of South Bohemia in České Budějovice, Research Institute of Fish Culture and Hydrobiology, 2008. 179 pp. ISBN 978-80-85887-81-5.

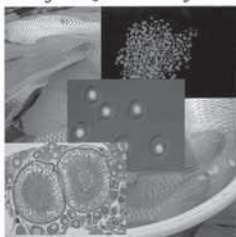
Kouřil, J., Mareš, J., Pokorný, J., Adámek, Z., Randák, T., Kolářová, J., Palívková, M. *Salmonid, grayling and whitefish culture*. Vodňany: University of South Bohemia in České Budějovice, Research Institute of Fish Culture and Hydrobiology, 2008. 141 pp. ISBN 978-80-85887-80-8.



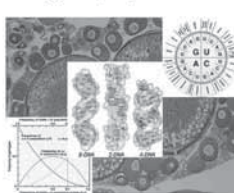
*Aplikovaná hydrobiologie*



*Genetika a šlechtění ryb*



*Molekulární základy biologie a genetiky v rybářství*



*Chov lososovitých druhů ryb, lipana a síhů*



Adámek Z., Helešic J., Maršálek B., Rulík M.

Vodňany 2008

Flajšhans M., Kocour M., Ráb P., Hulák M., Šlechta M., Linhart O.

Vodňany 2008

Hulák M.

Vodňany 2008

Kouřil J., Mareš J., Pokorný J., Adámek Z., Randák T., Kolářová J., Palívková M.

Vodňany 2008

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## PH.D. THESES

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- Alavi S.M.H. *Sperm motility and behavior in models of teleostean and chondrosteian fish*. Ph.D. Thesis. FFPW USB Vodňany, 2009, 146 pp.
- Buřič M. *Biology of spiny-cheek crayfish (Orconectes limosus, Rafinesque, 1817) under conditions of the Czech Republic and the study of factors influencing its invasive spreading*. Ph.D. Thesis. FFPW USB Vodňany, 2009, 145 pp.
- Pšenička M. *Ultrastructure of spermatozoa and fertilization process in sturgeon*. Ph.D. Thesis. FFPW USB Vodňany, 2009, 104 pp.
- Stejskal V. *Intensive culture and reproduction of Eurasian perch (Perca fluviatilis L.)*. Ph.D. Thesis. FFPW USB Vodňany, 2009, 108 pp.
- Sudová E. *Pharmacovigilance in aquaculture with attention to antibiotics and antiparasitics*. Ph.D. Thesis. FFPW USB Vodňany, 2009, 79 pp.

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## OTHER PUBLICATIONS

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- Velíšek J., Kroupová H. (red.), 2008. The 1st International Workshop – Aquatic Toxicology and Biomonitoring. Abstract Book. RIFCH USB Vodňany, 89 pp.
- Kozák P., Kouba A. (red.), 2009: Regional European Crayfish Workshop – Future of Native Crayfish in Europe. Abstract Book. FFPW USB Vodňany, 53 pp.
- Vykusová B. (red.), 2008. Výroční zpráva 2006–2007. RIFCH USB Vodňany, 64 pp.
- Vykusová B. (red.), 2008. Biennial Report 2006–2007. RIFCH USB Vodňany, 68 pp.

