

ACADEMY OF SCIENCES OF THE CZECH REPUBLIC  
**INSTITUTE OF VERTEBRATE  
BIOLOGY**



BIENNIAL REPORT

**2009–2010**

BRNO 2011

## Selected model species of vertebrates studied at Institute of Vertebrate Biology AS CR



Rachow's nothobranch (*Nothobranchius rachovii*)  
(Photo by O. Sedláček)



House mice (*Mus musculus domesticus* and *M. m. musculus*)  
(Photo by R. Mrkvica)



Tatra chamois (*Rupicapra rupicapra tatraica*)  
(Photo by J. Ksiažek)

# BIENNIAL REPORT

INSTITUTE OF VERTEBRATE  
BIOLOGY

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OF THE CZECH REPUBLIC

2009–2010



## **BRNO 2011**

### **BIENNIAL REPORT 2009–2010**

Periodical continuation of the former Institute's bulletins *Vertebratologické Zprávy* (1969–1987), *Zprávy ÚSEB* (1988–1991) and the *ILE Biennial Report* (1993–1994).

Edited by Josef Bryja, Hana Slabáková, Lenka Řezáčová and Marcel Honza

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The European otter is endangered species that is at IVB studied

by using non-invasive genetic approaches.

Photos on cover L. Votoček and J. Roleček

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## PREFACE

Dear reader,

It is my great pleasure to introduce what has already become a traditional publication of the Institute of Vertebrate Biology, the Biennial Report, which covers the scientific activity of all departments over the last two years.

When I started my career as Director in April of 2009 I did not really expect such turbulent times for the Academy of Sciences of the Czech Republic and the serious problems regarding management of the Institute that came soon after my election. One of the most serious of these problems was that relating to the institutional budget contributed by the State under the framework of the Institutional Research Plan. In 2010, the budget was cut by more than 10% compared to the previous year, being reduced to 20 million Czech crowns from 23 million CZK in 2009. At this point, I would like to express my deepest acknowledgements of all those fellows of the Institute who successfully applied for research grants from various national and foreign agencies. These research grants and various other contract funds significantly contributed to the budget with an additional 32 and 28 million CZK in 2009 and 2010, respectively.

Each chapter of this report provides a detailed summary of the results of the work completed over the last two years. The majority of scientific papers were published in high ranking journals covered by the Web of Science (152 titles with a total impact factor of 290). Of particular note is the impressive range of international cooperation and

wide distribution of study sites throughout the world that is characteristic of our research activities. Despite the majority of research hypotheses addressed by our fellows being primarily focused towards basic science, I must stress that the results of our work have also significantly contributed to applied problems in the areas of nature conservation, fisheries, forestry, agriculture and epidemiological surveillance.

The solid number of foreign students (18 individuals in 2009 and 20 in 2010) involved in our research is a clear indication that the Institute has a good reputation abroad. Our massive participation in education at Czech universities and the amazing number of graduate and post-graduate students (more than 100) studying with us is also strong evidence of our Institute's important position in the Czech educational system in fields such as zoology, ecology, evolutionary biology and biodiversity.

Over the last year, all Institutes within the Academy of Sciences of the Czech Republic were subjected to an evaluation for the period 2005–2009. The first part of this evaluation, involving a complex screening of various aspects of activity and efficiency and based on peer-review, scientometric analysis and immediate personal experience of both Czech and foreign experts, has now been completed. I am extremely pleased to be able to say that particular departments of the Institute have received high ranking scores and I believe that this will be reflected by an increase in the Institutional budget from the academic authorities over the coming years.

Finally, I would like to thank all of those who have contributed to these achievements and I am convinced more than ever that the Institute will continue to flourish over the coming years.

Dear reader, I hope you enjoy reading this latest Biennial report.

A handwritten signature in black ink, appearing to read 'M. Honza', written in a cursive style.

May, 2011

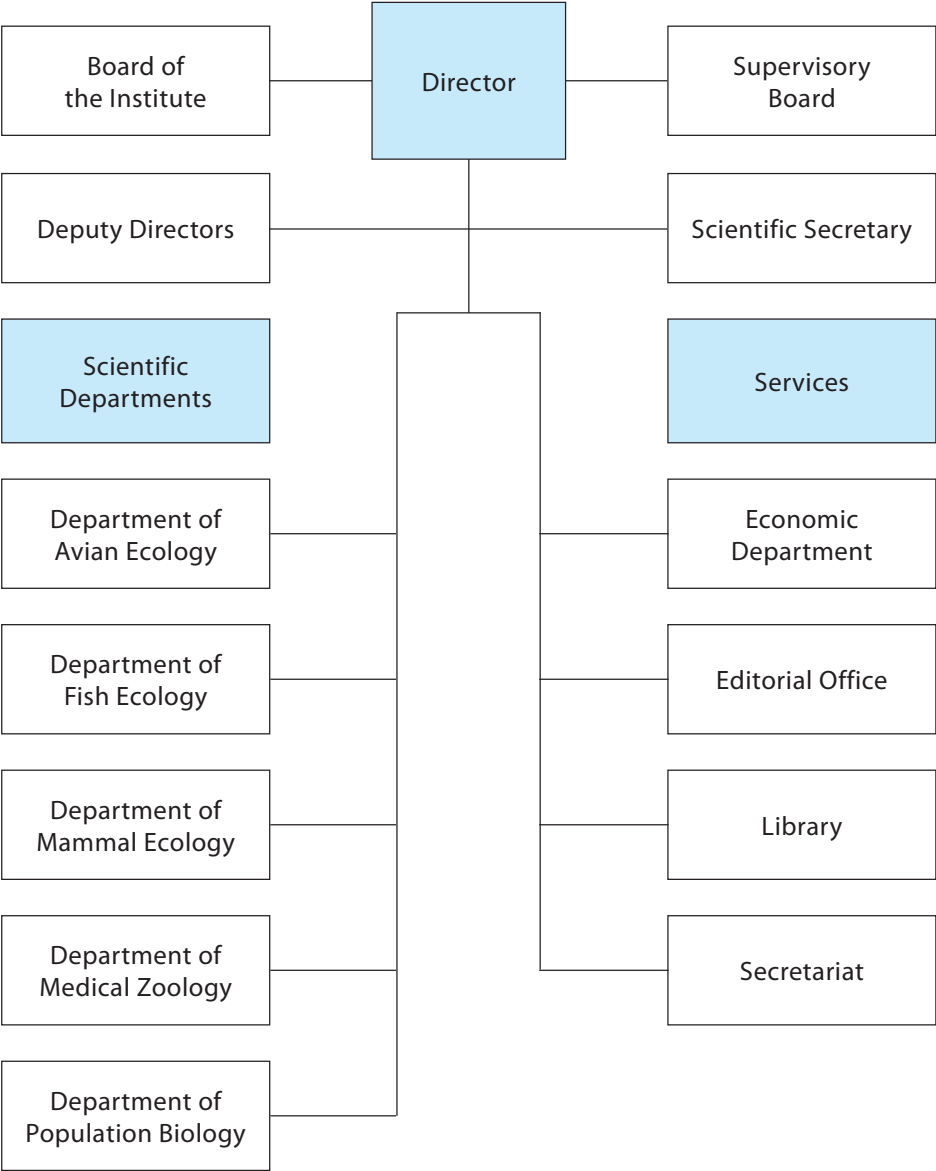
Marcel Honza, director of IVB





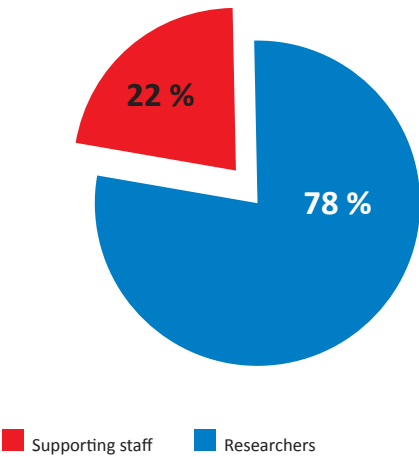
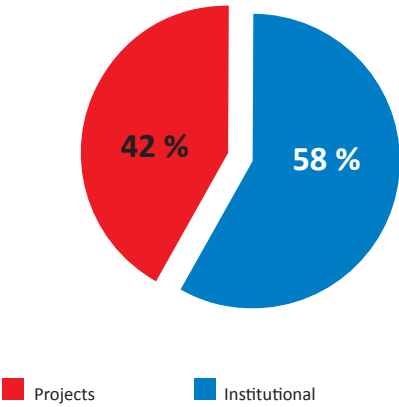
# 1. BASIC FACTS

## | STRUCTURE OF THE INSTITUTE OF VERTEBRATE BIOLOGY AS CR

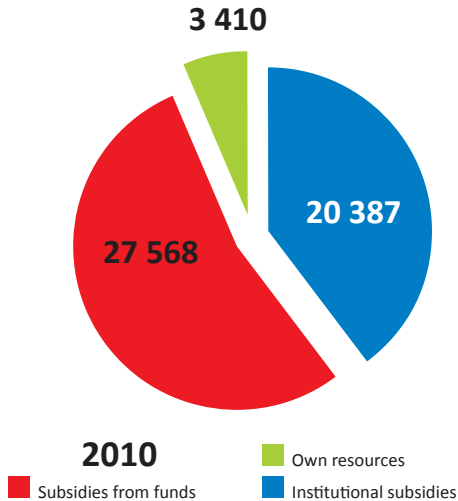
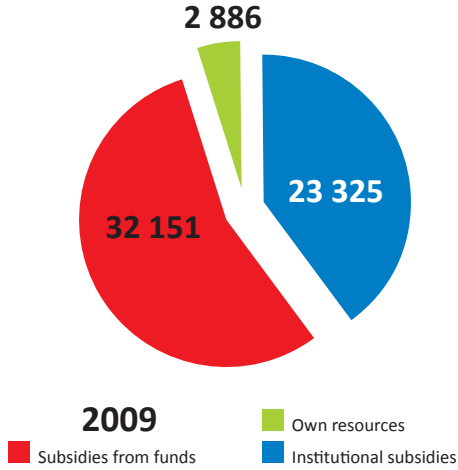


# | STAFF AND BUDGET

The Institute of Vertebrate Biology (IVB) is small according to the number of employees and its budget, but important in scientific production and other activities. In 2009, there were 67 full-time jobs, while in 2010 this number decreased to 58. The staff structure was similar in both years. More than 40% of workers (mainly post-docs, PhD students and technicians) were employed on the basis of external project funding in both years. More than half of the budget is obtained from such funds, while less than half comprises institutional subsidies from the Academy of Sciences.



Staff structure of the IVB in 2009–2010 (mean values for both years are presented).



Budget structure of the IVB in 2009–2010. Numbers are in thousands of Czech crowns.

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Prof. RNDr. Jiří GAISLER, DSc  
 (Masaryk University, Brno)

Prof. RNDr. Miloš MACHOLÁN, PhD  
 (Institute of Animal Physiology and Genetics AS  
 CR, v. v. i., Brno)

Assoc. Prof. RNDr. Zdeněk ŘEHAČ, PhD  
 (Masaryk University, Brno)

## | SUPERVISORY BOARD

### Chairman:

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*(Council of the Academy of Sciences, Prague, and  
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 CR, v. v. i., Liběchov)*

### Vice-chairman:

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*(Masaryk University, Brno)*

Assoc. Prof. RNDr. Jan KIRSCHNER, PhD  
*(Institute of Botany AS CR, v. v. i., Půhonice)*

Ing. Leoš NOVOTNÝ  
*(Business domain, Uherské Hradiště)*

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 Mgr. Radka PIÁLKOVÁ, PhD (*part-time*)

---

### Research priorities

Our research focuses on understanding the ecological and evolutionary basis of avian reproductive strategies. Important goals of this research are to identify the ecological factors that promote parasitic

reproductive behaviour, predator avoidance and nest predation. Main research topics include:

- avian brood parasitism as a model system for co-evolution
- sexual selection and evolution of male ornament in birds
- migratory connectivity, population differentiation and seasonal interactions in long distance migrants
- factors affecting nest predation and nest defence
- ectoparasites associated with birds

## DEPARTMENT OF FISH ECOLOGY

*Joined with former Department of Ichthyology since January 1st, 2010*

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Fish ecology

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Ecology, revitalisation of aquatic habitats

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Haematology and biochemistry

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Karyology, histology and fish reproduction

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(*part-time*)

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Mgr. Markéta KONEČNÁ, PhD  
Dr. Seth M. WHITE, PhD

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Mgr. Radomil ŘEŽUCHA (*part-time*)

### Technicians

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Ing. Jiří HUML (*part-time*)

Veronika MICHÁLKOVÁ (*part-time*)  
Iveta SLOVÁČKOVÁ (*part-time*)

## Research priorities

Fishes are used to investigate questions in ecology and evolution as well as applied issues in fisheries management, conservation of aquatic habitats and floodplain restoration. Research on fishes is performed at various levels of spatial and biological organisation (individual, population, and community). Our field and experimental studies are conducted in Europe, Asia and Africa. Current topics investigated at the department include:

- behavioural and evolutionary ecology of bitterlings
- adaptation and coevolution of the bitterling and their mussel hosts
- ecology, distribution and parasites of invasive fishes and their impact on native fish biodiversity
- 0+ juvenile fish community structure and optimisation of sampling methods in lowland rivers and their flood plains
- impacts of metazoan parasites on 0+ juvenile fish development
- evolutionary ecology of African annual fishes *Nothobranchius* spp.
- taxonomy, phylogeny and genetic diversity of fish populations
- indicative value of fish communities for rehabilitation of the aquatic environment and conservation of fish biodiversity

Wildlife ecology  
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Primateology

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Ecology and ethology of bats

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Molecular phylogeny of bats

## Technicians

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Jiří CHAMR

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Feeding ecology of herbivorous mammals

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Mgr. Jarmila KROJEROVÁ, PhD  
Mgr. Hana BERKOVÁ, PhD  
Mgr. Eva JÁNOVÁ, PhD

## Research priorities

Research is focused on the ecology of selected mammalian groups in various habitats in the temperate and tropical zones. Feeding behaviour and interactions between mammals and the environment is a leading topic of research. Recent projects also make use of population genetics and molecular phylogenetics methods in ecological studies. The results of investigations can improve the management of forest stands, game management, rodent pest control, and protection of biodiversity. Main research topics include:

- feeding ecology of large herbivores and their impact on vegetation
- foraging ecology and anti-predator strategies of bats and other features of their behaviour
- ecology and behaviour of large carnivores, and foraging ecology and distribution of mustelids
- synecology of small terrestrial mammals
- diet, feeding behaviour and digestion of great apes
- molecular ecology and phylogeny

## DEPARTMENT OF MEDICAL ZOOLOGY

### Head

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Ecology of pathogens and their vertebrate hosts

### Research Scientists

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Serosurveys for zoonotic pathogens

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Molecular detection of zoonotic pathogens

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Serology of zoonotic diseases, vector biology

## Research Assistants

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 Microorganisms in ixodid ticks

## Technicians

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## Research priorities

Research is focused on the ecology of selected microbial pathogens, causative agents of human and animal diseases, including emerging infectious diseases. Natural focality of zoonotic diseases is investigated in relation to the role played by wild vertebrates (hosts or reservoirs of infections) and their haematophagous ectoparasites (arthropod vectors of infections), under effects of recent changes of environmental conditions.

Main research topics include:

- arboviruses (i.e. viruses transmitted by ticks, mosquitoes and other haematophagous arthropods), such as West Nile, Ťahyňa, and tick-borne encephalitis viruses
- selected bacterial (*Borrelia burgdorferi* sensu lato, *Anaplasma phagocytophilum*, *Francisella tularensis*, *Brucella microti*) and protozoan (*Babesia* spp.) tick-borne pathogens
- circulation of vector-borne and zoonotic pathogens in terrestrial and aquatic ecosystems under changing environmental conditions and enhanced anthropogenic impacts
- surveillance of free-living and domestic vertebrates and humans for selected zoonotic pathogens, using serological surveys and epidemiological methods, in relation to preventive medicine (human and veterinary), environmental protection, and nature conservation



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Mgr. Petra HÁJKOVÁ, PhD

Mgr. Ondřej MIKULA, PhD (*part-time*)

Mgr. Peter MIKULÍČEK, PhD (*part-time*)

Alexis RIBAS SALVADOR, PhD (*part-time*)

Mgr. Karolina SOBEKOVÁ, PhD (*part-time*)

Ing. Jana SVOBODOVÁ, PhD (*part-time*)

Mgr. Barbora VOŠLAJEROVÁ, PhD

Ferhat MATUR, PhD

#### PhD students

Mgr. Jana ALBRECHTOVÁ (*part-time*)

RNDr. Petra DUFKOVÁ (*part-time*)

Mgr. Dagmar ČÍŽKOVÁ (*part-time*)

Mgr. Alena FORNŮSKOVÁ (*part-time*)

Mgr. Ľudovít ĎUREJE

Mgr. Adam KONEČNÝ (*part-time*)

Mgr. Hana PATZENHAUEROVÁ (*part-time*)

Mgr. Radka POLÁKOVÁ (*part-time*)

Mgr. Marta PROMEROVÁ (*part-time*)

Ing. Radovan SMOLINSKÝ, Ph.D. (*part-time*)

MVDr. Oldřich TOMÁŠEK, Ph.D. (*part-time*)

RNDr. Michal VINKLER (*part-time*)

Mgr. Barbora ZEMANOVÁ (*part-time*)

Mgr. Jan ZIMA (*part-time*)

#### Masters students

Hana BAINOVÁ (*part-time*)

Zuzana BAINOVÁ (*part-time*)

Lenka GETTOVÁ (*part-time*)

Andrea HÁJKOVÁ (*part-time*)

#### Technicians

Helena HEJLOVÁ

Mgr. Jana PIÁLKOVÁ (*part-time*)

Ludmila ROUSKOVÁ

Lucie VLČKOVÁ

Mgr. Monika ŠUGERKOVÁ (*part-time*)

## Research Priorities

Studies are performed on both laboratory and natural populations using the most advanced methods of molecular genetics, physiology, behavioural ecology, bioinformatics, etc. Empirical data from observations and experiments, supplemented by simulation modelling, are used to discuss important questions of evolutionary biology, such as (model organisms given in parentheses):

- hybrid zones as barriers against gene flow and their role in speciation (*Mus*)
- wildlife immunology and immunogenetics, host-parasite interactions (*Mus*, passerine birds, African rodents)
- study of factors affecting population structure (fish, bats and mammals)
- links between life history traits, adaptive genetic variation and population dynamics in small mammals (voles)
- phylogeography and reconstruction of historical colonisation of Europe (*Mustela*, bats, rodents) and Africa (mainly murid rodents)
- analysis of reproductive success and social systems by using DNA markers (e.g. parentage analyses in fish, birds, and mammals)
- conservation genetics of endangered vertebrate species, development of non-invasive techniques of DNA sampling and new molecular markers (*Lutra*, *Rupicapra*, *Spermophilus*)
- mechanisms and evolution of thermal physiology traits in ectotherms, predator-prey interaction (*Triturus*), functional approaches in studying morphological adaptations (*Zootoca*, *Triturus*)

The results of these studies are used in preparing recommendations for nature conservation and rodent pest control, and for lecturing at universities in Brno, České Budějovice, Prague, and Olomouc.

## 2. RESEARCH PROJECTS

### | LIST OF PROJECTS

#### Institutional Research Plan

AV0Z60930519 Biodiversity and ecology of vertebrates: implications in conservation and sustainable management of natural populations – Jan Zima 2005–2009, Marcel Honza, 2009–2011.

#### Projects supported by the Grant Agency of the Academy of Sciences of the Czech Republic

- IAA600930605** Evolution of antiparasitic strategies of selected hosts towards avian brood parasitism  
Recipient: Institute of Vertebrate Biology ASCR; Head Investigator: Marcel Honza. Research years: 2006–2010.
- IAA600930609** Genetic structure of chamois populations in Central Europe  
Recipient: Institute of Vertebrate Biology ASCR; Head Investigator: Jan Zima. Research years: 2006–2009.
- IAA600930903** Cues, recognition and responses in a coevolutionary arms race between brood parasites and their hosts  
Recipient: Institute of Vertebrate Biology ASCR; Head Investigator: Marcel Honza. Research years: 2009–2013.
- IAA601410802** Biology of African mole-rats from mesic tropic areas.  
Coordinating recipient: Faculty of Biological Sciences, University of South Bohemia, České Budějovice, Head Investigator: Radim Šumbera. Recipient: Institute of Vertebrate Biology ASCR; Head Investigator: Josef Bryja. Research years: 2008–2011.
- IAA601690901** Ectoparasites associated with mountain birds in Costa Rica: linking ecology, biodiversity and genetics  
Coordinating recipient: Faculty of Veterinary Hygiene and Ecology, University of Veterinary and Pharmaceutical Sciences, Brno, Head Investigator: Ivan Literák. Recipient: Institute of Vertebrate Biology ASCR; Head Investigator: Miroslav Čapek. Research years: 2009–2011.
- KJB600930611** Brood parasitism as an alternative reproductive strategy of ducks: genetically – endocrinological approach  
Recipient: Institute of Vertebrate Biology ASCR; Head Investigator: Radka Piálková. Research years: 2006–2009.
- KJB600930701** Quantitative trait loci (QTL) for male aggression in the house mouse  
Recipient: Institute of Vertebrate Biology ASCR; Head Investigator: Barbora Bímová. Research years: 2007–2009.
- KJB600930802** The European bitterling – endangered or non-native species in Central Europe?  
Coordinating recipient: Institute of Vertebrate Biology ASCR; Head Investigator: Martin Reichard. Research years: 2008–2010.
- KJB600930804** Genetic consequences of population decline in Eurasian otter (*Lutra lutra*) populations in the Czech and Slovak Republics  
Recipient: Institute of Vertebrate Biology ASCR; Head Investigator: Petra Hájková. Research years: 2008–2011.

**KJB601110803** Variation in resource allocation between reproductive phases in waterfowl  
 Coordinating recipient: Faculty of Science, Charles University, Prague; Head Investigator: David Hořák. Recipient: Institute of Vertebrate Biology ASCR; Head Investigator: Tomáš Albrecht. Research years: 2008–2010.

**1QS500450513** Population and genetic structure of brown trout and grayling as groundwork for efficient management of fisheries in salmonid waters  
 Coordinating recipient: Institute of Animal Physiology and Genetics ASCR, v. v. i., Liběchov; Head Investigator: Vlastimil Šlechta. Recipient: Institute of Vertebrate Biology ASCR; Head Investigator: Karel Halačka. Research years: 2005–2009.

## Projects supported by the Czech Science Foundation

**GAP505/10/1871** Toll-like receptors in passerine birds: description, characterisation of polymorphism and evolutionary consequences of allelic variation  
 Recipient: Institute of Vertebrate Biology ASCR; Head Investigator: Josef Bryja. Research years: 2010–2014.

**GA206/09/0589** The diachronic changes of long bone cross-sectional geometry in human prehistoric populations in Central Europe: The biomechanical analysis  
 Recipient: Institute of Vertebrate Biology ASCR; Head Investigator: Vladimír Sládek. Research years: 2009–2011.

**GAP506/10/0983** Comparative phylogeography of the Zambezi region in Southeastern Africa using small mammals as a model  
 Recipient: Institute of Vertebrate Biology ASCR; Head Investigator: Josef Bryja. Research years: 2010–2014.

**GA206/09/0815** Demography, metapopulation dynamics and ecology of *Nothobranchius* fishes in Mozambique  
 Recipient: Institute of Vertebrate Biology ASCR; Head Investigator: Martin Reichard. Research years: 2009–2012.

**GAP506/10/2170** The role of predator-prey interactions in the coadaptation of thermal biology  
 Recipient: Institute of Vertebrate Biology ASCR; Head Investigator: Lumír Gvoždík. Research years: 2010–2013.

**GA206/09/0927** Impact of increased contact with humans on diversity and ecology of protozoan parasites of African great apes  
 Recipient: Faculty of Veterinary Medicine, University of Veterinary and Pharmaceutical Sciences, Brno; Head Investigator: David Modrý. Subrecipient: Institute of Vertebrate Biology ASCR; Head Investigator: Klára Petrželková. Research years: 2009–2011.

**GA206/08/0640** Immunogenetic study of a house mouse hybrid zone  
 Recipient: Institute of Vertebrate Biology ASCR; Head Investigator: Jaroslav Piálek. Research years: 2008–2012.

**GA206/09/1163** Personalities, male mating tactics and role of females in sexual selection: studies on fish model systems  
 Recipient: Institute of Vertebrate Biology ASCR; Head Investigator: Martin Reichard. Research years: 2009–2013.

**GA206/08/1281** Components of sexual selection in the monogamous grey partridge  
 Recipient: Faculty of Forestry, Wildlife and Wood Sciences, Czech University of Agriculture, Prague; Head Investigator: Miroslav Šálek. Subrecipient: Institute of Vertebrate Biology ASCR; Head Investigator: Tomáš Albrecht. Research years: 2008–2012.

**GA524/09/1569** Genetic structure of sika deer populations in the Czech Republic  
 Recipient: Institute of Vertebrate Biology ASCR;

- Head Investigator: Petr Koubek. Research years: 2009–2012.
- GP206/09/P608** Revision of the species structure of the genera *Gobio* and *Romanogobio* in the Eurasian context  
Recipient: Institute of Vertebrate Biology ASCR; Head Investigator: Jan Mendel. Research years: 2009–2011.
- GP206/09/P624** Genetic diversity and phylogeography of the genus *Scotophilus*  
Recipient: Institute of Vertebrate Biology ASCR; Head Investigator: Peter Vallo. Research years: 2009–2011.
- GP521/08/P529** The ecological importance of set-aside and cultivated crops for the small mammals of agrocenosis  
Recipient: Institute of Vertebrate Biology ASCR; Head Investigator: Eva Jánová. Research years: 2008–2010.
- GP524/09/P620** The analysis of the selected immune and physiological parameters in *Carassius gibelio*, a species with different ploidy and atypical reproductive strategy  
Recipient: Institute of Vertebrate Biology ASCR; Head Investigator: Lukáš Vetešník. Research years: 2009–2011.

## Projects supported by the Ministry of Agriculture

- QH71305** Development of new methods of rearing selected promising species for aquaculture using non-traditional technologies.  
Coordinating recipient: Faculty of Fisheries and Protection of Waters, University of South Bohemia, České Budějovice; Head Investigator: Pavel Kozák. Recipient: Institute of Vertebrate Biology ASCR; Head Investigator: Miroslav Prokeš. Research years: 2007–2011.
- QH72075** Rodents as an important factor influencing forest regeneration  
Coordinating recipient: Institute of Vertebrate Biology ASCR; Head Investigator: Miloslav Holmka. Research years: 2007–2011.

## Projects supported by the Ministry of Environment

- SPH2D1/9/07** The biological and ecological requirements of fishes: factors determining the function of fish ladders  
Recipient: Institute of Vertebrate Biology ASCR; Head Investigator: Stanislav Lusk. Research years: 2007–2010.
- SP/2D4/16/08** Filling gaps in knowledge of biology and ecology of Eurasian otter: ecological modelling  
Recipient: ALKA Wildlife, o.p.s.; Head Investigator: Kateřina Poledníková. Subrecipient: Institute of Vertebrate Biology ASCR; Head Investigator: Petra Hájková. Research years: 2008–2010.
- SP/2D4/55/07** Fish biodiversity in the Morava and Dyje confluence area – supporting and stabilisation of rare and endangered species populations  
Recipient: Institute of Vertebrate Biology ASCR; Head Investigator: Karel Halačka. Research years: 2007–2009.
- CZ0072** Rescue programs for Endangered Species  
Provider: EEA/Norway Financial mechanisms, Coordinating Recipient: Ministry of Environment of the Czech Republic, Recipient: Institute of Vertebrate Biology ASCR (sub-project: Genetic structure of freshwater pearl mussel in the Czech Republic); Head Investigator: Josef Bryja. Research years: 2009–2010.

## Projects supported by the Ministry of Education, Youth and Sport

### LC06073 Biodiversity Research Centre

Coordinating recipient: Institute of Systems Biology and Ecology ASCR, v. v. i., České Budějovice; Head Investigator: Pavel Kindlmann. Recipient: Institute of Vertebrate Biology ASCR; Head Investigator: Jan Zima. Research years: 2006–2011.

### LC522 Ichthyoparasitology Research Centre

Coordinating recipient: Faculty of Science, Masaryk University; Head Investigator: Milan Gelnar. Recipient: Institute of Vertebrate Biology ASCR;

Head Investigator: Pavel Jurajda. Research years: 2005–2011.

### 2B08003 Changes of mosquito biodiversity – vectors of pathogenic agents in relationship with weather changeability

Coordinating recipient: Biology Centre ASCR, v. v. i., České Budějovice; Head Investigator: Ivan Gelbič. Recipient: Institute of Vertebrate Biology ASCR; Head Investigator: Jiří Halouzka / Oldřich Šebesta. Research years: 2008–2011.

## International projects

### European Union – 6th Framework Programme

**Integrated project EDEN** (no. 010284-2) Emerging diseases in a changing European environment (coordinated by CIRAD Montpellier, France) – Zdeněk Hubálek, 2004–2009.

**Integrated project MODELKEY** (no. SSPI-CT-2003-511237-2) Models for assessing and forecasting the impact of environmental key pollutants on marine and freshwater ecosystems and biodiversity (coordinated by Umweltforschungszentrum Leipzig – Halle GmbH, Germany) – Pavel Jurajda, 2005–2010.

### European Union – 7th Framework Programme

**ConGRESS** Conservation genetic resources for effective species survival (coordinated by Mike Brufford, School of Biosciences, Cardiff University, UK) – Josef Bryja, 2010–2013.

### Other EU projects

**European Science Foundation Research Networking Programme.** Integrating population genetics and conservation biology: Merging theoretical, experimental and applied approaches (ConGen) – Josef Bryja (member of the steering committee), 2004–2009.

### European Science Foundation Research Networking Programme.

Thermal adaptation in ectotherms: Linking life history, physiology, behaviour and genetics (ThermAdapt) – Lumír Gvoždík (member of the steering committee), 2006–2011.

**VBORNET – European Network for Arthropod Vector Surveillance for Human Public Health** (coordinated by Avia GIS Zoersel, Belgium) – Zdeněk Hubálek

### Bilateral projects

#### National Science Foundation (no. BCS-0642297)

Collaborative research: On the verge of modernity: Post-Pleistocene evolution of the European skeleton. (coordinated by The Johns Hopkins University, USA) – Vladimír Sládek, 2007–2010.

#### National Science Foundation (no. DEB0746560)

Collaborative research: Dynamics of genes in mouse hybrid zones. (coordinated by P. K. Tucker, University of Michigan, USA) – Jaroslav Piálek, 2008–2011.

#### MEB080890 Gastrointestinal ciliates and their role in the digestion of great apes

Provider: Ministry of Education, Youth and Sports of the Czech Republic – bilateral project Czech Republic – Slovakia, Recipient: Institute

of Vertebrate Biology ASCR, v. v. i., Brno; Head Investigator: Klára J. Petrželková. Research years: 2008–2009.

**MEB090802** Conservation genetics of selected vertebrates in the Western Balkans

Provider: Ministry of Education, Youth and Sports of the Czech Republic – bilateral project Czech Republic – Slovenia, Recipient: Institute of Vertebrate Biology ASCR, v. v. i., Brno; Head Investigator: Josef Bryja. Research years: 2008–2009.

#### *Individual projects*

**Leverhulme Trust**, Research project “Host specialisation and host race formation in the European bitterling” (coordinated by University of Leicester, UK) – Martin Reichard, 2007–2010.

**M200930901** Molecular biodiversity inventory of the ichthyofauna of the Czech Republic

Program of Internal Support of the AS CR – International Collaboration Projects (coordinated by Biodiversity Institute of Ontario, Canada) – Jan Mendel, 2009–2011.

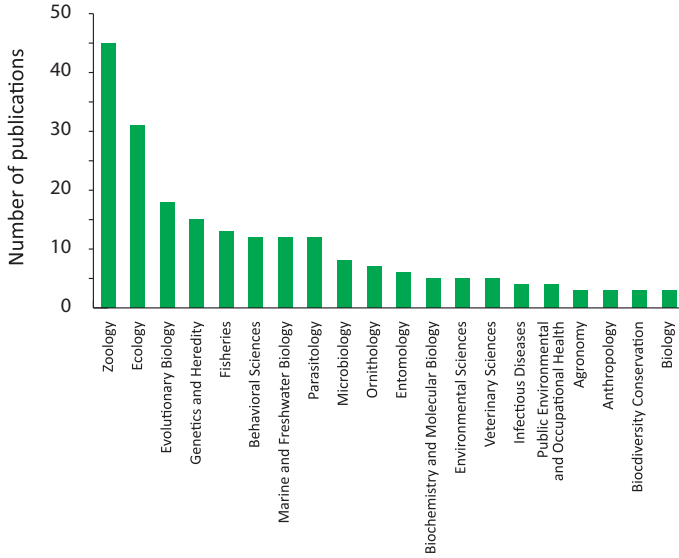
**M200930971** Evolutionary significance of extra-pair paternity in passerines

Program of Internal Support of the AS CR – International Collaboration Projects (coordinated by University of Oslo, National Centrum for Biosystematics, Norway) – Tomáš Albrecht, 2009.

### 3. SCIENTIFIC RESULTS

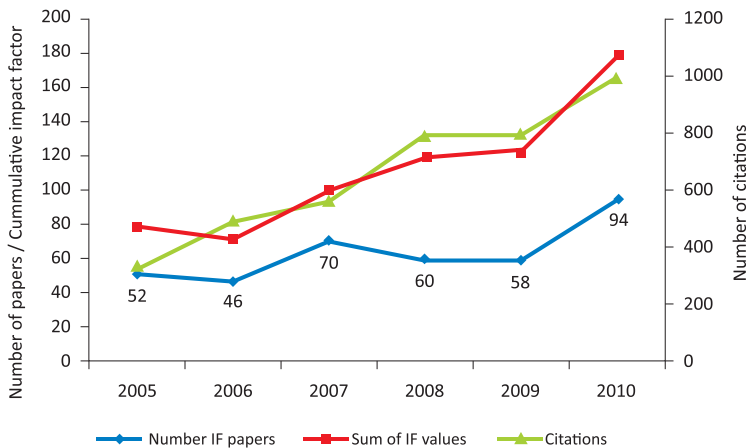
## | SUMMARY OF PUBLICATION OUTPUT

Publication profile of IVB publications over 2009–2010. Categories follow the Web of Science database.



Publication Output

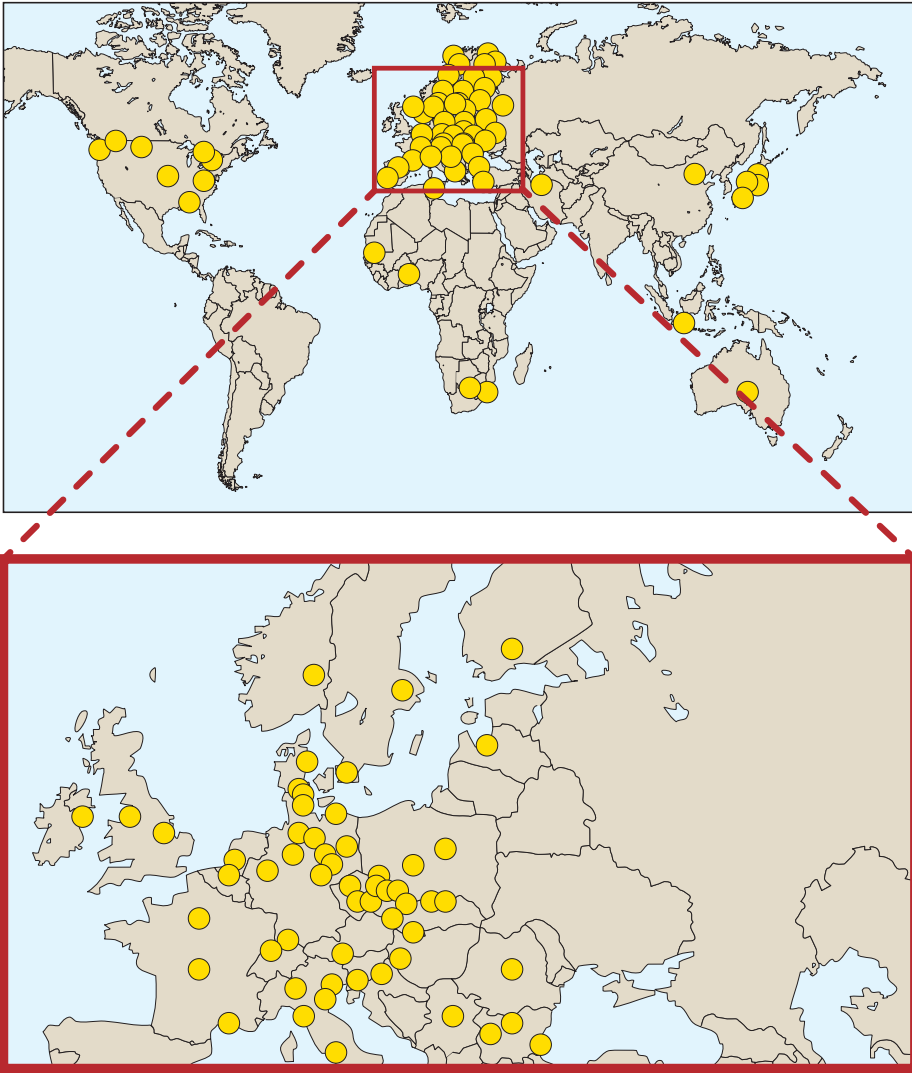
The publication activity of IVB shows an increasing trend in most scientometric criteria over past years.





## International cooperation

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Map of collaborating institutions from ResearcherID – only publications from the Web of Science co-authored by researchers of the IVB for 2009–2010 are included.