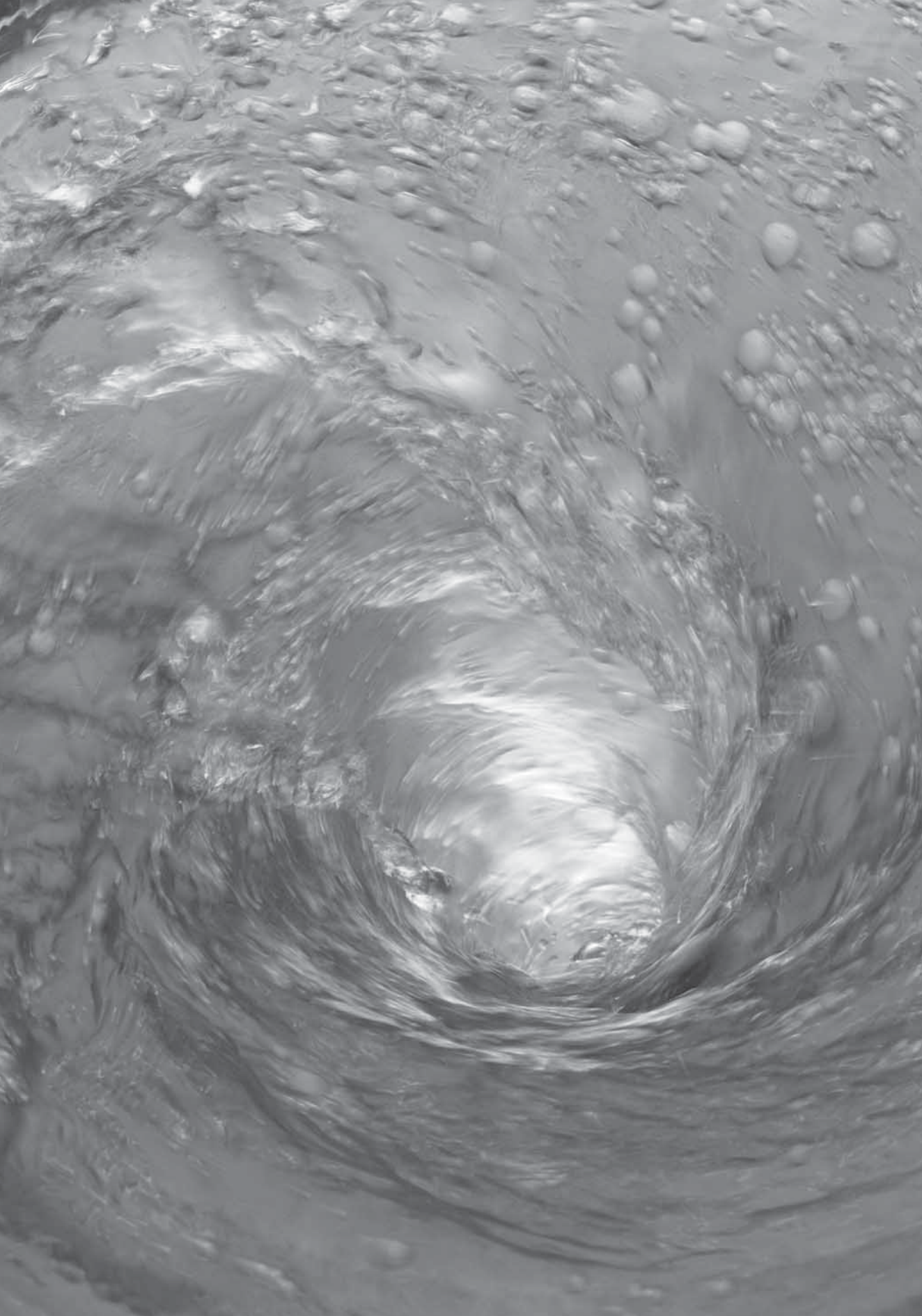
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## AUDIOVISUAL WORKS

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- Kouřil J. a kol., 2008. Biology and breeding brook trout. Tutorial film on DVD.(in Czech).
- Kozák P., Mauric Z., 2008. Biology, conservation and breeding of crayfish. Tutorial film on DVD (in English).
- Linhart O. a kol., 2008. Fishery Research in RIFCH USB, the Czech Republic. Tutorial film on DVD (in English).
- Linhart O. a kol., 2008. Fishery Research in RIFCH USB. Tutorial film on DVD. (in Czech).
- Máchová J., Mauric Z., 2008. Test of subchronic toxicity on rainbow trout. Tutorial film on DVD. (in Czech).
- Vácha F., 2008. Processing of freshwater and marine fish. Tutorial film on DVD. (in Czech)

*Processed by: Dipl.-Ing. Blanka Vykusová, CSc.*



# CONSTRUCTIONAL PLANS



Project title:	<b>South Bohemian Research Centre of Aquaculture and Biodiversity of Hydrocenoses</b>
Operation programme:	OP R&DFI
Priority axis:	2. Regional R&D centres
Field of support:	2.1 Regional R&D centres
Start of the project:	01/2010
Termination of the project:	12/2013
Project registration number:	CZ.1.05/2.1.00/01.0024
Total eligible costs:	CZK 273.4 mil.