## Complete list of publications

### Books, textbooks, edited proceedings

- ANDĚRA M, ANDREAS M, BALVÍN O, BAČKOR P, BARTONIČKA T, BENDA P, BERKOVÁ H, BLÁHOVÁ A, CELUCH M, ČERVENÝ J, DANKO Š, FLOUSEK J, GAISLER J, HANÁK V, HANZAL V, HOFMANNOVÁ A, HORÁČEK D, HORÁČEK I, HULVA P, JAHELKOVÁ H, JÓŽA M, KAŇUCH P, KOVAŘÍK M, LEHOTSKÁ B, LEHOTSKÝ R, LEMBERK V, LUČAN RK, PJENČÁK P, REITER A, ŘEHÁK Z, NOVÁ-SCHMITZEROVÁ P, ŠAFÁŘ J, TÁJEK P, UHRIN M, ZUKAL J, 2010. A tribute to bats. Lesnická práce, Kostelec nad Černými lesy, 400 pp. ISBN 978-80-87154-44-1.
- AULAGNIER S, HAFFNER P, MITCHELL-JONES AJ, MOUTOU F, ZIMA J, 2009. Guía de los mamíferos de Europa, del norte de África y de Oriente Medio. Lynx Edicions, Barcelona, 272 pp. ISBN 978-84-96553-52-1.
- AULAGNIER S, HAFFNER P, MITCHELL-JONES AJ, MOUTOU F, ZIMA J, 2009. Mammals of Europe, North Africa and the Middle East. A&C Black Publishers, London, 272 pp. ISBN 978-1-4081-1399-8.
- AULAGNIER S, HAFFNER P, MITCHELL-JONES AJ, MOUTOU F, ZIMA J, 2009. Die Säugetiere Europas, Nordafrikas und Vorderasiens. Haupt Verlag, Bern, 272 pp. ISBN 978-3-258-07506-8.
- BRYJA J, ŘEHÁK Z, ZUKAL J (eds), 2009. Zoologické dny Brno 2009. ÚBO AV ČR, Brno, 251 pp. ISBN 978-80-87189-03-0.
- BRYJA J, ZASADIL P (eds), 2010. Zoologické dny Praha 2010. ÚBO AV ČR, Brno, 277 pp. ISBN 978-80-87189-07-8.
- ČERVENÝ J, KAMLER J, KHOLOVÁ H, KOUBEK P, MARTÍNKOVÁ N, 2010. Myslivost: Ottova encyklopedie. 2nd rev. ed. Ottovo nakladatelství, Praha, 591 pp. ISBN 978-80-7360-895-8.
- KOVALIK P, PAČENOVSKÝ S, ČAPEK M, TOPERCER J, 2010. Slovenské mená vtákov sveta. SOS/BirdLife Slovensko, Bratislava, 396 pp. ISBN 978-80-970481-0-5.
- KRYŠTUFEK B, AMORI G, MITCHELL-JONES AJ, ZIMA J (eds), 2009. Mammal conservation in Europe: Status and priorities. Folia Zoologica 58: 245–362.

### Chapters in books

- DUPAIN J, NELL C, PETRŽELKOVÁ KJ, GARCIA P, MODRÝ D, PONCE FG, 2009. Gastrointestinal parasites of bonobos in the Lomako Forest, Democratic Republic of Congo. In Huffman M, Chapman C (eds), Primate parasite ecology: the dynamics and study of host-parasite relationships. Cambridge University Press, Cambridge: 297–310. ISBN 978-0-521-87246-1.
- HUBÁLEK Z, 2009. Epidemiology of Lyme borreliosis. In Lipsker D, Jaulhac BB (eds), Lyme borreliosis – biological and clinical aspects. Karger, Basel: 31–50. ISBN 978-3-8055-9114-0.
- SLÁDEK V, LAŠTŮVKOVÁ P, SOSNA D, HORA M, 2010. Martin Maxmilián z Golče, průzkum v hrobce Lorety v Golčově Jeníkově. In Kilián J (ed.), Martin Maxmilián z Golče kolem 1593–1653. Veduta, České Budějovice: 200–207.

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- ADÁMEK Z, JURAJDA P, PRÁŠEK V, SUKOP I, 2010. Seasonal diet pattern of non-native tubenose goby (*Proterorhinus semilunaris*) in the lowland reservoir (Mušov, Czech Republic). *Knowledge and Management of Aquatic Ecosystems* 397: 02.
- ADÁMEK Z, ORENDT C, WOLFRAM G, SYCHRA J, 2010. Macrozoobenthos response to environmental degradation in a heavily modified stream: case study the Upper Elbe River, Czech Republic. *Biologia* 65: 527–536.
- AGBALI M, REICHARD M, BRYJOVÁ A, BRYJA J, SMITH C, 2010. Mate choice for nonadditive genetic benefits correlate with MHC dissimilarity in the rose bitterling (*Rhodeus ocellatus*). *Evolution* 64: 1683–1696.
- ALBRECHT T, VINKLER M, SCHNITZER J, POLÁKOVÁ R, MUNCLINGER P, BRYJA J, 2009. Extra-pair fertilizations contribute to selection on secondary male ornamentation in a socially monogamous passerine. *Journal of Evolutionary Biology* 22: 2020–2030.
- AN J, CHOI S-K, SOMMER J, LOUIS JR E, BRENNEMAN R, ZEMANOVÁ B, HÁJKOVÁ P, PARK G, MIN M-S, KIM K-S, LEE H, 2010. A core set of microsatellite markers for conservation genetics studies of Korean goral (*Naemorhedus caudatus*) and its cross-species amplification in Caprinae species. *Journal of Veterinary Science* 11: 351–353.
- ARSLAN A, ZIMA J, 2010. Banded karyotypes of *Allactaga williamsi* from Central Anatolia. *Turkish Journal of Zoology* 34: 533–537.
- BARANČEKOVÁ M, KROJEROVÁ-PROKEŠOVÁ J, ŠUSTR P, HEURICH M, 2010. Annual changes in roe deer (*Capreolus capreolus* L.) diet in the Bohemian Forest, Czech Republic/Germany. *European Journal of Wildlife Research* 56: 327–333.
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- BENDA P, VALLO P, 2009. Taxonomic revision of the genus *Triaenops* (Chiroptera: Hipposideridae) with description of a new species from southern Arabia and definitions of a new genus and tribe. *Folia Zoologica* 58: 1–45.
- BENEDIKT V, BARUŠ V, ČAPEK M, HAVLÍČEK M, LITERÁK I, 2009. Blood parasites (*Haemoproteus* and microfilariae) in birds from the Caribbean slope of Costa Rica. *Acta Parasitologica* 54: 197–204.
- BERKOVÁ H, ZUKAL J, 2010. Cave visitation by temperate zone bats: effects of climatic factors. *Journal of Zoology* 280: 387–395.
- BÍMOVÁ B, ALBRECHT T, MACHOLÁN M, PIÁLEK J, 2009. Signalling components of the house mouse mate recognition system. *Behavioural Processes* 80: 20–27.
- BRYJA J, GRANJON L, DOBIGNY G, PATZENHAUEROVÁ H, KONEČNÝ A, DUPLANTIER J-M, GAUTHIER P, COLYN M, DURNEZ L, LALIS A, NICOLAS V, 2010. Plio-Pleistocene history of West African Sudanian savanna and the phylogeography of the *Praomys daltoni* complex (Rodentia): the environment/geography/genetic interplay. *Molecular Ecology* 19: 4783–4799.
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## Participation in scientific conferences

- 1st International Symposium on Bat Migration, Berlin, Germany, January 16-18, 2009
- Zoological days, Brno, Czech Republic, February 12-13, 2009
- International Symposium on Improving the Ecological Status of Fish Communities in Inland Waters and EFI + Workshop, Hull, UK, March 31 – April 2, 2009
- 78th Annual Meeting of the American Association of Physical Anthropologists, Chicago, USA, March 31 – April 3, 2009
- 17th Helminthological Days, Vranov nad Dyji, Czech Republic, May 11-15, 2009
- ConGen Conference, Trondheim, Norway, May 23-26, 2009
- Balkans – Hot Spots of Ancient and Present Genetic Diversity, Sofia, Bulgaria, June 17–20, 2009
- 15th Conference of Czech and Slovak Limnological Societies, Třeboň, Czech Republic, June 22-26, 2009
- 6th International Symposium on Monogenea, Cape Town, South Africa, August 2-7, 2009
- 10th International Mammalogical Congress, Mendoza, Argentina, August 9-14, 2009
- 29th IUGB Congress, Moscow, Russia, August 17-22, 2009
- 7th Conference of the European Ornithologists' Union, Zürich, Switzerland, August 21-26, 2009
- 12th ESEB Congress, Turin, Italy, August 24-29, 2009
- MC 2009 – Joint Meeting of Dreiländertagung and 9th Multinational Congress on Microscopy, Graz, Austria, August 30 – September 4, 2009
- 2nd European Congress of Conservation Biology, Prague, Czech Republic, September 1-5, 2009
- 18th Czech and Slovak Plant Protection Conference, Brno, Czech Republic, September 2–4, 2009
- 13th European Congress of Ichthyology, Klaipėda, Lithuania, September 6–12, 2009
- Ecological days, Stará Lesná, Slovakia, September 20–22, 2009
- 7th International Conference on Behaviour, Physiology and Genetics of Wildlife, Berlin, September 21–24, 2009
- 27th Mustelid colloquium, Lisbon, October 18–20, 2009
- 6th River Landscape, Olomouc, Czech Republic, October 21, 2009
- 5th World Conference on Mountain Ungulates, Granada, November 10–14, 2009
- 3rd Conference of the Slovak Plant Health Society, Nitra, Slovakia, November 18–19, 2009
- International Conference on Evolutionary Ecology of Fishes Diversification, Adaptation and Speciation, Berlin, Germany, November 23–25, 2009
- 15th Ferianc's Days, Bratislava, Slovakia, November 26, 2009
- Konferencja Klodzko-Orlicka 2009, Bystrzyca Klodzka, Poland, November 30, 2009
- MODELKEY – How to Assess the Impact of Key Pollutants, Leipzig, Germany, November 30–December 2, 2009
- 60 Years of the Study Programme of the Fishery Specialisation at Mendel University of Agriculture and Forestry in Brno, Brno, Czech Republic, December 2–3, 2009
- Zoological Days, Prague, Czech Republic, February 11–12, 2010
- 4th International Conference on Rodent Biology and Management, Bloemfontein, South Africa, April 12–16, 2010
- Student Research Conference, Bratislava, Slovakia, April 28, 2010
- 18th Helminthological Days, Rožnov pod Radhoštěm, Czech Republic, May 10–14, 2010
- 12th Czech Conference of Ichthyology, Vodňany, Czech Republic, May 19–20, 2010
- 9th Slovak and Czech Parasitological Days, Liptovský Ján, Slovakia, May 24–28, 2010
- 2nd Conference of the European Consortium for the Barcode of Life, Braga, Portugal, June 2–4, 2010
- SEB Annual Main Meeting 2010, Prague, Czech Republic, June 30–July 3, 2010
- 24th Annual Meeting of the Society for Conservation Biology, Edmonton, Canada, July 3–7, 2010
- 12th Rodens et Spatium, Zonguldak, Turkey, July 19–23, 2010
- 7th International Deer Biology Congress, Huilo Huilo, Chile, August 2–7, 2010
- 12th International Congress of Parasitology, Melbourne, Australia, August 15–20, 2010

- 15th International Bat Research Conference, Prague, Czech Republic, August 23–27, 2010
- International Loach Conference 2010, Prague, Czech Republic, August 31–September 3, 2010
- New Directions in Sexual Selection Research, Bath, UK, September 1–4, 2010
- FSAM 2010: Fish Sampling with Active Methods, České Budějovice, Czech Republic, September 8–11, 2010
- 2nd Conference of Nature Conservation, Olomouc, Czech Republic, September 14–17, 2010
- Digital Imaging in Fisheries Biology, Písek, Czech Republic, September 20–23, 2010
- 13th Congress of the International Society for Behavioral Ecology, Perth, Australia, September 26–October 1, 2010
- 3rd European Ground Squirrel Meeting, Ordu, Turkey, September 27–October 1, 2010
- Magdeburg water protection conference, Teplice, Czech Republic, October 4–6, 2010
- 11th Avian Immunology Research Group Meeting, Budapest, Hungary, October 7–10, 2010
- 14th Annual Forum 2000 Conference “The World We Want to Live In”, Prague, Czech Republic, October 10–12, 2010
- 6th International Show Cave Association Congress, Demänovská Valley, Slovakia, October 18–23, 2010
- 16th Ferianc’s Days, Bratislava, Slovakia, December 9–10, 2010
- Speciation 2010, Laxenburg, near Vienna, Austria, December 13–15, 2010

# MOST IMPORTANT SCIENTIFIC ACHIEVEMENTS IN BASIC AND APPLIED RESEARCH

## EVOLUTIONARY ECOLOGY

### (a) Behaviour

#### The role of high-voltage power lines on the magnetic alignment of ruminants

Resting and grazing cattle and deer tend to align their body axes in a geomagnetic North-South direction. The mechanism(s) that underlie this behaviour remain unknown. Here, we show that extremely low-frequency magnetic fields (ELFMFs) generated by high-voltage power lines disrupt the alignment of these animals' bodies to the geomagnetic field. Body orientation of cattle and roe deer was random on pastures under or near power lines. Moreover, cattle exposed to various magnetic fields directly beneath, or in the vicinity of, power lines trending in various magnetic directions exhibited distinct patterns of alignment. The disturbing effect of the ELFMFs on body

alignment diminished with distance from the conductors. These findings constitute evidence for magnetic sensing in large mammals, as well as evidence of an overt behavioural reaction to weak ELFMFs in vertebrates. The demonstrated reaction to weak ELFMFs implies effects at the cellular and molecular levels.

BURDA H, BEGALL S, ČERVENÝ J, NEEF J, NĚMEC P, 2009. Extremely low-frequency electromagnetic fields disrupt magnetic alignment of ruminants. *Proceedings of the National Academy of Sciences of the United States of America* 106: 5708–5713.



High-voltage power lines disrupt alignment of roe deer bodies with the geomagnetic field.

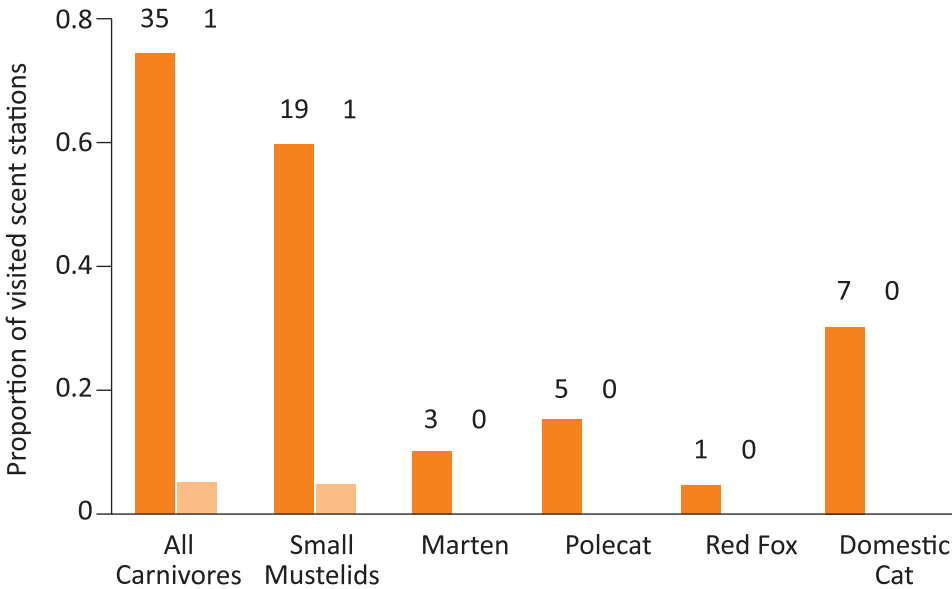
(Photo by J. Červený)

### Nest predation rates, nest predators and birds in mosaic landscapes

Predation on nests affects individual reproductive success and the population dynamics of birds. Identification of factors affecting the behaviour of nest predators and nest predation intensity is crucial for conservation of avian populations. Increased predation pressure along abrupt human-made habitat edges and linear structures occurring in the landscape, such as habitat corridors, is often associated with increased predator activity. Factors affecting predator affinity for these landscape structures, however, remain largely untested. We

the same habitat. Further, the probability of detection was higher in corridors than in the landscape matrix for all carnivore species. Our study suggests that the maintenance of corridors could be an efficient management practice for the preservation of carnivore populations in agricultural landscapes, but may expose bird nests placed near corridors to increased predation pressure. We suggest that an observed shift in the composition of bird communities in relation to roads transecting contiguous forest patches is connected with a potential role

Evolutionary Ecology



Proportion of corridor (dark orange) and hayfield (light orange) scent stations that were visited at least once by a particular carnivore group during the entire experiment. Numbers above the bars indicate the total number of visits for particular species recorded during the experiment.

evaluated the hypothesis that the high prevalence of mammalian predators along habitat edges arises due to increased abundance of their principal prey, small mammals. Through a survey of scent stations, we also evaluated the hypothesis that linear strips (2–12m wide) of shrubby vegetation and dense high grass are more likely to be exploited by diverse carnivore species than surrounding hayfields. Our data provide support for the hypothesis that a high abundance of carnivores in habitat edges is associated with increased numbers of small mammals in

of increased nest predation rates in response to the appearance of these linear structures. Nest predation could also be strongly affected by density of nests and by introduction of alien nest predators. Using artificial nests, we found that nest density was not associated with nest predation intensity in mosaic agricultural landscapes. However, the occurrence of American mink, an introduced species, was associated with nest predation, an increase in nest survival being apparent in transects of riverine habitats where the mink population had been



reduced (adult animals trapped and removed). Our results contribute to a better understanding of the potential role of humans in affecting bird community structure and predator-prey interactions in mosaic landscapes of central Europe.

PADYŠÁKOVÁ E, ŠÁLEK M, POLEDNÍK L, SEDLÁČEK F, ALBRECHT T, 2010. Predation on simulated duck nests in relation to nest density and landscape structure. *Wildlife Research* 37: 597–603.

ŠÁLEK M, KREISINGER J, SEDLÁČEK F, ALBRECHT T, 2010. Do prey densities determine preferences of mammalian predators for habitat edges in an agricultural landscape? *Landscape and Urban Planning* 98: 86–91.

ŠÁLEK M, SVOBODOVÁ J, ZASADIL P, 2010. Edge effect of low-traffic forest roads on bird communities in secondary production forests in central Europe. *Landscape Ecology* 25: 1113–1124.

PADYŠÁKOVÁ E, ŠÁLEK M, POLEDNÍK L, SEDLÁČEK F, ALBRECHT T, 2009. Removal of American mink increases the success of simulated nests in linear habitat. *Wildlife Research* 36: 225–230.

ŠÁLEK M, KREISINGER J, SEDLÁČEK F, ALBRECHT T, 2009. Corridor vs. hayfield matrix use by mammalian predators in an agricultural landscape. *Agriculture, Ecosystems and Environment* 134: 8–13.

### Adaptive capacity of ectothermal vertebrates to climate change

Ectotherms cope with climatic changes using various thermal strategies, including thermoregulatory behaviour, phenotypic plasticity, and thermal sensitivity. The relatively long generation time of many vertebrate species limits their response to fast climatic changes through evolutionary adaptation. Fortunately, they may employ various phenotypic modifications that may reduce extinction risk, either by buffering against selection pressure of the thermal environment (e.g. thermoregulatory behaviour) or by accelerating rates of thermal adaptation (e.g. adaptive thermal acclimation). We examined the non-genetic adaptive capacity of ectotherms to changes in the thermal environment using newts as a model system. Our approach was mainly based on testing predictions of optimality models using factorial experiments that were designed according to temperature variation in the natural habitats of newts. Our results revealed that newts use a particularly complex thermal strategy involving both behavioural and plastic mechanisms, probably resulting from their exposure to diverse selection pressures due to indirect development and a biphasic lifestyle (i.e. aquatic and terrestrial). Diel variation in environmental temperatures was reduced by thermoregulatory behaviour, temperature oviposition preferences, and modifications of diving behaviour. Temperature shifts during embryonic development or during the season were partially compensated for by developmental or seasonal acclimation. Despite



Natural breeding habitat (A) of the Alpine newt, *Ichthyosaura alpestris* (B). (Photos by L. Gvoždík)

a relatively long generation time, newts possess non-genetic capacities that may effectively reduce the adverse effect of fast climatic change on their populations. In addition, their unique thermal strategy makes them an interesting model system for further studies on thermal ecology and impacts of climate change on populations of ectothermic vertebrates.

DVOŘÁK J, GVOŽDÍK L, 2010. Adaptive accuracy of temperature oviposition preferences in newts. *Evolutionary Ecology* 24: 1115–1127.

SMOLINSKÝ R, GVOŽDÍK L, 2009. The ontogenetic shift in thermoregulatory behaviour of newt larvae: testing the “enemy-free temperatures” hypothesis. *Journal of Zoology* 279: 180–186.

## Behaviour of bats

Bats have been used as models for a number of ecological and evolutionary studies. In the first of these, we focussed on the role of climatic factors on activity of bats in a cave. Climatic factors influence not only seasonal, but also night-to-night and overnight patterns in cave visitation. At the same time, seasonal climatic changes, which become more pronounced

DVOŘÁK J, GVOŽDÍK L, 2009. Oviposition preferences in newts: Does temperature matter? *Ethology* 115: 533–539.

ŠAMAJOVÁ P, GVOŽDÍK L, 2009. The influence of temperature on diving behaviour in the alpine newt, *Triturus alpestris*. *Journal of Thermal Biology* 34: 401–405.

MĚRÁKOVÁ E, GVOŽDÍK L, 2009. Thermal acclimation of swimming performance in newt larvae: the influence of diel temperature fluctuations during embryogenesis. *Functional Ecology* 23: 989–995.

ŠAMAJOVÁ P, GVOŽDÍK L, 2010. Inaccurate or disparate temperature cues? Seasonal acclimation of terrestrial and aquatic locomotor capacity in newts. *Functional Ecology* 24: 1023–1030.

at increasing latitudes, require flexible behavioural adjustments of circadian and circannual activity patterns in temperate zone microchiropteran bats. The activity of bats in the Kateřinská cave (Moravian Karst) was significantly influenced by climatic factors over five defined periods. Flight activity during late hibernation was positively affected by mean ambient temperature, and negatively affected by minimal temperature of the preceding day. Similarly, summer activity increased as the range of daily temperature increased, and was suppressed by rainfall during the preceding day. In contrast, a higher amount of rainfall (> 10 mm) during the study day caused an increase in activity. During hibernation, ambient temperature was the best predictor of the general level of activity. The percentage of nights during which activity occurred increased with increasing temperature. Activity occurred even at temperatures of less than 0°C.

Two other studies focussed on two cryptic species, *Pipistrellus pipistrellus* and *P. pygmaeus*. These morphologically indistinguishable species form large hibernating aggregations and display behaviour known as late summer or autumn “invasions”, when flocks of bats enter the cave. It is not known, however, whether these are properties of both or only one of the species. Using a DNA-based identification method, all but four individuals from hibernating sites were identified as *P. pipistrellus*. This means that winter roosts of *P. pygmaeus* remain largely unknown in Central Europe. Similarly, no



Kateřinská cave – a model locality for bat research.  
(Photo by J. Zuka)

*P. pygmaeus* were found in the “invasion” assemblages. Very abundant groups of *P. pipistrellus* in underground hibernacula, and their exclusive occurrence at sites of “invasions”, suggest that roosting behaviour during this time may be species-specific.

In the final study, possible sexual preferences of both *Pipistrellus* species (based on olfactory signals), were studied in a dual choice experiment using a glass Y-maze. Both sexes, without reference to species, performed lower searching activity in tests with urinary scent than with signals composed of facial gland scents. Males of both species were able to discriminate, and showed preference for, the odour of conspecific females, with only a small proportion of disassortative choices. Females of both species did not display species-specific preferences. Absence of female odour preference, and the small proportion of male

disassortative choices, may provide a theoretical background for the existence of inter-species hybridisation, or indicate a more important role for acoustic signals in pre-mating behaviour.

BERKOVÁ H, ZUKAL J, 2010. Cave visitation by temperate zone bats: effects of climatic factors. *Journal of Zoology* 280: 387–395.

BARTONIČKA T, KAŇUCH P, BÍMOVÁ B, BRYJA J, 2010. Olfactory discrimination between two cryptic species of bats *Pipistrellus pipistrellus* and *P. pygmaeus*. *Folia Zoologica* 59: 175–182.

KAŇUCH P, FORNŮSKOVÁ A, BARTONIČKA T, BRYJA J, ŘEHÁK Z, 2010. Do two cryptic pipistrelle bat species differ in their autumn and winter roosting strategies within the range of sympatry? *Folia Zoologica* 59: 102–107.

## (b) Mate choice and social structure

### Mechanisms of sexual selection in fishes

Sexual selection is a powerful process that results in adaptations to maximise reproductive success of an individual over other individuals in a population. Sexual selection, as an extension of natural selection, postulates that not only individual survival, but also production of progeny is a central point in evolutionary theory. We studied mechanisms of sexual selection in a small cyprinid fish, the Chinese rose bitterling *Rhodeus ocellatus*, that lays its eggs onto the gills of freshwater mussels. We have demonstrated that female choice and outcome of male-male competition for best mating opportunities frequently disagree. As a result, females often reproduce with dominant males because they possess the most valuable resources and can exclude other males from reproduction. Using in-vitro fertilisation techniques, we have demonstrated that this situation causes significant costs to females in terms of survival of their progeny. Fertilisation rate, embryo survival and growth rate were considerably higher when a female reproduced with a preferred male. We later identified that female mate choice decisions are likely based on olfactory signals that communicate dissimilarity between partners in a complex of im-

mune genes (MHC). We concentrated on analysis of functional distances between individual MHC genotypes, a step forward from the more traditionally used phylogenetic differences between MHC alleles. Finally, we tested predictions arising from our results in another fish species with a different mating system, the African annual killifish *Nothobranchius korthausae*. We confirmed that there is no benefit to females in mating with dominant males in terms of increased survival of



Female and male bitterling. (Photo by C. Smith)



progeny and that compatibility between mates has considerable consequences for fertilisation and hatching success. We also looked at male-oriented mechanisms of sexual selection and found that male bitterling are flexible in their mating behaviour according to local abundance of females and availability of resources. Notably, we demonstrated that male mating behaviour was more sensitive to crowding, a measure of the number of other fish that a male encounters in competition for a resource, than to fish density itself. Density, especially when measured simply as the number of individuals per unit area, may fail to capture the degree of competition for resources.

AGBALI M, REICHARD M, BRYJOVÁ A, BRYJA J, SMITH C, 2010. Mate choice for nonadditive ge-

netic benefits correlate with MHC dissimilarity in the rose bitterling (*Rhodeus ocellatus*). *Evolution* 64: 1683–1696.

CASALINI M, REICHARD M, SMITH C, 2010.

The effect of crowding and density on male mating behaviour in the rose bitterling (*Rhodeus ocellatus*). *Behaviour* 147: 1035–1050.

CASALINI M, AGBALI M, REICHARD M,

KONEČNÁ M, BRYJOVÁ A, SMITH C, 2009. Male dominance, female mate choice and intersexual conflict in the rose bitterling (*Rhodeus ocellatus*). *Evolution* 63: 366–376.

POLAČIK M, REICHARD M, 2009. Indirect fitness benefits are not related to male dominance in a killifish. *Behavioral Ecology and Sociobiology* 63: 1427–1435.

## Consequences of sexual selection in fishes

Sexual selection has important consequences for populations and individuals. An example of population consequences may be the effect of resource monopolisation by several dominant individuals leading to an overall decrease in the number of offspring produced by the entire population. An individual consequence may be expressed as a trade-off between current ability to reproduce and a decrease in value of some important physiological trait, with potential consequences for other reproductive attempts or survival. We showed that availability of breeding resources (freshwater mussels) was a more important determinant of population-level recruitment in the European bitterling *Rhodeus amarus* than the spatial distribution of the resource. Using the same study population, we further demonstrated that more rapid development of embryos is achieved when eggs are distributed among more resources. This leads to a larger body size of juvenile fish at the end of the growing season, which may have positive consequences for overwinter survival. Using an experiment that spanned a substantial part of the male lifespan, we found that spatial distribution of freshwater mussels (while keeping the density of mussels constant) had a considerable effect on selection on male phenotypic traits. When mussels were positioned in dense clusters we detected strong directional selection on traits associated with competition between males, namely gonad mass (an indicator of sperm competition) and the extent of

red carotenoid-based pigment in the iris (an index of dominance status). In contrast, when mussels were dispersed throughout the experimental basin, only selection on male body size was recorded. A notable extension of this study revealed that male European bitterling are sensitive to sperm limitation. In the case of intensive competition for fertilisation, males had decreased numbers of sperm in their ejaculates. This escalated intersexual conflict over the number of sperm invested in a particular reproductive act and females responded to sperm limitation with specialised behaviour that stimulated males to invest more ejaculate in each clutch of eggs. Finally, we tested the role of sexual selection in reproductive isolation among two distinct populations of African annual killifish. We found that female choice played only a marginal role between isolated island and mainland populations of *Nothobranchius korthausae*, despite a long history of separation (at least 10 thousand years) and distinct colour differences between males from the two populations. In conclusion, we demonstrated that sexual selection has important consequences at both the individual and population level.

KONEČNÁ M, SMITH C, REICHARD M, 2010.

Population and individual consequences of breeding resource availability in the European bitterling (*Rhodeus amarus*). *Behavioral Ecology and Sociobiology* 64: 1069–1079.

REICHARD M, ONDRAČKOVÁ M, BRYJOVÁ A, SMITH C, BRYJA J, 2009. Breeding resource distribution affects selection gradients on male phenotypic traits: experimental study on lifetime reproductive success in the bitterling fish (*Rhodeus amarus*). *Evolution* 63: 377–390.

REICHARD M, POLAČIK M, 2010. Reproductive isolating barriers between colour-differentiated

populations of an African annual killifish *Nothobranchius korthausae* (Cyprinodontiformes). *Biological Journal of the Linnean Society* 100: 62–72.

SMITH C, PATEMAN-JONES C, ZIEBA G, PRZYBYLSKI M, REICHARD M, 2009. Sperm depletion as a consequence of increased sperm competition risk in the European bitterling, *Rhodeus amarus*. *Animal Behaviour* 77: 1227–1233.

## Extra-pair paternity and mechanisms of mate choice in birds

In socially monogamous birds, extra-pair fertilisation (EPF) leads to sperm competition and may intensify the strength of sexual selection. We evaluated the idea that EPF contributes to the evolution or maintenance of male feather ornamentation in a sexually dichromatic passerine, the scarlet rosefinch *Carpodacus erythrinus*. We found that the colouration of ornamental breast feathers was a good predictor of basic sources of variation in male within-pair and extra-pair fertilisation success. The annual realised reproductive success of males was positively associated with measures of ornamental colouration when

however, remains unclear. We propose a new hypothesis based on the handicap principle to explain a link between individual quality and expression of carotenoid-based ornamentation. Rates of extrapair paternity represent a commonly used index for the risk of sperm competition in birds; however, paternity data are difficult to get and exist for only a few percent of the approximately 10,400 extant species.

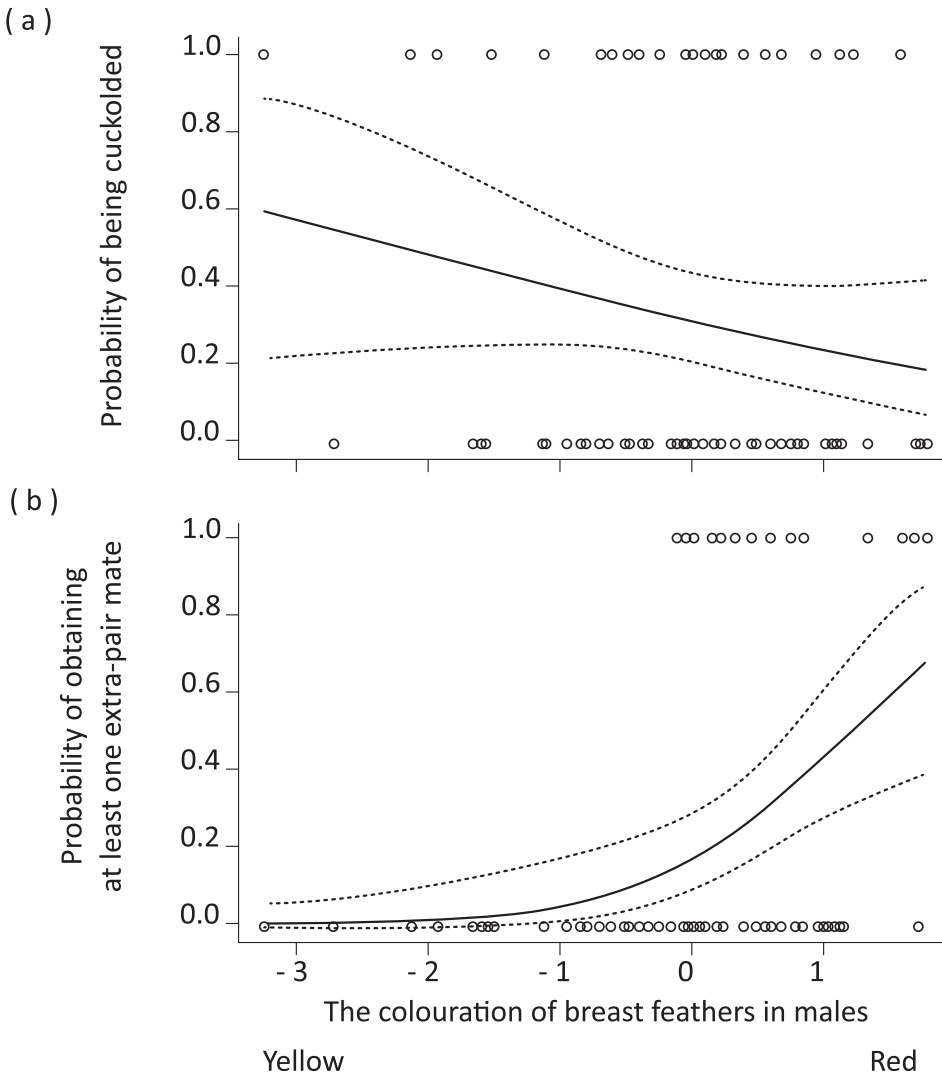
Recent findings from passerine birds suggest that standardised measures of sperm length variation can predict the rate of extrapair paternity. We evaluated this idea using sperm samples from 55 passerine



The scarlet rosefinch is a very suitable model for sexual selection studies due to conspicuous sexual dimorphism and a relatively high proportion of extra-pair fertilisations. (Photo by R. Poláková)

gains and losses because of EPF were considered. Our study corroborates the potentially important role of EPF in the evolution and/or maintenance of elaborate carotenoid-based male ornaments in socially monogamous taxa. The mechanism ensuring the honesty of signalisation by carotenoid pigments,

species from Canada and Europe for which extrapair paternity rates were already available. We found that both the coefficient of between-male variation and within-male variation in sperm length were strong predictors of the rate of extrapair paternity, explaining as much as 65% and 58%, respectively, of the variation



Predicted probability of (a) being cuckolded and (b) obtaining at least one extra-pair mate for rosefinch males as a function of carotenoid-based ornamentation. Dotted lines are 95% confidence limits.

(Original figure from Albrecht et al. 2009)

in extrapair paternity among species. We propose that a new index based on sperm traits holds great potential for mapping the risk of sperm competition across a wide range of passerine and non-passerine birds. While most studies have used passerines as model taxon to study promiscuous behaviour, data from non-passerines are essentially missing. A method based on non-invasive sampling of genetic material

was used to determine the rate of extra-pair paternity in a non-passerine species, the mallard *Anas platyrhynchos*. Extra-pair offspring were detected in 48% of nests and accounted for 9.3% of all offspring. This indicates the frequent occurrence of multiple male mating in waterfowl and also indicates that sperm competition may represent an important mechanism of sexual selection in these birds.

- KREISINGER J, MUNCLINGER P, JAVŮRKOVÁ V, ALBRECHT T, 2010. Analysis of extra-pair paternity and conspecific brood parasitism in mallards *Anas platyrhynchos* using non-invasive techniques. *Journal of Avian Biology* 41: 551–557.
- LIFJELD JT, LASKEMOEN T, KLEVEN O, ALBRECHT T, ROBERTSON RJ, 2010. Sperm length variation as a predictor of extrapair paternity in passerine birds. *PLoS ONE* 5(10): e13456.
- ALBRECHT T, VINKLER M, SCHNITZER J, POLÁKOVÁ R, MUNCLINGER P, BRYJA J, 2009. Extra-pair fertilizations contribute to selection on secondary male ornamentation in a socially monogamous passerine. *Journal of Evolutionary Biology* 22: 2020–2030.
- VINKLER M, ALBRECHT T, 2009. The question waiting to be asked: Innate immunity receptors in the perspective of zoological research. *Folia Zoologica* 58(Suppl. 1): 15–28.

## Mate choice in the house mouse hybrid zone

The traditional view of mating signal evolution suggests that certain features of mate choice signals can be used for species recognition. In theory, only individuals of the same species are able to perform the signal-response sequence necessary to achieve mating, whereas this sequence will not be completed successfully in interspecific pairs. Thus, species-specific mate recognition signals can serve as a significant barrier between diverged genomes, prevent their mixing, and eventually lead to complete speciation. Closely related or recently diverging taxa, where the exchange of genes still occurs and the process of speciation has not yet been achieved, are ideal for studying the role of such divergent signals in behavioural and reproductive isolation during the speciation process. The house mouse represents a unique model to address just such questions. This species is an ideal laboratory animal, with a fully described genome sequence on the one hand and clearly identified natural hybrid zones between

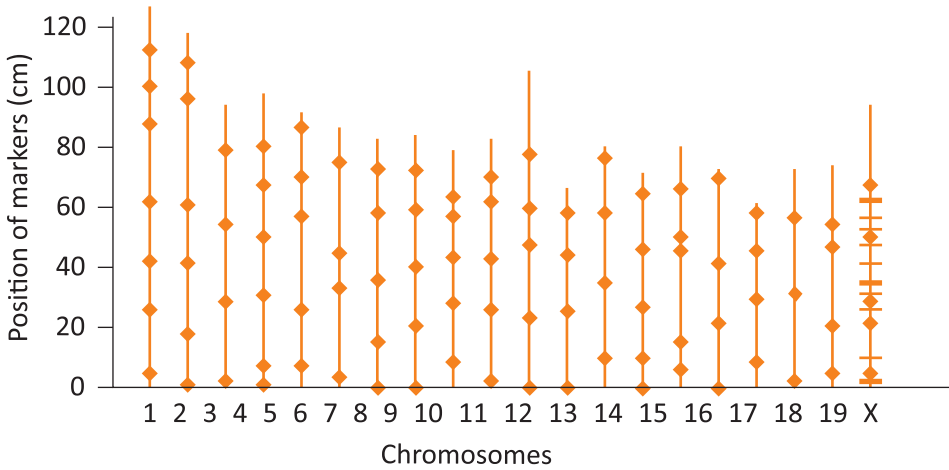
different mouse subspecies on the other. We studied the role of assortative mating leading to behavioural isolation between two subspecies of the house mouse, *Mus musculus musculus* and *M. m. domesticus*, in both natural populations from the Czech-Bavarian transect across their hybrid zone as well as in the laboratory, using wild-derived inbred strains representing both subspecies.