The objective of the project is to build a top quality regional research and development centre in South Bohemia, a region that has years of tradition in fishing and fish farming industry on a water area of 25,000 ha, and which represents half of the fish production in the Czech Republic. The centre will have an international outreach, especially in Central Europe, and will focus on aquaculture and biodiversity hydrocenosis to increase the basis for strengthening basic, applied and technological research related to fisheries, including education.

The project will include the development of research background with increasing of critical capacity, equipment and technological infrastructure. The improved research background will enable us to carry out competitive research in Europe and effective implementation of innovations in practice by strengthening cooperation with the application sphere.

Construction works on the project will take place in 2011–2012.



Current state



Visualization – future state



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**MAIN BUILDING OF THE FFWP (OBJECT OF THE FISHERY CENTRE OF MOLECULAR BIOLOGY, ECOTOXICOLOGY AND INFORMATICS – OBJECT „A“, SEE THE MAP ABOVE)**

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Basic and applied research (objectives, grants) is already carried out in the main building but its development is limited by insufficient capacities and technologies. Execution of the project will result in expansion of laboratories capacity and modernization of premises for the applied research. Modernized laboratories and offices will primarily serve for researchers.

Regarding the building activities, the project execution will result in superstructure of the building by one floor and prolongation of the building by one third with incorporation of a necessary elevator.

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**GENETIC FISHERY CENTRE FFWP (OBJECT „C“, SEE THE MAP ABOVE)**

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*Current state*



*Visualization – future state*

In the frame of the project, a two-storey building of the Genetic Fishery Centre will be constructed. This will be an object of primarily technological nature and will serve as specialized experimental workplace for spawning, hatching and culture of fish. Fish breeding, preservation of genetic sources of existing breeds and populations of sturgeons and crayfish will be also carried out in the object. Research of other cartilaginous fish species and study of quantitative and population genetics of fish and crayfish will be carried out in the centre as well.

The Genetic Centre will be adapted for an all-year-round operation, i.e. it will be possible to extend the reproduction season to almost a whole year by thermal stimulation of fish (heating of the object and heating of technological water will be solved by means of thermal pumps). Technology will be adapted to the needs of cartilaginous fish and fish with similar way of culture (sheatfish, perch, pikeperch, etc.).

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**EXPERIMENTAL FISH BREEDING FACILITY FFWP (OBJECT „D“, SEE THE MAP ABOVE)**

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*Current state*



*Visualization – future state*

The reconstruction and the rebuilding of the experimental fish breeding facility are also planned in the project. Experimental fish facility is currently a single-storey and partially a two-storey building on the plot No. 2563 in the cadastral area of Vodňany which serves as an experimental facility for fish culture and also as an operation- and building-related administrative unit. The planned rebuilding will fundamentally change the building utilization, which will in the designed state include operational part used for laboratory experimental culture of fish (these spaces situated on the 1st floor) and part of mainly laboratory nature situated on the 2nd floor. The object will form a background for unique experimental laboratories with two useful aboveground floors.

Further, the pond No. 25 (on land plot No. 300/25) next to the building will be rebuilt to the outside mangers. This area will be divided into 3 parts, a concrete floor and concrete walls for each manger will be constructed on the pond bottom. Technological equipment for fish culture will be placed in the concrete mangers.