We found a strong divergence in both signalling and preference within the subspecies-specific recognition system between the two subspecies. We analysed the role of different odour cues in species-specific recognition and assortative mating, including bedding, faeces, urinary and salivary proteins, and, specifically, salivary Androgen binding proteins (ABP). Our results revealed that salivary proteins in general, and ABPs in particular, may participate in a complex system of subspecies-specific recognition, probably through transmission of information between interacting animals in close contact. In contrast, long-lasting signals, such as urine and faeces, seem to be more important subspecies-specific indicators, with the former in particular proposed as a “hot candidate” for speciation traits in future studies.

Experimentally designed crosses were used to map quantitative trait loci involved in mating preference in order to facilitate studies on the genetic basis of behavioural isolation barriers. These were used to develop a panel consisting of 106 microsatellite and single nucleotide polymorphism (SNP) markers. The distribution of markers is uniform across all autosomes and the X chromosome (interlocus distance of about 14cM and 5cM, respectively), and the markers provide a high discrimination power between the two mouse genomes.



House mouse in a Y maze used for behavioural tests of sexual preferences. (Photo by R. Mrkvica)



Relative distribution of microsatellite (diamonds) and SNP (bars) markers amplified in strains and wild individuals of house mice. Positions of markers (relative to the centromere located at the bottom of each chromosome) are reported according to the Mouse Genome Informatics (*mgj version 4.01*; [www.informatics.jax.org](http://www.informatics.jax.org)).

BÍMOVÁ B, ALBRECHT T, MACHOLÁN M, PIÁLEK J, 2009. Signalling components of the house mouse mate recognition system. *Behavioural Processes* 80: 20–27.

KAWALCO A, DUFKOVÁ P, WÓJCIK JM, PIÁLEK J, 2009. Polymerase chain reaction multiplexing of microsatellites and single nucleotide polymorphism markers for quantitative trait loci mapping of wild house mice. *Molecular Ecology Resources* 9: 140–143.

### Social structure in subterranean rodents

African mole-rats (Bathyergidae, Rodentia) are highly specialised subterranean rodents that have evolved a wide range of social organisations varying from solitary to eusocial. Much attention has been focused on social species due to unusual features of their breeding and social systems, with solitary species being virtually ignored. For the first time, we have used genetic methods of parentage assignment to study the relatedness of the silvery mole-rat *Heliophobius argenteocinereus*, a solitary mole-rat that was assumed to be monogamous. Microsatellite markers were used to analyse mating system and kinship structure in populations from southern Malawi. Isolation by distance between individuals was apparent in two studied populations, but not in a third, probably as a result of barriers limiting dispersal in the latter population. This population was found to have a polygynous mating system, with a strongly female-biased adult sex ra-



The parents of young silvery mole-rats (*Heliophobius argenteocinereus*) were identified by using hypervariable genetic markers – microsatellites. (Photo by R. Šumbera)



tio. In this case, large distances between the burrow systems of mating partners exclude the possibility of belowground searching for mates, suggesting that males might seek for females aboveground. Interestingly, among the litters analysed from various localities, one multiple-sired litter was found. Our results suggest, therefore, that mating systems in potentially monogamous solitary subterranean ro-

denents may be much more variable than previously expected and can differ among populations.

PATZENHAUEROVÁ H, BRYJA J, ŠUMBERA R, 2010. Kinship structure and mating system in a solitary subterranean rodent, the silvery mole-rat. *Behavioral Ecology and Sociobiology* 64: 757–767.

### (c) Host-parasite coevolution

#### Brood parasitism in birds – a model system for coevolution

Antagonistic adaptations by avian brood parasites and their hosts provide some of the best examples of direct coevolution in nature. Successfully parasitised hosts often raise only cuckoo (*Cuculus canorus*) young and have zero reproductive success. This creates conditions for an escalating coevolutionary arms race between hosts and parasites. Our studies have examined both adaptations of hosts and the counter-adaptations of

parasites. In a series of dummy experiments, we explored nest defence tactics of various hosts, including ducks. We demonstrated that hosts adjust not only their aggressive behaviour, but also subsequent nest attendance according to the type of enemy that appeared at the nest. Further, we found that both pair members either cooperate in aggressive behaviour and egg rejection or each of them maintains a specific role, i.e. the male in



Just hatched cuckoo chick.

(Photo by M. Šulc)

mobbing and nest guarding and the female in egg rejection. Repeated presence of a cuckoo at the nest increased nest defence, but the hosts did not make more recognition errors. Other major adaptations include those related to the parasitic egg. Our studies confirmed that egg type affects mode and timing of egg rejection, and that the essential cues used for egg discrimination are found at the blunt egg pole. In a highly parasitised population, hosts were more likely to tolerate cuckoo eggs in nests with multiple parasitism and, as a result, multiple parasitism more than doubled cuckoos' reproductive output per host nest compared to single parasitism. When all previous lines of defence fail, the last chance for the hosts to defeat brood parasitism is to discriminate against parasitic young. However, we did not find that hosts recognise the nestlings they are caring for; instead, they risk themselves equally for their own and parasitic young while defending the nest against predators. Finally, we investigated whether female cuckoos choose their hosts non-randomly based on external cues reflecting their fostering abilities. Our study revealed that cuckoos parasitise great reed warbler females of higher quality, as reflected in host body condition and egg colour characteristics.

POŽGAYOVÁ M, PROCHÁZKA P, HONZA M, 2009. Adjustment of incubation according to the threat posed: a further signal of enemy recognition in the blackcap *Sylvia atricapilla*? *Journal of Ornithology* 150: 569–576.

POŽGAYOVÁ M, PROCHÁZKA P, HONZA M, 2009. Sex-specific defence behaviour against brood parasitism in a host with female-only incubation. *Behavioural Processes* 81: 34–38.

ČAPEK M, POŽGAYOVÁ M, PROCHÁZKA P, HONZA M, 2010. Repeated presentations of the Common Cuckoo increase nest defense by the Eurasian Reed Warbler but do not induce it to make recognition errors. *Condor* 112: 763–769

POLAČIKOVÁ L, STOKKE BG, PROCHÁZKA P, HONZA M, MOKSNES A, RØSKAFT E, 2010. The role of blunt egg pole characteristics for recognition of eggs in the song thrush (*Turdus philomelos*). *Behaviour* 147: 465–478.

STOKKE BG, POLAČIKOVÁ L, DYRCZ A, HAFSTAD I, MOKSNES A, RØSKAFT E, 2010. Responses of Reed Warblers *Acrocephalus scirpaceus* to non-mimetic eggs of different sizes in a nest parasitism experiment. *Acta Ornithologica* 45: 98–104.

MOSKÁT C, HAUBER ME, AVILÉS JM, BÁN M, HARGITAI R, HONZA M, 2009. Increased host tolerance of multiple cuckoo eggs leads to higher fledging success of the brood parasite. *Animal Behaviour* 77: 1281–1290.

HONZA M, PIÁLKOVÁ R, ALBRECHT T, NEUŽILOVÁ Š, 2009. Nest defence against conspecific intruders in the common pochard *Aythya ferina*: natural observations and an experimental test. *Acta Ornithologica* 44: 151–158.

HONZA M, PROCHÁZKA P, ŠICHA V, POŽGAYOVÁ M, 2010. Nest defence in a cuckoo host: great reed warblers risk themselves equally for their own and parasitic chicks. *Behaviour* 147: 741–756.

POLAČIKOVÁ L, PROCHÁZKA P, CHERRY MI, HONZA M, 2009. Choosing suitable hosts: common cuckoos *Cuculus canorus* parasitize great reed warblers *Acrocephalus arundinaceus* of high quality. *Evolutionary Ecology* 23: 879–891.

## Bitterling-mussel coevolutionary relationship

The relationship between hosts and parasites is often characterised by the rapid evolution of parasite adaptations to exploit the host, and counter-adaptations in the host to avoid being parasitised or to decrease the costs imposed by parasitism. This means that the relationship is dynamic and the current coevolutionary state between a parasite and its host varies during the history of their contact and is related to the frequency with which the two species interact. We studied the unique reciprocal coevolutionary relationship of a fish, the European bitterling *Rhodeus amarus*, and freshwater mussels (Unionidae). Bitterling parasitise freshwater mussels by laying their eggs in the mussel's gills and, in turn, mussel larvae (glochidia) parasitise the skin and gills of fish. First, we used samples from across the current range of the European bitterling to investigate possible scenarios for its colonisation of Europe and found that bitterling populations vary in their history of associations with their hosts (freshwater mussels). Second, we chose populations from areas of recent (Central Europe, Czech Republic) and ancient (Black Sea region, Turkey) sympatry to compare mussel use by bitterling, mussel counter-adaptations to bitterling parasitisation, and ability of glochidia to attach to bitterling. We found that all bitterling from both regions had similar host preferences and avoided one mussel species (*Anodonta cygnea*). Preferences among other mussel species were related to local mussel abundance rather than duration of co-occurrence. Individual fish were not consistent in their oviposition choices, which preclude the evolution of host-specific lineages. Mussels were demonstrated to have evolved strong defences to bitterling parasitism in the area of ancient sympatry in Turkey, but have no such defences in the large areas of Europe where bitterling are currently invasive. Bitterling avoided glochidia infection irrespective of the duration of sympatry. In conclusion, we found that bitterling are parasites of mussel throughout their range, but the ability of freshwater mussels to decrease their rate of parasitisation is extremely low in areas where bitterling have expanded relatively recently.



Bitterling and freshwater mussels are an ideal model system for studies on host-parasite coevolution.  
(Photo by C. Smith)

- REICHARD M, POLAČIK M, TARKAN A, SPENCE R, GAYGUSUZ Ö, ERCAN E, ONDRAČKOVÁ M, SMITH C, 2010. The bitterling–mussel coevolutionary relationship in areas of recent and ancient sympatry. *Evolution* 64: 3047–3056.
- BRYJA J, SMITH C, KONEČNÝ A, REICHARD M, 2010. Range-wide population genetic structure of the European bitterling (*Rhodeus amarus*) based on microsatellite and mitochondrial DNA analysis. *Molecular Ecology* 19: 4708–4722.





## BIODIVERSITY

### (a) Phylogeography and population genetics

#### Cryptic diversity of rodents and bats in Africa and the Middle East

Numerous activities of the Institute over past years have focused on understanding processes leading to the high diversity of small African mammals, especially rodents and bats. To achieve these aims, various genetic markers (sequences of mitochondrial and nuclear DNA, microsatellites, karyotypes, etc.) are combined with morphometric methods. Recent studies have examined rodents of the *Praomys daltoni* complex, which are typical inhabitants of the Sudanian savannah ecosystem in western Africa and represent a suitable model for testing the effects of Quaternary climatic oscillations on extant genetic variation patterns. Phy-

may also have contributed to genetic differentiation, especially by forming barriers after secondary contact of expanding populations. The combination of three types of genetic marker (mtDNA sequences, microsatellite loci, cytogenetic data) for the *P. daltoni* group provides evidence for the presence of up to three lineages, which most probably represent distinct species (though they do not correspond to currently recognised species). Furthermore, incongruence between nuclear and mtDNA markers in some individuals unambiguously points towards a past introgression event. The results thus highlight the importance



High cryptic diversity was found in groups of small mammals from Africa and the Near East.

(A) A murine rodent from the complex *Praomys* cf. *daltoni*.

(Photo by L. Granjon);

(B) Faces of two *Triaenops* morphotypes from Hawf, eastern Yemen: left = morphotype A (= *T. parvus* sp. nov.), right = morphotype B (= *T. persicus* s. str.).

(Photo by P. Benda)

logeographical analyses of mitochondrial DNA sequences (cytochrome *b*) across the distribution range of the complex revealed several well-defined clades that do not support a division of the clade into the two species currently recognised on the basis of morphology, i.e. *P. daltoni* (Thomas, 1892) and *P. derooi* (Van der Straeten & Verheyen, 1978). Rather, the observed genetic structure fits the refuge hypothesis, suggesting that only a small number of populations repeatedly survived in distinct forest-savannah mosaic blocks during the arid phases of the Pleistocene, and then expanded again during moister periods. West African rivers

of combining different molecular markers for an accurate interpretation of genetic data.

In a further study, the monospecific bat genus *Triaenops*, which is distributed across Africa and the Middle East, was revised using morphological and molecular genetic traits of geographically representative samples, including type material. A proposed division of the currently recognised *T. persicus* into three separate species corresponds with the geographically delimited forms of *T. afer* in Africa, and *T. persicus* s. str. and *T. parvus* sp. nov. in the Middle East. Considerable differences in morphology and phylogenetic position also support the

exemption of *T. auritus* and *T. furculus* from Madagascar, and *T. pauliani* from the Seychelles, into a separate genus *Paratriaenops* gen. nov., and the genera *Triaenops* and *Paratriaenops* into a separate tribe Triaenopini within the family Hipposideridae.

BRYJA J, GRANJON L, DOBIGNY G, PATZENHAUEROVÁ H, KONEČNÝ A, DUPLANTIER J-M, GAUTHIER P, COLYN M, DURNEZ L, LALIS A, NICOLAS V, 2010. Plio-Pleistocene history of West African Sudanian savanna and the phylogeography of the *Praomys daltoni* complex

(Rodentia): the environment/geography/genetic interplay. *Molecular Ecology* 19: 4783–4799.

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BENDA P, VALLO P, 2009. Taxonomic revision of the genus *Triaenops* (Chiroptera: Hipposideridae) with description of a new species from southern Arabia and definitions of a new genus and tribe. *Folia Zoologica* 58: 1–45.

## Phylogeography and population genetic structure of small mammals in Europe

Genetic data from the whole distribution range of a species (or species complexes) can provide important information on the history of particular populations, such as colonisation routes, location of glacial refugia, etc. In Europe, the role of Pleistocene glacial cycles on current genetic diversity of organisms is relatively well described; however, there are still many groups of animals whose history for the last two millions years remains obscure. One such group consists of the steppic species, such as the European ground squirrel *Spermophilus citellus*. We sequenced mitochondrial DNA in order to study the phylogeographic architecture of this species with the aim of shedding light on a putative long-term presence of the steppic ecosystem in South-eastern Europe. Three highly divergent phylogenetic lineages (Southern, Northern and Jakupica) were recognised, which suggests the past existence of an allopatric fragmentation event posed by effective biogeographic barriers. The estimated time for divergence of the Southern lineage (cca 0.58 Mya) suggests the long-term persistence of a short-grass steppic refugium in the southern Balkans. Although divergence between the Northern and Jakupica lineages occurred more recently (cca 0.3 Mya), it still putatively predates two glacial cycles. The three phylogeographic lineages of the European ground squirrel, therefore, should be regarded as independent units for conservation management purposes.

Further studies investigated a highly diversified bat group of the *Pipistrellus pipistrellus* species

complex, with a radiation centre in the Mediterranean biodiversity hotspot, through a combination of mitochondrial sequences and nuclear microsatellites with the aim of describing the phylogeography, demography and population structure of this model taxon and address details of its diversification. The study sample comprised 583 animals



The greater mouse-eared bat *Myotis myotis* colonised Central Europe (predominantly from Iberia) following the last glaciation. (Photo: N. Martínková)

from 118 localities representatively covering the bats' range in the western Palearctic. The overall pattern within this group includes a mosaic of phylogenetically basal, often morphologically distant, relatively small and mostly allopatric demes in the Mediterranean Basin, as well as two sympatric sibling species in the large continental part of the range. Southern populations exhibit constant size, whereas northern populations show a demographic growth trend associated with range expansion during the Pleistocene climate oscillations. Although the northern populations are reproductively isolated (with intense intraspecific gene flow over very long distances), we detected introgression events among several Mediterranean lineages. This pattern implies an incomplete establishment of reproductive isolating mechanisms in these populations as well as the existence of a past reinforcement stage in continental siblings. The occurrence of reticulations in the radiation centre among morphologically and ecologically derived relict demes suggests that adaptive unequal gene exchange within hybridising populations could play a role in speciation and adaptive radiation within this group.

Our final study reconstructed the colonisation waves of the greater mouse-eared bat *Myotis myotis* (Borkhausen, 1797) into Central Europe. We confirmed that the spread of the species occurred mainly from the Iberian glacial refugium and we confirmed a decrease in genetic variability from south to north, i.e. during the colonisation wave. We also found a new haplotype, however, that is closely related to sequences from haplogroup D,

previously only described for this species from Greece and Bulgaria. This suggests two possible scenarios. Firstly, that a colonisation route from the Balkan refugium also existed for this species, and, secondly, that the Balkan haplotype entered Central Europe via interspecific hybridisation with *M. blythii*, a species in which haplogroup D is the most frequent in Europe and which is known to have colonised Europe from the south-east.

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BRYJA J, UHRIN M, KAŇUCH P, BÉMOVÁ P, MARTÍNKOVÁ N, ZUKAL J, 2010. Mitochondrial DNA confirms low genetic variation of the greater mouse-eared bats, *Myotis myotis*, in Central Europe. *Acta Chiropterologica* 12: 73–81.

HULVA P, FORNŮSKOVÁ A, CHUDÁRKOVÁ A, EVIN A, ALLEGRINI B, BENDA P, BRYJA J, 2010. Mechanisms of radiation in a bat group from the genus *Pipistrellus* inferred by phylogeography, demography and population genetics. *Molecular Ecology* 19: 5417–5431.

BRYJA J, KAŇUCH P, FORNŮSKOVÁ A, BARTONIČKA T, ŘEHÁK Z, 2009. Low population genetic structuring of two cryptic bat species suggests their migratory behaviour in continental Europe. *Biological Journal of the Linnean Society* 96: 103–114.

## Genetic threats for fragmented populations of mountain mammals

Habitat changes with increasing altitude, driven by changing climatic conditions along mountain slopes. As a result, mountainous environments differ from those in lowlands, creating a mosaic of heterogeneous habitats where lowlands form a dispersal barrier for mountain organisms and habitat heterogeneity contributes to population fragmentation within mountain ranges. We studied the population genetic structure of mountain mammals in order to investigate connectivity between populations with respect to population isolation in different habitat islands in mountains. We chose moun-

tain ungulates and rodents as our model organisms, and we used DNA sequence length variation of microsatellite markers as a genetic print of historical population processes. The chosen species have distribution ranges of various sizes, with and without overlapping. We found that humans strongly influence long-distance gene flow in game species. In Alpine and Pyrenean chamois, *Rupicapra rupicapra* and *R. pyrenaica*, the subspecies occupy different mountain ranges and they are genetically distinct, indicating relatively recent genetic divergence between most taxa. However, we found genetic signals



The Tatra vole *Microtus tatricus* shows limited gene flow between populations.  
(Photo by N. Martínková)

for introductions and translocations between populations with a strong game management record. In rodents, human-mediated translocations might be accidental rather than deliberate, especially in mice or rats, but in mountain rodents, the chance of such events is minimal. Population genetics of Martino's vole *Dinaromys bogdanovi* and the Tatra vole *Microtus tatricus* show that populations are genetically structured, indicating fragmentation, and genetic diversity fluctuates in time in accordance with immigration events. This is more often attributable to male dispersal in the Tatra vole as males travel longer distances.

Population genetic structure of mountain mammals suggests that their conservation exhibits similar challenges to those of island animals. Natural migration is limited in mountains; however, humans play an important role in increasing genetic admixture and assimilation between populations in economically targeted species.

AN J, CHOI S-K, SOMMER J, LOUIS JR E, BRENNEMAN R, ZEMANOVÁ B, HÁJKOVÁ P, PARK G, MIN M-S, KIM K-S, LEE H, 2010. A core set of microsatellite markers for conservation genetics studies of Korean goral (*Naemorhe-*

*dus caudatus*) and its cross-species amplification in Caprinae species. *Journal of Veterinary Science* 11: 351–353.

BUŽAN EV, KRYŠTUFEK B, BRYJA J, 2010. Microsatellite markers confirm extensive population fragmentation of the endangered Balkan palaeoendemic Martino's vole (*Dinaromys bogdanovi*). *Conservation Genetics* 11: 1783–1794.

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## (b) Population biology

### Biology of African annual fishes

African annual killifish of the genus *Nothobranchius* (Nothobranchiidae, Cyprinodontiformes) have a unique life history that makes them a valuable biological model. The total lifespan of particular species and populations varies between 3 and 12 months, and one species, *N. furzeri*, represents the vertebrate species with the shortest lifespan. This

has led to its use as a model species in ageing research. So far, research on ageing has been largely dependent on experiments using invertebrate species such as *Caenorhabditis elegans* or *Drosophila melanogaster*. Laboratory mice and rats have also been used, but their long lifespan constitutes a serious methodological impediment as research on



ageing requires the observation of an individual from its birth to death. Furthermore, most laboratory strains used in ageing research possess malfunctioned physiology that restricts viability. Research then aims to circumvent the negative consequences of such targeted malfunctions that mimic age-related disorders. In *Nothobranchius* fishes, the short lifespan has evolved under natural selection, along with all trade-offs between individual functions. In the first step of our research into this group of animals, we attempted to describe their biology in the wild. *Nothobranchius* survive the dry season as eggs buried in the sediment and hatch during the rainy season. They grow very quickly and become sexually mature within a few weeks. We analysed the habitat of *N. furzeri* (the model species in ageing research) and two other *Nothobranchius* species that co-occur with *N. furzeri*. We characterised the natural diet of those species along with other characteristics of their ecological niche. Finally, we mapped their distribution in southern and central Mozambique and produced the first demographic analyses. We found that populations of all three study species were much more abundant than previously believed and highlighted the fact that field work must be held during the rainy season as most populations diminish at the end of the rain. Despite their abundance, annual fishes are vulnerable to changes in the ecosystem connected with human intervention. Indeed, their diversity is still largely unexplored and we discovered a new species of killifish during our research in central Mozambique. We have also initiated a call to reconsider the use of one species of annual killifish as a bio-

control of aquatic mosquito larvae in endemic malaria areas in Africa. Planned human-assisted distribution of a non-native *Nothobranchius* species (from the island of Zanzibar) throughout Africa has a range of potentially negative impacts on other *Nothobranchius* species. As annual killifish already inhabit most areas where populations are viable, we argued that the distribution of an alien species throughout Africa would have no effect on malaria mosquito abundance and may only benefit a small group of people with economic interests in the distribution of the target species.

POLAČIK M, REICHARD M, 2010. Diet overlap among three sympatric African annual killifish species (*Nothobranchius* spp.) from Mozambique. *Journal of Fish Biology* 77: 754–768.

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REICHARD M, POLAČIK M, SEDLÁČEK O, 2009. Distribution, colour polymorphism and habitat use of the African killifish, *Nothobranchius furzeri*, the vertebrate with the shortest life span. *Journal of Fish Biology* 74: 198–212.

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*Nothobranchius kadleci*, sp. nov.  
(Photo by O. Sedláček)



## Ecology and parasites of invasive gobies

Invasion success is often connected with phenotypic plasticity, competitiveness of the invasive species or parasite/predator release. Recently, a number of goby fish species (Gobiidae) have spread beyond their original Ponto-Caspian range and successfully invaded various river systems within and outside Europe. We investigated three of the goby species in their native range (the lower River Danube) and within their range of introduction (the middle Danube river basin). Invasion success of non-native bighead goby *Neogobius kessleri* and round goby *N. melanostomus* populations was related to better somatic condition and faster growth as a result of

suggesting a potential important regulator of goby population density in the range of introduction. Parasitological examination indicated a reduced parasite infection load in introduced *N. melanostomus* may have contributed to the higher invasiveness of this species. A tendency to reduced parasite intensity in the non-native range was also found for *N. kessleri*. A high susceptibility to local parasites, however, prevented the bighead goby from taking advantage of parasite loss during the introduction process. The importance of gobies as an intermediate or paratenic host was documented in both ranges. Interestingly, introduced gobies appear to be suitable hosts for invasive parasites (*Anguillicoloides crassus*, *Anodonta woodiana*) introduced into the middle Danube independently of gobies and, therefore, represent an important factor in the dispersal of these parasites.



Cooperative parasitological survey of gobies in the Institute of Zoology of the Bulgarian Academy of Sciences in Sofia (left to right: M. Ondračková, M. Dávidová, T. Trichkova). (Photo by R. Blažek)



Bighead goby *Neogobius kessleri* predating a large specimen of racer goby *N. gymnotrachelus*. (Photo by J. Huml)

significantly higher prey availability in the area of introduction compared to their native range. Consumption of a combination of both amphipods and less nutritious molluscs was recorded in the native *N. melanostomus* population, despite a strong preference for amphipods confirmed experimentally. The results show that molluscs represent an alternative prey within the native range of the round goby, rather than a preferred prey as indicated by studies in North America. Diet analysis in the non-native range showed a clear preference for amphipods by both *N. kessleri* and *N. melanostomus*, and for chironomids and the crustacean *Asellus aquaticus* by the tubenose goby *Proterorhinus semilunaris*. The occurrence of cannibalism was documented in all three goby species, though to varying degrees,

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ONDRAČKOVÁ M, DÁVIDOVÁ M, BLAŽEK R, GELNAR M, JURAJDA P, 2009. The interaction between an introduced fish host and local parasite fauna: *Neogobius kessleri* in the middle Danube River. *Parasitology Research* 105: 201–208.

ADÁMEK Z, JURAJDA P, PRÁŠEK V, SUKOP I, 2010. Seasonal diet pattern of non-native tubenose goby (*Proterorhinus semilunaris*) in the lowland reservoir (Mušov, Czech Republic). *Knowledge and Management of Aquatic Ecosystems* 397: 02.

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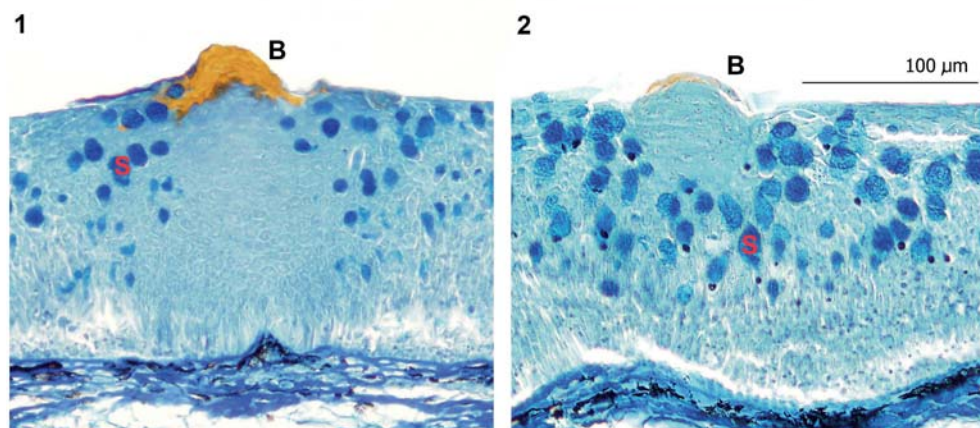
SLOBODA M, MIHALCA AD, FALKA I, PETRŽELKOVÁ KJ, CARLSSON M, GHIRA I, MODRÝ D, 2010. Are gobiid fish more susceptible to predation if parasitized by *Eustrongylides excisus*? An answer from robbed snakes. *Ecological Research* 25: 469–473.

## Morphology of fishes

Morphological (meristic and morphometric traits), karyological and molecular (microsatellites, cytochrome *b*) analyses were performed to characterise a hybrid of the roach *Rutilus rutilus* and nase *Chondrostoma nasus*. Meristic and morphometric traits were different between the hybrid and both parental species. The number of chromosomes found in the hybrid specimen indicated that this individual represents the post-F1 generation of hybrids, while microsatellite analysis showed the presence of variants typical for *R. rutilus* and *C. nasus*.

alternatively to higher parasite infection or immunosuppression during spawning.

Skin histology from the Danubian spined loach *Cobitis elongatoides* suggests that the hypothesis that spawning marks (lighter spots on the sides of the female body) are the result of physical damage to the epidermis by a male during spawning is not true. Physiological changes that induce a specific local decrease in lateral pigmentation in some individuals appears to be a more likely source.



Breeding tubercles (B) in the epidermis of *Carassius gibelio* during the spawning period. 1 – diploid male, 2 – triploid female, S – goblet secretory cells; Image produced using Mallory's trichrome stains and Alcian blue.

(Photo by K. Halačka)

A reduction in epidermal club cells and an increase in goblet cells were found in *Carassius gibelio* during spawning when compared to post-spawning. A significantly lower proportion of club cells at spawning were found in diploid males and triploid females than in diploid females. This could be linked to male efforts to avoid a fright reaction and the potential adoption of this strategy by gynogenetic females, or

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HALAČKA K, VETEŠNÍK L, PAPOUŠEK I, MENDEL J, ŠIMKOVÁ A, 2010. The epidermal structure of *Carassius gibelio*: a link with ploidy status in spawning and postspawning periods. *Journal of Fish Biology* 77: 2171–2179.



Hybrid of roach *Rutilus rutilus* and nase *Chondrostoma nasus*.

(Photo by L. Vetešník)

## (c) Community structure

### Ecology of 0+ juvenile fish communities

The Department of Fish Ecology has a long-term interest in the ecology of floodplain fishes, including their natural reproduction, resource partitioning, habitat use and methodological aspects of their sampling.

In lowland rivers and their floodplains, it is always problematic to find methods that provide accurate estimates of fish communities. For example, representative sampling of adult fish in larger lowland rivers is almost impossible. Small closed floodplain borrow pits should, in theory, provide simple conditions for the sampling of adult fish assemblages. Our results, however, show that none of the conventional methods (i.e. electrofishing, beach seining) provide an unbiased picture of adult fish assemblages at these localities, and that labour-intensive whole lake seining also suffers from biases caused by fish escaping from the sides of the haul. For accurate estimation of adult fish assemblages in floodplain oxbows, it is necessary to combine different sampling methods or standardise conventional sampling methods. To address these problems, we have increasingly focused our attention on sam-

pling of the 0+ fish assemblage, which frequently corresponds with the adult fish community and stream condition.

A six-year study of the natural reproduction of fishes in floodplain borrow-pits at the confluence of the Rivers Morava and Dyje has indicated that recruitment is positively affected by several months of flooding in the meadows surrounding the pits. The suitability of these man-made substitute biotopes for fish reproduction is a result of both the hydrological regime and the geomorphology of the pits, e.g. slope of bank and absence-presence of vegetation.

A methodological study was undertaken to describe bias in 0+ juvenile assemblage catches due to “fright bias” caused by the presence of the sampler. Based on video recording, we analysed the reaction of 0+ fish to three different electrofishing sampling methods (hand operated anode, thrown anode and prepositioned anode) on sand-gravel beaches. A prepositioned anode appears to be the most suitable point-abundance- electrofishing sampling technique for the sampling of 0+ fish assemblages on river beaches and, if time consump-

tion could be reduced, it would also be the most suitable for monitoring surveys in general.

The adult fish community of a river is an important factor in the evaluation of the ecological status of rivers, as required under the Water Framework Directive of the EU. Historically, rivers of the Czech Republic have been stocked with a wide range of fish species (about 52% of species) and this will affect the composition of samples. In our study, we suggest the use of 0+ juvenile fish assemblages as an alternative to adult assemblages and argue the advantages of 0+ fish sampling (e.g. representative samples from large rivers, easy catchability, and quicker reflection of habitat changes).

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KONEČNÁ M, JURAJDA P, REICHARD M, 2009. River discharge drives recruitment success of the European bitterling *Rhodeus amarus* in a regulated river in central Europe. *Journal of Fish Biology* 74: 1642–1650.

RYŠAVÁ-NOVÁKOVÁ M, ONDRAČKOVÁ M, JURAJDA P, 2009. The importance of surrogate habitats in lowland river floodplains for fish community composition. *Fisheries Management and Ecology* 16: 468–477.

## Consequences of anthropogenic changes on rodent communities in Western Africa

Expansion of human activities in the Sudanian savannah is changing natural habitats, together with their animal communities. The abundance and diversity of small mammal communities were investigated, using well-designed sampling schema, in human-influenced savannahs in close

proximity to the Niokolo Koba National Park (NKNP) in south-eastern Senegal and compared with those from the NKNP. Two localities were sampled in both natural and human-influenced areas during two dry and two rainy seasons. Total sampling effort represented 5,400 trap-nights.



Sudanian savannah is significantly altered by human activities.

(A) Savannah in the Niokolo Koba National Park and (B) habitats outside the park (a small cotton field).

(Photo by J. Červený)

The abundance of rodents in Sudanian savannah was, in general, very low. Ninety-eight individuals of eleven rodent species were captured outside the NKNP, while only 28 individuals of five species were caught inside the park (all of which were also found outside the NKNP). The most abundant species outside the NKNP was *Mastomys erythroleucus*, while inside the NKNP it was *Praomys daltoni*. Both relative abundance and diversity were significantly higher in human-influenced landscapes than in the natural savannahs of the NKNP. The difference in species richness may be linked with lower population densities of certain species in the NKNP and the effect of traditional agriculture, which may support the presence of species typical for a deforested landscape. In addition,

food availability and abundance of predators are also among possible reasons for the higher rodent abundance outside the NKNP.

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KONEČNÝ A: *Consequences of anthropogenic changes on rodent communities and populations: study cases on native and introduced species in Eastern Senegal*. PhD dissertation, Institute of Vertebrate Biology AS ČR, Brno, Masaryk University in Brno, and Université Montpellier II.

## DISEASE ECOLOGY

### (a) Microbial pathogens

#### *Mosquito-borne diseases*

As part of the EDEN FP6 European Research Program, six viral isolates were obtained from 23,243 female mosquitoes collected along the lower reaches of the River Dyje in Southern Moravia (Czech Republic): 5 isolates of *Orthobunyavirus* Ťahyňa (TAHV, 3 isolations from *Aedes vexans*, 1 from *A. sticticus*, 1 from *Culex modestus*), and 1 isolation of *Flavivirus* West Nile (WNV, lineage



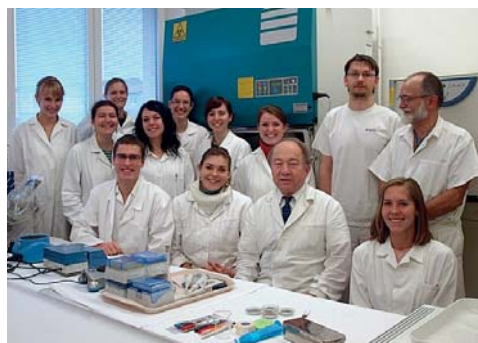
Examination of a tube cell culture.

(Photo by M. Nováková)

Rabensburg, from *A. rossicus*). The mosquito collections were carried out using CDC light traps with CO<sub>2</sub> and pigeon-baited traps. Two study sites were established, the first at the Nesyt fishpond and the second in the Soutok region. The results showed marked differences in abundance and mosquito species composition between both study site and trapping method. *A. vexans* predominated in the floodplain-forest ecosystem of the Soutok study area, while species composition at the fishpond study site was more varied, the most common species being *C. pipiens*. At the latter study site, *Anopheles hyrcanus* (var. *pseudopictus*) and *Uranotaenia unguiculata* were also repeatedly found, these being mosquito species with a largely southern Eurasian distribution. These species have possibly moved into the region as a result of climate change. The largest capture of mosquitoes was in CO<sub>2</sub> traps placed 1 m above ground level.

Capture of mosquitoes in pigeon-baited traps or in CO<sub>2</sub> traps placed in the tree canopy was markedly less effective at both study sites, the predominant species caught being *C. pipiens*.

A total of 178 free-living birds (14 spp.) in a freshwater reed swamp habitat in southern Moravia were examined for haemagglutination-inhibiting (HI) antibodies to *Alphavirus* Sindbis (SINV), bunyaviruses TAHV and Batai (BATV). Antibodies were detected for all three viruses in 0.7% (SINV), 14.0% (TAHV) and 6.8% (BATV) of the birds. The survey indicated circulation of both TAHV and BATV in the area, but no SINV



Laboratory training of Masaryk University students in the Department of Medical Zoology.

(Photo by M. Nováková)

activity.

Three reviews on mosquito-borne viruses have been published in collaboration with Austrian, Italian, Hungarian and Romanian virologists: „Zoonotic mosquito-borne flaviviruses“, „Epidemiology of West Nile in Europe and in the Mediterranean Basin“, and „Public health importance of mosquito-borne viruses in Europe“. To date, eight mosquito-borne viruses pathogenic for man have been reported in Europe, five of them autochthonous (Sindbis, West Nile, Ťahyňa, Inkoo, Batai), and three allochthonous – occasionally introduced (Chikungunya, dengue, yellow fever).



However, mosquitoes in Europe may also transmit additional, non-viral human diseases such as dirofilariosis and malaria. Epidemiological surveillance of diseases transmitted by mosquitoes, therefore, is recommended for Europe.

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### Tick-borne diseases

Ixodid ticks, being vectors of many pathogens, represent a significant health risk for many vertebrate species, including humans. A total of 151 bacterial isolates were recovered from field-collected ticks (*Ixodes ricinus*, *Dermacentor reticulatus*, *Haemaphysalis concinna*) and identified by means of 16S rRNA gene sequencing. Several species of medical importance were found.

We tested the *in vitro* effect of salivary gland extract from fed *I. ricinus*, the competent vector of



Preparation of PCR in the molecular laboratory.  
(Photo by M. Štreitová)



Collection of ixodid ticks by flagging in a forest habitat.  
(Photo by M. Nováková)

Lyme borreliosis (LB) in Europe, on the growth of *Borrelia burgdorferi*. Salivary gland extract caused a marked stimulation in the growth of borreliae. This result confirmed the substantial role of salivary glands in the pathogen transmission mechanism to the vertebrate host.

*Ixodes ricinus* ticks were collected from two slag heaps (waste rock) from coal mines in the Ostrava region and examined for borreliae. Surprisingly, the results suggested that slag heaps, when covered by woody vegetation and frequented by humans, could theoretically pose roughly the same LB transmission risk to humans as common forest biotopes.