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**INTERNATIONAL ENVIRONMENTAL EDUCATION, CONSULTANCY AND INFORMATION CENTRE FOR PROTECTING WATERS (OBJECT „F“, SEE THE MAP ABOVE)**

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*Current state*

**F**



*Visualization – future state*

Project title:	<b>International Environmental Education, Consultancy and Information Centre for Protecting Waters in Vodňany</b>
Operation programme:	OP Environment
Priority axis:	7. The development of infrastructure for environmental education, consultancy and awareness
Field of support:	7.1. The development of infrastructure for the implementation of environmental education programmes, the providing of environmental consultancy and environmental information
Start of the project:	07/2010
Termination of the project:	12/2011
Total eligible costs:	CZK 54 mil.

Project plan consists of the reconstruction and the rebuilding of the object “Wölflů mlýn” in order to use it for the accommodation education centre EECA which will also provide consultancy services in the field of protecting waters, aquatic animals and environment-friendly water management.

The reconstructed storage spaces of former “Wölflů mlýn” will be used as lecture rooms, specialized classrooms and accommodation capacities for organizing specialized educationally training stays, courses, seminars, workshops and conferences focused on environmental education and consultancy. A large lecture hall for 80 learners, two university classrooms, office for providing everyday consultancy services, technical background (a copy room, a dining room, etc.) and the accommodation part with a capacity of 38 people will arise there.

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**DEVELOPMENT OF RESEARCH AND EDUCATIONAL CAPACITIES OF FFPW AND FA**

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*Visualization – future state*

Project title:	<b>Development of research and educational capacities of FFPW and FA</b>
Operation programme:	OP R&DFI
Priority axis:	4. Infrastructure for university education related to research
Field of support:	4.1. Infrastructure for university education related to research
Start of the project:	09/2010
Termination of the project:	12/2013
Total budget:	CZK 242 mil.
Contribution of USB FFPW:	CZK 2 mil.
Spoluúčasť FROV JU:	CZK 2 mil.

The aim of the project is to build appropriate educational capacities of IA FFPW in České Budějovice. This will ensure premises for the university education and follow-up R&D and experimental activities. Another aim is to provide conditions for the development of bachelor, master and doctoral studies with the connection to the R&D activities.

It is designed as a three-storey building together with FA, the part of FFPW includes approximately 1/3 of the building. Separate entrance (atrium) and the entrance from the car park; aquaristic rooms, a study department and technical background will be situated on the 1st floor. Lecture and study rooms for Ph.D. students will be on the 2nd floor and the offices of management of the Institute of Aquaculture will be situated on the 3rd floor.

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#### **OPERATING PREMISES, GARAGES AND ACCOMMODATION FOR PH.D. STUDENTS**

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A purpose of the project is to create **operating premises, garages and accommodation for Ph.D. students in the main building of FFPW.**

Total cost of cca CZK 8 mil. will be paid from own resources.



*Visualization – future state*

*Processed by: Dipl.-Ing. Petra Plachtová*

# POPULARIZATION OF OUR RESULTS AND AWARDS

## Popularization of Our Scientific Results in Media

### THE INTERVIEW REGARDING THE REPRODUCTIVE CHOICE OF CRAYFISH

The Czech radio Leonardo broadcasted on the 19th June 2008 the interview regarding the reproductive choice of crayfish posterior the published article "Crayfish females eavesdrop on fighting males before choosing the dominant" in Current Biology (Aquiloni, L., Buřič, M., Gherardi, F.). The Czech radio Leonardo is a digital and an internet station which is focused on popularization of science, nature, history and medicine. A modified record of the talk was also published in the Czech newspaper "Lidové noviny" on the 25th June 2008 in the science annex.

### ARE THE CZECH RIVERS CLEAN?

A press conference on this topic took place in the house "U Beránka" in České Budějovice on the 21st August 2008. The questions regarding the hygienic quality of fish out of our fish culture, the living conditions of fish in our waters, the problem of water pollution and other interesting questions were answered by Dipl.-Ing. Tomáš Randák, Ph.D., the head of the Laboratory of Environmental Chemistry and Biochemistry of RIFCH.

### THE PRESS CONFERENCE: STURGEONS, LIVING FOSSILS



The University of South Bohemia in České Budějovice, the Research Institute of Fish Culture and Hydrobiology in Vodňany (RIFCH) is the Czech leading workplace focused on the protection of genetic resources of sturgeons, the research of their biology, physiology, genetics and technology of their breeding. RIFCH is also an active member of World Sturgeon Conservation Society, the international company for sturgeons' protection. The researchers from the department of Genetics and fish breeding tried to introduce this topic to a broad public at the press conference on the 11th September 2008.

### FISH – GASTRONOMIC EXPERIENCE AND MEDICINE

A press conference on the topic "Fish - gastronomic experience and medicine" took place in České Budějovice on 22nd December 2008. This theme was prior to the Christmas time in the center of interest for broad public, which could learn that eating the fish was a medicine against cardiovascular diseases. Dipl.-Ing. Pavel Kozák, Ph.D. and Dipl.-Ing. Jan Mráz were the main guests of this press conference.

### THE RESEARCHERS FROM VODŇANY STRIVE FOR THE RETURN OF STERLET INTO OUR RIVERS

News server "Tyden.cz" published an article about the project of sterlets preservation, which was realized by the researchers from the University of South Bohemia in České Budějovice, Research Institute of Fish Culture and Hydrobiology in Vodňany.

The researchers did the artificial reproduction of sterlets that time. The numbers of these fish have dramatically dropped and there is a threat of their extinction. Some of the fish, which the researchers produced, can now enrich the biodiversity of Morava and Dyje rivers, where sterlets used to occur plentifully.

## **ASTACOLOGIC MEETING ON AIRWAVES**

On the occasion of planning of another cooperation and beginning of new experiments a meeting of experts was held. The „Cray fishers“ were from the Charles University in Prague (A. Petrušek), the Ostrava University (Z. Ďuriš) and RIFCH in Vodňany (P. Kozák, M. Buřič, A. Kouba). The meeting was held by the river Pšovka in a picturesque region of Protected Landscape Area Kokořínsko where the catching of crayfish and the installation of the equipment for catching of migrating crayfish also took place. The redactor of Czech radio Mr. M. Janáč took the unique opportunity for getting a wide spectrum of information about crayfish. The listeners of airwaves (concretely of Meteor program) were able to get familiar with the situation of crayfish in our country, their biology, the methods and the results of the recent research of the non-indigenous species or the occurrence of crayfish plague disease. The discussion was held in a friendly and informal way with the effort to introduce these matters about crayfish comprehensibly not only as a brief list of information.



## **STURGEONS FROM VODŇANY ON THE TELEVISION CHANNEL ČT2**

On Saturday, the 9th May 2009 there was a scientific magazine PORT on the TV channel ČT2, where the first reportage concerned the topic “Sturgeons from Vodňany“. The reportage was shot at the facilities of Genetic Fisheries Center and laboratories of the main building of RIFCH with the commentaries of Dipl.-Ing. David Gela, Ph.D. and Assoc. Prof. Dipl.-Ing. Martin Flajšhans, Dr.rer.agr.

## **THE PRESS CONFERENCE ON THE 29TH JULY 2009: PERCH AND PIKEPERCH – COMMON FISH DELICACY “WITHOUT BONES” ON YOUR TABLE**

The press conference on the topic “Perch and pikeperch – common fish delicacy ‘without bones’ on your table“ took place in the experimental fishing facility of RIFCH in Vodňany. Among participants of the conference, there was also Mr. Aleš Hazuka from the Czech Television. He shot the reportage about this topic for Regional News, which was broadcasted the same day on the channel ČT1.

## **FISHING DAYS IN VODŇANY 2008, 2009**

Fishing days in Vodňany were again prepared by the FDV association whose members are RIFCH Vodňany (FFPW), Fishery High School in Vodňany and the Town Vodňany. The support of the event was also provided by the Czech Fishing Association and ČEZ – the Nuclear power plant of Temelín. In 2008 (May 15–17), the 18th run of FDV was held. In its frame, the traditional display of fishery films (FISHFILM) took place, that time on the topic “The fish world by a film producer and a diver Mr. Hugo Habrman“. The special program included a two-day seminar “Perspectives of Czech fishery“.