Sera of 642 wild boars *Sus scrofa* from ten administrative regions of the Czech Republic were examined by indirect haemagglutination assay for the presence of anti-Borrelia IgG. Antibodies were detected in serum samples from all 10 regions, the overall seroprevalence rate reaching 12.8%. The study highlights the importance of wild boar in LB ecology.

In another study, blood sera collected from 400 domestic animals in north-eastern Hungary were screened for antibodies against TBE flavivirus and Bhanja bunyavirus. Seropositivity rate to TBE virus was 26.5% in cattle, 7.0% in sheep, and 0.0% in horses.

Epidemiological studies carried out within the European EDEN project (FP6) explored the increasing incidence of human TBE cases in Europe over recent years. Explanations for the dynamics of tick-borne disease systems usually focus on changes in the transmission potential in natural enzootic cycles. Recent analyses, however, have revealed that variation in human activities affecting the degree of human exposure to these natural cycles are a very important factor as regards the incidence of TBE in humans.

An up-to-date review of LB epidemiology was prepared as a chapter for a book "Lyme Borreliosis – Biological and Clinical Aspects" (Published by Karger).

Bhanja bunyavirus is a neglected arbovirus pathogenic for young domestic ruminants and also for humans. A comparative biogeographic study of eight known natural foci of Bhanja virus infections in Europe has revealed their common features. Based on this comparative analysis, predicted new areas for Bhanja virus distribution in Europe have been identified as Greece, southern

France, Albania, Spain, Hungary, Turkey, southern Ukraine, southern Switzerland, south-eastern Austria, southern Germany, Moldova, and southern European Russia.

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## Rodent-borne diseases

Small mammals from a rural landscape in southern Moravia (Czech Republic) were investigated for the presence of the Hantavirus Tula (TULV) antigen. In total, 1,566 individuals from 10 species were examined. The antigen prevalence in 871 common voles *Microtus arvalis*, the main reservoir of TULV, was 10% and increased with increasing population density. The highest number of TULV antigen-positive common voles was found in set-aside plots and winter crops such as rape and winter wheat, i.e. habitats important for overwintering of voles. Older individuals were more often infected than young voles. Further, 186 pygmy field mice *Apodemus uralensis* were also examined, of which 3 proved positive (this represents the first positive hantavirus antigen record for this species), while only 1 of 195 wood mice *A. sylvaticus* proved positive. The remaining five rodent species (*A. flavicollis*, *Mus musculus*, *Microtus minutus*, *Myodes glareolus*, and *Microtus subterraneus*) and two insectivore species (*Sorex araneus*, *S. minutus*) were all negative.

Two very similar staphylococcal strains were isolated in the Czech Republic from viscera of common voles with generalised *Brucella microti* infection. A detailed characterisation undertaken through ribotyping (EcoRI and HindIII), rpoB and hsp60 gene sequencing, whole-cell protein analysis and rep-PCR using the (GTG)<sub>5</sub> primer, distinguished the two strains from all valid staphylococci descriptions, and DNA-DNA hybridisation from the closest phylogenetically related species *Staphylococcus muscae* (only 26.75% similarity). The strains analysed are coagulase-negative, novobiocin-susceptible, oxidase negative, and are very closely related phenotypically. The major fatty acids were iso-C15:0, iso-C17:0, anteiso-C15:0, and unsaturated C-18:2w6,9c/ ante-C18:0 and C-18:1w9c. MK-7 represented the predominant isoprenoid quinone. The two isolates represent a novel species with the proposed name *Staphylococcus microti*.

Lung tissue of 156 rodents of the genera *Apodemus*, *Myodes*, *Microtus* and *Muscardinus* from the Czech Republic, 29 *Spalax ehrenbergi* from Israel and 106 rodents from Africa (genera *Heliophobius*, *Mastomys*, *Acomys*, *Aethomys*, *Saccostomus*, *Tatera*, *Mus*, *Cryptomys*, *Dasyms*, *Dendromus*, *Grammo-*

*mys* and *Steatomys*) were examined for the presence of adiaspores of the fungal genus *Emmonsia*. In the Czech Republic, 9 (5.8%) animals (*A. flavicollis*, *M. glareolus* and *Microtus agrestis*) proved positive for adiaspores of *E. crescens*. *Apodemus flavicollis* was the most frequently infected species, whereas *A. sylvaticus*, *M. subterraneus* and *Muscardinus avellanarius* proved negative. All lung samples of rodents from Africa and Israel proved negative.

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## Coronaviruses in African bats

Several coronaviruses (CoV) exist worldwide that cause severe infections in humans. These mainly affect the respiratory system (e.g. hCoV-229E, which causes the human cold) and can even be responsible for serious international issues (e.g. the recent SARS epidemic). Studies conducted in the aftermath of the SARS epidemic have identified CoV in bats and implicated this mammalian order as the most likely reservoir for most known coronaviruses. The study of bats as regards CoV is, therefore, highly relevant in terms of diversification, host restriction, virus prevalence, risk of exposure, and the circumstances of past host transition events. Several serological studies have demonstrated that African bats have anti-CoV antibodies and, in recent years, CoV has also been identified in bats by DNA sequencing. In our study of CoV in Ghanaian bats, we tested 12 fruit bat and micro bat species from two different caves, a lake



Coronaviruses may cause severe infections in humans. It is important, therefore, to respect appropriate safety rules when sampling, especially in the tropics.

(Inset) Peter Vallo sampling bats in western Central Africa. (Main photo) African collaborators capturing bats with a mist-net. (Photos by P. Vallo)

habitat of diverse insectivorous bats, and a large urban fruit bat roosting site using a non-invasive sampling technique. Virus prevalence in insectivorous bats ( $n=123$ ) was 9.76%. CoV was detected in 212 faecal samples from *Eidolon helvum* fruit bats, while leaf-nosed bats morphologically related to *Hipposideros ruber* had both group 1 and group 2 CoV (concentration  $<45,000$  copies/100 mg of bat faeces). The diverse group 1 CoV shared a common ancestor with the human common cold virus hCoV-229E but not with hCoV-NL63, disputing the hypothesis of common human descent. The most recent common ancestor of hCoV-229E and group 1 CoV existed in 1686–1800 AD. The group 2 CoV shares an ancient ancestor (2,400 years) with the SARS-like group of CoV.

In a further study, we evaluated CoV in rhinolophid and vespertilionid bat species common in Europe. Rhinolophids were shown to carry a CoV distantly related to the agent of SARS at high frequencies and concentrations, as well as two *Alphacoronavirus* clades. Three other CoV clades present in *Miniopterus* bats in China were also present in European *Miniopterus*. An additional novel *Alphacoronavirus* clade was detected in *Nyctalus leisleri*.

A CoV grouping criterion was developed by comparing amino acid identities across an 816-bp fragment of the RNA-dependent RNA polymerase for all accepted mammalian CoV species. Strict associations with host bat genera were confirmed for six independent CoV groups represented simultaneously in China and Europe. A SARS-related virus from a Bulgarian specimen of *Rhinolophus blasii* was fully sequenced. These studies underline the importance of assessments of the zoonotic potential of widely distributed bat-borne CoV.

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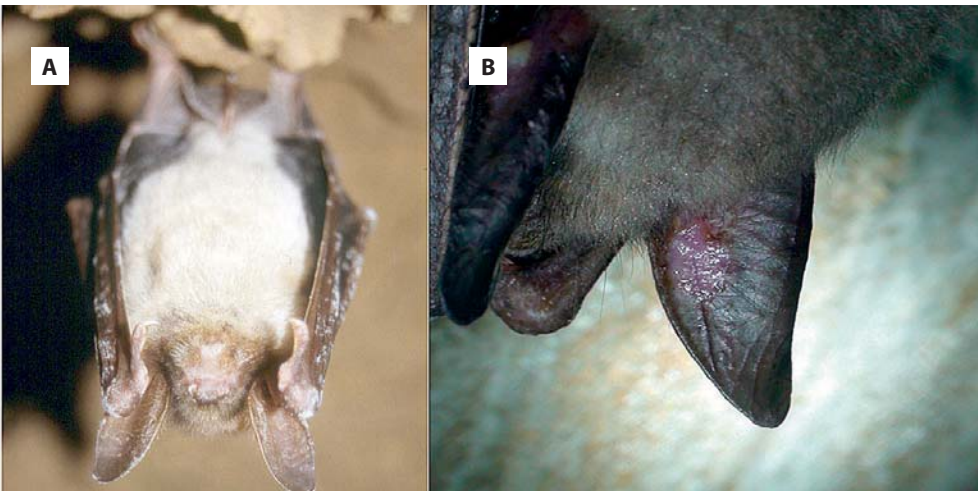
tory syndrome coronavirus and close relatives of human coronavirus 229E in bats, Ghana. *Emerging Infectious Diseases* 15: 1377–1384.

### White-nose syndrome in European bats

White-nose syndrome is an emerging infectious disease associated with a fungal skin infection that has caused drastic die-offs in North American hibernating bats. The fungus, *Geomyces destructans*, grows at cold temperatures and the drop in body temperature of bats during hibernation proves ideal for *G. destructans* growth. In Europe, the fungus was first found in France but no massive mortality has yet been reported. We studied presence of the pathogen in the Czech Republic and Slovakia over two successive winters. We found that *G. destructans* infects at least four cave-dwelling bat species and is most frequent in the greater mouse-eared bat *Myotis myotis*. It has probably been present in Europe for an extended period as we found photographs of bats with clinical signs of geomycosis from as early as 1995. The occurrence of geomycosis increased in 2010, evidenced by both direct observation and from photographs of hibernating bats. To date, no die-offs have been

recorded and long-term survey data show population fluctuation within predicted trends. Future research should aim at establishing whether geomycosis in Europe occurs together with white-nose syndrome, and what effects it has on hibernating bat populations.

MARTÍNKOVÁ N, BAČKOR P, BARTONIČKA T, BLAŽKOVÁ P, ČERVENÝ J, FALTEISEK L, GAISLER J, HANZAL V, HORÁČEK D, HUBÁLEK Z, JAHELKOVÁ H, KOLAŘÍK M, KORYTÁR L, KUBÁTOVÁ A, LEHOTSKÁ B, LEHOTSKÝ R, LUČAN RK, MÁJEK O, MATĚJŮ J, ŘEHÁK Z, ŠAFÁŘ J, TÁJEK P, TKADLEC E, UHRIN M, WAGNER J, WEINFURTOVÁ D, ZIMA J, ZUKAL J, HORÁČEK I, 2010. Increasing incidence of *Geomyces destructans* fungus in bats from the Czech Republic and Slovakia. *PLoS ONE* 5(11): e13853. doi: 10.1371/journal.pone.0013853



(A) Clinical signs of an unidentified fungal infection in the greater mouse-eared bat *Myotis myotis*, observed in 1997.

(Photo by J. Šafář)

(B) Skin lesions with confirmed geomycosis observed in 2010.

(Photo by I. Horáček)

## (b) Diversity of metazoan parasites of vertebrates

### Advances in parasitology of non-human primates

All great apes are considered as endangered or critically endangered species by the IUCN. Infectious diseases are listed as amongst the most important threats to ape populations. We focus our research, therefore, on gastrointestinal parasites of these highly endangered animals.

In two studies, we assessed parasite community composition in sympatric native and introduced primates of the Rubondo Island National Park (Tanzania, Africa). Except for two clearly distin-

tive conditions, we recorded *Trogloidyrella abrasarti* in most of the groups of captive chimpanzees and bonobos, and in all wild chimpanzee populations studied. Despite previous assumptions of pathogenicity of entodiniomorphids, and the significant increase in numbers in captive as compared to wild animals, we observed no symptoms, such as diarrhoea or indigestion, which could be attributed to the presence of these ciliates. In a further study, we documented transmissions of *T. abras-*



(A) Klára J. Petrželková and Kamasha, a Ugandan chimpanzee tracker, collecting samples and data on chimpanzees in the Kalinzu Forest Reserve, Uganda.



(B) Proglottid of a *Bertiella* tapeworm sp. on chimpanzee faeces in the Kalinzu Forest Reserve, Uganda.

guishable chimpanzee-specific parasites, the majority of parasite taxa reported were found in all three primate species studied. Both released chimpanzees and *Colobus* monkeys appear to have acquired  $\geq 1$  parasite from native vervet monkeys. Despite a lack of any apparent health problems from infections in introduced Rubondo primates, parasite monitoring during reintroduction/introduction projects is necessary in order to decrease potential risks resulting from the exchange of parasites between translocated and native species.

Until recently, entodiniomorphid ciliates represented a neglected component of the parasite fauna of great apes and detail studies were urgently needed to estimate the significance of these microorganisms under natural and captive conditions. While previous studies have presumed that entodiniomorphid ciliates disappear under cap-

*sarti* among adult and infant captive gorillas and revealed that *T. abrasarti* affects both captive gorillas and chimpanzees. We concluded that zoo transport plays a major role in the distribution of *T. abrasarti* among captive gorillas. We were also interested in another ciliate species occurring in great apes, *Balantidium coli*. Both asymptomatic infections and clinical balantidiasis have been reported for this species. Although not detected in any wild populations of African great apes, *B. coli* were commonly diagnosed in captive apes. We concluded that the sedimentation method was the most sensitive technique for diagnosis of ciliates occurring in apes. High starch diets in captive apes are likely to exacerbate the occurrence of *B. coli*, as well as the numbers of entodiniomorphids.

We found a new ciliate species, *Troglocorys cava*, in the faeces of a wild chimpanzee in Uganda and

performed a formal description of this new species. A pinworm species, *Lemuricola pongoi*, parasitising a Sumatran orang-utan was also described, allowing a final generic treatment of this taxon.

FOITOVÁ I, BARUŠ V, KOUBKOVÁ B, MAŠOVÁ Š, NURCAHYO W, 2010. Description of *Lemuricola (Lemuricola) pongoi*-male (Nematoda: Enterobiinae) parasitising orangutan *Pongo abelii*. Parasitology Research 106:817–820.

PETRÁŠOVÁ J, MODRÝ D, HUFFMAN MA, MAPUA MI, BOBÁKOVÁ L, MAZUCH V, SINGH J, KAUR T, PETRŽELKOVÁ KJ, 2010. Gastrointestinal parasites of indigenous and introduced primate species of Rubondo Island National Park, Tanzania. International Journal of Primatology 31: 920–936.

PETRŽELKOVÁ KJ, HASEGAWA H, APPLETON CC, HUFFMAN MA, ARCHER CE, MOSCOVICE LR, MAPUA MI, SINGH J, KAUR T, 2010. Gastrointestinal parasites of the chimpanzee population introduced onto Rubondo Island National Park, Tanzania. American Journal of Primatology 72: 307–316.

POMAJBÍKOVÁ K, PETRŽELKOVÁ KJ, PROFOUSOVÁ I, PETRÁŠOVÁ J, KIŠIDAYOVÁ S, VÁRADYOVÁ Z, MODRÝ D, 2010. A survey of entodiniomorphid ciliates in chimpanzees and bonobos. American Journal of Physical Anthropology 142: 42–48.

TOKIWA T, MODRÝ D, ITO A, POMAJBÍKOVÁ K, PETRŽELKOVÁ KJ, IMAI S, 2010. A new entodiniomorphid ciliate, *Troglocorys cava* n. g., n. sp., from the wild eastern chimpanzee (*Pan troglodytes schweinfurthii*) from Uganda. Journal of Eukaryotic Microbiology 57: 115–120.

MODRÝ D, PETRŽELKOVÁ KJ, POMAJBÍKOVÁ K, TOKIWA T, KŘÍŽEK J, IMAI S, VALLO P, PROFOUSOVÁ I, ŠLAPETA J, 2009. The occurrence and an ape-to-ape transmission of entodiniomorphid ciliate *Trogloidyella abrassarti* in captive gorillas. Journal of Eukaryotic Microbiology 56: 83–87.

POMAJBÍKOVÁ K, PETRŽELKOVÁ KJ, PROFOUSOVÁ I, PETRÁŠOVÁ J, MODRÝ D, 2010. Discrepancies in the occurrence of *Balantidium coli* between wild and captive African great apes. Journal of Parasitology 96: 1139–1144.

## Species biodiversity of helminths parasitizing vertebrates in East Senegal, Africa



Scanning electron micrograph of cephalic end with coloured papillae of *Multicaecum heterotis* from African bonytongue (*Heterotis niloticus*) (Photo by Š. Mašová)

Parasitological research was conducted on vertebrates (reptiles and fish) between 2004 and 2009 in the Niokolo Koba National Park (East Senegal, Africa). A new tapeworm species, *Oochoristica bever-*

*idgei* (Anoplocephalidae), was found and described from the West African species of gecko, *Tarentola parvicarinata* (Gekkonidae). This species is conclusively differentiated both morphologically and morphometrically from all other known *Oochoristica* species parasitizing hosts from the Gekkonidae (11 species) and parasitizing all Sub-Saharan African reptiles. A roundworm, *Parapharyngodon micipsae* (Nematoda: Pharyngodonidae), is the first record from *T. parvicarinata*. It was redescribed and, for the first time, studied using scanning electron microscopy (SEM). SEM allowed us to establish stable morphological features (not affected by the process of parasite fixation and body length), especially important for species determination within the genus *Parapharyngodon*.

The nematode genus *Cithariniella* (Pharyngodonidae) contains four species that parasitise African freshwater fishes only. Three species, *C. citharini*, *C. khalili* and *C. gonzalesi*, were recorded from the recta of squeaker (Siluriformes: Mochokidae) and cithari-

nid (Characiformes: Citharinidae) from the River Gambia and the Mare de Simenti (a large shallow, temporary oxbow lake). The last mentioned species is the first record from Senegal and a new host record in *Paradistichodus dimidiatus*. The morphological characteristics obtained by SEM were clearly able to differentiate species. The shape and size of cephalic papillae and lips were identified as new determination features. A useful key for differentiating species of the genus was prepared based on these results.

The ascaridoid species *Multicaecum heterotis* (Nematoda: Heterocheilidae) was recorded and determined in the intestine of the African bonytongue (*Heterotis niloticus*, Osteoglossiformes: Arapaimidae). Their examination using light microscopy and, for the first time, both environmental scanning electron microscopy (ESEM) and SEM, revealed some previously unreported morphological features and a detailed redescription of this species was provided. The presence of dentigerous ridges on the inner edges of the lips substantiates the transfer of the species from the genus *Brevimulticaecum* to *Multicaecum*. *Multicaecum heterotis* is the first species of the genus to be sequenced. Partial sequences of a small ribosomal subunit (18S) and the internal transcribed spacer 2 region (ITS2) of nuclear ribosomal DNA (rDNA) were analysed and compared with other ascaridoid genera. The first useful determination key for species from the genera *Brevimulticaecum* and *Multicaecum* was proposed.

KOUBKOVÁ B, BARUŠ V, HODOVÁ I, 2010. Nematodes of *Cithariniella* (Pharyngodonidae) from freshwater fishes in Senegal, with a key to species. *Helminthologia* 47: 105–114.

MAŠOVÁ Š, TENORA F, BARUŠ V, KOUBEK P, 2010. A new anoplocephalid (Cestoda) from *Tarentola parvicarinata* (Lacertilia: Gekkonidae) in Senegal (West Africa). *Journal of Parasitology* 96: 977–981.