The 19th volume of FDV took place on May 14–16, 2009. A two-day seminar “Breeding of precacious fish species and grant policy in fishery“ was on the program. The traditional exhibition FISHTECH, organized in a two-year interval, was visited by more than 1000 visitors, both laics and experts. It is necessary to mention an excellent cultural program, including folklore choruses from partner towns, a celebratory firework and the Saturday’s fish market in the square. These actions became an integral part of the fishing days, the same way as the Doors open day when interested people can get to know all our workplaces.

# AWARDS

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## PRESTIGIOUS AWARD "INNOVATION AWARD"

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Experimental team of Jana Picková got a prestigious award "Innovation Award, €10,000" which was given at the international conference "AquaVision 2008" in Stavanger, Norway on 30th September 2008. Jana Picková works at the Swedish university of agriculture in Uppsala, SLU. She is also together with Vladimír Žlábek an employee of RIFCH. The research results published in the scientific magazine "Lipids" impressed the leading experts of the fishing industry. The executed



experiments bring new information about the possibilities of use of the alternative components for production of fish feed. Global lack of fish oils used for the feed production for aquaculture is nowadays most often compensating for the oils of a vegetable origin. Qualitative composition of lipids and bioactive substances included in the vegetable oils can considerably influence the fish metabolism and the final quality of fish products. The awarded study focuses on the impact of sesamin on lipometabolism in a salmon and a rainbow trout.

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## THE AWARD OF RIFCH DIRECTOR FOR THE BEST PUBLICATION OF AN AUTHOR YOUNGER THAN 35 YEARS FOR 2008

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At the meeting of the scientific board of RIFCH on 27th January 2009, the award of RIFCH director for the best publication of an author younger than 35 years for 2008 was given to Dipl.-Ing. Hana Kroupová, Ph.D. for her work "Effect of subchronic nitrite exposure on rainbow trout (*Oncorhynchus mykiss*)" which was published in the journal of Ecotoxicology and Environmental Safety (IF 2007: 2.014).

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## THE AWARD FOR THE BEST SCIENTIFIC PUBLICATION OF FFPW EMPLOYEES YOUNGER THAN 35 YEARS FOR 2009

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On the basis of voting and recommendation of scientific board of FFPW three scientific publications were awarded by the dean of FFPW in the competition "The award for the best scientific publication of FFPW employees younger than 35 years for 2009; in this order: **1st place:** Li, Z. et al.: Responses of antioxidant status and Na<sup>+</sup>-K<sup>+</sup>-ATPase activity in gill of rainbow trout, *Oncorhynchus mykiss*, chronically treated with carbamazepine. *Chemosphere*. • **2nd place:** Randak et al.: Effects of pollution on chub in the River Elbe, Czech Republic; *Ecotoxicology and Environmental Safety*. • **3rd place:** Alavi et al: Effects of osmolality on sperm morphology, motility and flagellar wave parameters in Northern pike (*Esox lucius* L.); *Theriogenology*.

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## AWARD OF A TITLE DOCTOR HONORIS CAUSA TO PROF. DR. JACKY COSSON

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Celebratory Scientific board of USB assembled in the town hall in České Budějovice on Tuesday, 1st December, 2009 to award a title Doctor honoris causa to Prof. Dr. Jacky Cosson. Dr. Jacky Cosson is a significant French scientist in the field of the fish sperm motility. Nowadays, he holds a scientific degree of the scientific director in CNRS (Center National Research and Science) fully focused on the development of science, which represents a degree higher than a university professor. This degree is perceived as the highest possible one from the view of career progress in scientific sphere in France. Therefore, it is our great honour that the title Doctor honoris causa was awarded to Prof. Dr. Jacky Cosson just by the Scientific board.





*Visualization of FFPW building in USB campus  
Scheduled horizon of construction 2010–2013*



*Visualization of FFPW main building  
Scheduled horizon of construction 2010–2013*



# Biennial Report

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