MAŠOVÁ Š, BARUŠ V, HODOVÁ I, KOUBEK P, KOUBKOVÁ B, 2009. Redescription of *Parapharyngodon micipsae* (Seurat 1917) (Nematoda Pharyngodonidae) from the new host *Tarentola parvicarinata* Joger 1980 (Squamata Gekkonidae). *Tropical Zoology* 22: 243–255.

MAŠOVÁ Š, MORAVEC F, BARUŠ V, SEIFERTOVÁ M, 2010. Redescription, systematic status and molecular characterisation of *Multicaecum heterotis* Petter, Vassiliadès et Marchand, 1979 (Nematoda: Heterocheilidae), an intestinal parasite of *Heterotis niloticus* (Osteichthyes: Arapaimidae) in Africa. *Folia Parasitologica* 57: 280–288.

## Avian host-parasite associations in tropical areas of Africa and the Americas

In some parts of the world, especially in tropical areas where numerous species of birds occur, little is known about the diversity and distribution of avian parasites. Many species new to science are still waiting to be discovered. We studied avian host-parasite associations in western Africa (Sudanese savannah in Senegal, generalised vegetation landscape-type Sudano-Guinean woodland), Central America (various types of tropical forests on both the Caribbean and Pacific slopes of Costa Rica), and South America (tropical savannah of the Cerrado biome in Brazil). A total of 2,571 birds of 323 species belonging to 18 orders and 52 families were examined. We concentrated on both ectoparasites, namely chewing lice (Phthi-

raptera: Menoponidae, Philopteridae), louse-flies (Diptera: Hippoboscidae), feather mites (Astigmata: Proctophylloidea) and endoparasites, namely blood parasites (Chromatorida: Haemoprotozoa and microfilaria – a stage in the life cycle of certain parasitic nematodes in the family Onchocercidae, Spirurida). We found associations of parasites with pigeons and doves (Columbidae), cuckoos (Cuculidae), kingfishers (Alcedinidae), woodpeckers (Picidae), ground antbirds (Formicariidae), ovenbirds and woodcreepers (Furnariidae), manakins (Pipridae), tyrant flycatchers (Tyrannidae), helmetshrikes (Prionopodidae), vireos (Vireonidae), monarch flycatchers (Monarchidae), white-eyes (Zosteropidae), thrushes (Turdidae),





(A) The long-tailed manakin *Chiroxiphia linearis*, the host of a new chewing louse *Tyranniphlopterus toledo*. Rincon de la Vieja NP, Cordillera de Guanacaste, Costa Rica. (Photo by M. Čapek)  
 (B) The white-crested helmetshrike *Prionops plumatus*, a host of the louse fly *Ornithophila metallica*. Dar Salam, Tambacounda, Senegal. (Photo by M. Čapek)

Old World flycatchers (Muscicapidae), weavers (Ploceidae), estrildid finches (Estrildidae), emberizids (Emberizidae), saltators, cardinals and allies (Cardinalidae), and tanagers (Thraupidae). Nine species new to science were identified of parasites living on the surface of the host (ectoparasites). The new species of parasite and their type hosts were as follows: chewing lice (Phthiraptera) – *Tyranniphlopterus toledo* ex *Chiroxiphia linearis* (Pipridae), *Brueelia queleae* ex *Quelea quelea* (Ploceidae), *B. fasciata* ex *Amadina fasciata* (Estrildidae), *B. cantans* ex *Euodice cantans* (Estrildidae), *B. senegala* ex *Lagonosticta senegala* (Estrildidae); feather mites (Astigmata) – *Dolichodectes gymnornis* ex *Gymnornis dentata* (Ploceidae), *Montesauria plocei* ex *Ploceus cucullatus* (Ploceidae), *M. zosteropsis* ex *Zosterops senegalensis* (Zosteropidae), *Proterothrix terpsiphone* ex *Terpsiphone viridis* (Monarchidae). Of protozoan parasites (endoparasites) we found representatives of the genus *Haemoproteus* (Haemoproteidae) and microfilariae (Onchocercidae). The prevalence of *Haemoproteus* in birds at two localities in Central America was 0.8% and 4.4%, whereas prevalence of infection by microfilariae was 8.1% and 3.5%, respectively. A number of other parasite species were recorded for the first time in the study areas and, moreover, our study also revealed new host-specific associations.

BENEDIKT V, BARUŠ V, ČAPEK M, HAVLÍČEK M, LITERÁK I, 2009. Blood parasites (*Haemoproteus* and microfilariae) in birds from the

Caribbean slope of Costa Rica. *Acta Parasitologica* 54: 197–204.

MIRONOV SV, LITERÁK I, ČAPEK M, KOUBEK P, 2010. New species of the feather mite subfamily Pterodectinae (Astigmata, Proctophylloidae) from passerines in Senegal. *Acta Parasitologica* 55: 399–413.

SYCHRA O, BARLEV E, LITERÁK I, ČAPEK M, KOUBEK P, PROCHÁZKA P, 2010. The chewing lice (Phthiraptera) of red-billed quelea (*Quelea quelea*) in Senegal, with a description of a new species. *African Entomology* 18: 17–22.

SYCHRA O, LITERÁK I, ČAPEK M, 2009. Chewing lice of the genus *Myrsidea* Waterston (Phthiraptera: Menoponidae) from the Emberizidae and Thraupidae (Passeriformes) in Mato Grosso do Sul, Brazil. *Neotropical Entomology* 38: 501–503.

SYCHRA O, LITERÁK I, NAJER T, ČAPEK M, KOUBEK P, PROCHÁZKA P, 2010. Chewing lice (Insecta: Phthiraptera) from estrildid finches (Aves: Passeriformes: Estrildidae) and louse-flies (Insecta: Diptera: Hippoboscidae) from birds in Senegal, with descriptions of three new species of the genus *Brueelia*. *Zootaxa* 2714: 59–68.

SYCHRA O, NAJER T, KOUNEK F, ČAPEK M, LITERÁK I, 2010. Chewing lice (Phthiraptera) on manakins (Passeriformes: Pipridae) from Costa Rica, with description of a new species of the genus *Tyranniphlopterus* (Phthiraptera: Philopteridae). *Parasitology Research* 106: 925–931.

## (c) Evolutionary immunoecology

### Wildlife immunogenetics

Immunity is one of the most intriguing features common to all organisms. As optimal functioning of the immune system is crucial for survival, intensive research has been devoted over the past three decades to exploration of the genetic background of immunity in animals. More rigorous investigation has, however, concerned only humans and several species of laboratory animal. Thus, although this endeavour has proved to be highly rewarding in human medical research, more general information about most aspects of immune system evolution across taxa is still rather limited. This is despite the potential practical importance of such knowledge in epidemiology, zoohygiene, veterinary sciences, nature conservation management and livestock breeding. Nevertheless, recent scientific interest in immunogenetics of non-laboratory animals has dramatically increased and, thanks to these first results, we start to sense the enormous diversity of immunologically active structures encoded in animal genomes. Our research focuses mainly on two structurally and functionally dissimilar immune molecules: 1) MHC glycopro-



The zebra finch is a widespread model species for genetic and genomic studies in passerines.  
(Photo by H. Bainová)

selection on the antigen-binding site and recombination have played an important role in generating the MHC-genetic diversity observed.

PRRs are among the molecules that are far less frequently studied in non-model animals. Our efforts, therefore, have been aimed mainly at emphasising their potential importance for wildlife immunogenetics and description of the genes in previously unstudied taxa, using PRR Toll-like



The Tlr4 gene, sequenced for the zebra finch, is the first known passerine Toll-like receptor with predicted structure and confirmed function. Abbreviations indicate protein domains with different functions.

teins responsible for antigen presentation to adaptive immunity, and 2) Pattern recognition receptors (PRRs) that detect conserved microbial molecules and trigger innate immunity.

The MHC-based research projects aim at mapping MHC-binding region diversity in free-living populations of a mountain water vole *Arvicola scherman* and a passerine bird, the scarlet rosefinch *Carpodacus erythrinus*. For voles, the results indicate the association of specific MHC class II alleles with the proinflammatory immune phenotype. For rosefinches, we found 82 different MHC class I variants, the highest intrapopulational MHC class I variation observed in birds. The data also indicate that positive

receptors (TLRs) as a model group. We showed that TLR-polymorphism may play an important role in the evolution of anti-parasite defence. Our group was the first to describe TLR4 in the zebra finch *Taeniopygia guttata* and also to show that heterozygotes in this gene may frequently occur.

CHARBONNEL N, BRYJA J, GALAN M, DETER J, TOLLENAERE C, CHAVAL Y, MORAND S, COSSON J-F, 2010. Negative relationships between cellular immune response, Mhc class II heterozygosity and secondary sexual trait in the montane water vole. *Evolutionary Applications* 3: 279–290.



PROMEROVÁ M, ALBRECHT T, BRYJA J, 2009.

Extremely high MHC class I variation in a population of a long-distance migrant, the scarlet rosefinch (*Carpodacus erythrinus*). *Immunogenetics* 61: 451–461.

VINKLER M, ALBRECHT T, 2009. The question waiting to be asked: Innate immunity receptors

in the perspective of zoological research. *Folia Zoologica* 58(Suppl. 1): 15–28.

VINKLER M, BRYJOVÁ A, ALBRECHT T, BRYJA J, 2009. Identification of the first toll-like receptor gene in passerine birds: TLR4 orthologue in zebra finch (*Taeniopygia guttata*). *Tissue Antigens* 74: 32–41.

## Improving the theoretical and methodological framework of current immunoeological research

Although immunoeology (also known as ecoimmunology or ecological immunology) was proposed as a newly emerging science discipline nearly 15 years ago, its methodological apparatus and theoretical background is still relatively modest compared to classical immunology. This might be because the immune system is often viewed only as a black box in ecology. Inevitably, this approach leads to oversimplifications that might dramatically alter the interpretations of test results. We feel that this attitude is erroneous and that animal ecologists need to follow advances in current immunology and other, non-zoological scientific fields. Our research, therefore, has been directed toward revision of some of the currently most widely adopted methods and evaluation of the interpretation of their results.

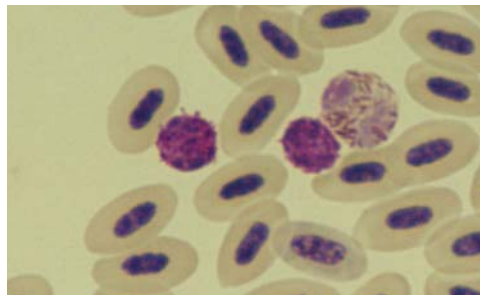
The phytohaemagglutinin (PHA) skin-swelling test is one of the most widely used techniques for cell-mediated immunity examination in immunoeology. While the test results are frequently discussed as a measurement of T-cell activity, however, this relationship has never been proven. Using the zebra finch *Taeniopygia guttata*, we provided the very first evidence to show the importance of erythroagglutination in the development of an inflammatory response to PHA-P, with no effect of T-cell stimulation found. This result has important implications as regards the interpretation of test results and predicted evolutionary immunological adaptations. Furthermore, using the scarlet rosefinch *Carpodacus erythrinus*, we have demonstrated the importance of detailed haematological examination for correct health prediction. Our results revealed that, in some passerine species, basophils may be numerous in peripheral blood and that these cells may be associated with the occurrence of blood-borne parasite infections. Hence, in this species, basophil count is a better health indicator than the commonly used heterophil:lymphocyte ratio.

Finally, we also aimed at examination of some of the basic theoretical concepts of immunoeology, trying to merge the presently outstanding data with the paradigm. We have proposed a novel hypothesis on the physiological mechanism preserving honesty of carotenoid-based health signalling through ornaments (the carotenoid maintenance handicap hypothesis). The proposed model is based on the handicap principle, involving the possible harmful effect of carotenoid metabolites.

VINKLER M, SCHNITZER J, MUNCLINGER P, VOTÝPKA J, ALBRECHT T, 2010. Haematological health assessment in a passerine with extremely high proportion of basophils in peripheral blood. *Journal of Ornithology* 151: 841–849.

VINKLER M, BAINOVÁ H, ALBRECHT T, 2010. Functional analysis of the skin-swelling response to phytohaemagglutinin. *Functional Ecology* 24: 1081–1086.

VINKLER M, ALBRECHT T, 2010. Carotenoid maintenance handicap and the physiology of carotenoid-based signalisation of health. *Naturwissenschaften* 97: 19–28.



Avian blood offers multiple possibilities for health and condition investigation in birds.

(Photo by M. Vinkler)

## APPLIED ECOLOGY

### (a) Conservation biology

#### The use of non-invasive genetic sampling and conservation genetics of Eurasian otters

Successful conservation and management of rare and elusive species requires reliable estimates of population size, however, acquisition of such data is often challenging. We compared the two most frequently used methods of assessing abundance of Eurasian otter *Lutra lutra* populations: non-invasive genetic sampling (NGS), based on genotyping of faeces, and field surveys, based on snow tracking. Our results suggest that the performance of both NGS and snow tracking are comparable in simple linear habitats but, in complex habitats with very high otter density, capture-mark-recapture analysis using genetic data, or a combination of genetic and field methods, is recommended. We emphasise that, to obtain reliable estimates using



The European otter was the first species, in which the non-invasive genetic analyses of DNA from faecal samples were used in the Institute.

(Photo by J. Roleček)

NGS, it is necessary to follow strict protocols for detection and elimination of genotyping errors, and we suggested improvements that may increase success rate and efficiency of NGS in otters.

Subsequently, we participated in a pan-European research project on otter genetic diversity and population genetic structure. A total of 616 samples, collected from 19 European countries, were genotyped at the mtDNA control-region and 11 autosomal microsatellites. The mtDNA variability was low, suggesting that extant otter mtDNA lineages originated recently. A star-shaped mtDNA network did not allow the outlining of any phylogeographic inference. Microsatellites were only moderately variable; the average allele number was low, suggesting small historical effective population size. Extant otters are likely to have originated from the expansion of a single refugial population. Bayesian clustering and landscape genetic analyses, however, indicated that local populations are genetically differentiated, perhaps as a consequence of post-glacial demographic fluctuations and recent isolation. These results delineated a framework that should be used for implementing conservation programs in Europe, particularly if they are based on the reintroduction of wild or captive-reproduced otters.

HÁJKOVÁ P, ZEMANOVÁ B, ROCHEK, HÁJEK B, 2009. An evaluation of field and noninvasive genetic methods for estimating Eurasian otter population size. *Conservation Genetics* 10: 1667–1681.

MUCCI N, ARRENDAL J, ANSORGE H, BAILEY M, BODNER M, DELIBES M, FERRANDO A, FOURNIER P, FOURNIER C, GODOY JA, HÁJKOVÁ P, HAUER S, HEGGBERGET TM, HEIDECHE D, KIRJAVAINEN H, KRUEGER H.-H, KVALOY K, LAFONTAINE L, LANSZKI J, LEMARCHAND C, LIUKKO U-M, LOESCHCKE V, LUDWIG G, MADSEN AB, MERCIER L, OZOLINS J, PAUNOVIC M, PERTOLDI C, PIRIZ A, PRIGIONI C, SANTOS-REIS M, LUIS TS, STJERNBERG T, SCHMID H, SUCHENTRUNK F, TEUBNER J, TORNBORG R, ZINKE O, RANDI E, 2010. Genetic diversity and landscape genetic structure of otter (*Lutra lutra*) populations in Europe. *Conservation Genetics* 11: 583–599.

## Alien fish species in the Czech Republic and their impact on the native fish fauna

In the hydrological network of the Czech Republic, the native species composition of fish communities living in any stream is determined by its pertinence to the river system of a corresponding sea-drainage area (the Black, North, and Baltic seas), the distance of a river section from its spring, and elevation above sea-level. The essential factors affecting the native qualitative and quantitative characteristics of the ichthyofauna of the Czech Republic include human activities, both direct (fisheries) and indirect (stream modifications, dams, pollution). At present, the native status of the fish communities is most markedly changed by fishery management activities. Non-native fish species tend to enrich the species spectrum of fish communities and, at the same time, they are competitive against native species. Over the course of the past 150 years, attempts were made at introducing 39 non-native fish species, largely in connection with fishery management. A further two species (*Carassius auratus*, *Neogobius melanostomus*) have invaded our streams through their own migration activity along the Danube River. However, only 12 of the non-native species are permanently occurring in this country, either in their acclimatisation or naturalisation stages. The species *C. auratus* (complex), *Pseudorasbora parva*,

*Ameiurus nebulosus*, *Gasterosteus aculeatus*, and *N. melanostomus* have established naturally reproducing populations, i.e. they have become naturalised. The existence and occurrence of the remaining species (in the acclimatisation stage) which have come into their own in aquaculture, depend upon artificial rearing and the releasing of fry. The annual production of non-native species, fit for human consumption, varies around 2,000 tonnes, i.e. 8.5 % of total fish production in this country.

The non-native species *C. auratus*, *P. parva* and *Ameiurus nebulosus* are considered as having a significant negative influence on the native biodiversity of this country. Of the non-native invasive fish species occurring in this country at present, *C. auratus* in particular directly participates in devastating the native populations of *C. carassius*, *Tinca tinca*, and others, and causes complications even in fishpond cultures. While a considerable part (over 50 %) of the native species is endangered to varying degrees, they are exposed to passive protection only.

HARTVICH P, LUSK S, RUTKAYOVÁ J, 2010.  
Threatened fishes of the world: *Misgurnus fos-*



The gibel carp (*Carassius gibelio*) - the most successful invasive fish in waters of the Czech Republic.

(Photo by K. Halačka)

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- LUSK S, PIVNIČKA K, 2009. Fish assemblages in the Czech Republic – species saturation, frequency and changes along the longitudinal stream gradient. *Acta Universitatis Carolinae. Environmentalica* 23: 45–68.
- MUSIL J, JURAJDA P, ADÁMEK Z, HORKÝ P, SLAVÍK O, 2010. Non-native fish introductions in the Czech Republic – species inventory, facts and future perspectives. *Journal of Applied Ichthyology* 26(Suppl. 2): 38–45.

### Feeding ecology of protected herbivores

Many mammalian species are endangered by the increasing pressure of civilisation in both the agricultural landscape and in, to date, untouched wildlife areas. Knowledge of the feeding ecology of protected animals, therefore, is essential to ensure their survival and for their active protection.

The Eurasian beaver *Castor fiber* became extinct in the Czech Republic in the 19th century. After a successful reintroduction at the end of the last century, its numbers have gradually risen. Beaver re-occurrence, however, together with their unique foraging strategy, has led to an increasing number of conflicts between beaver conservation and forestry management and agriculture. To date, diet composition of beaver was preferentially studied

during winter through the monitoring of gnawing on woody plants. This study presents data on the dietary composition of beavers during the vegetation season, based on macro- and micro-histological analysis of their faeces. This methodology enabled us to evaluate the beaver's role in the present agricultural landscape. In general, beavers consumed mostly deciduous trees and forbs. Consumption of grasses, aquatic plants and field crops was negligible. The proportion of deciduous trees and forbs in the diet was highly influenced by season and by the diversity and cover of riparian stands. The results showed a high degree of ecological plasticity in diet selection by reintroduced Eurasian beaver in the Czech Republic but, so far, there is no evidence that they cause high levels of damage to economically important trees or field crops.

The western Derby eland *Taurotragus derbianus derbianus* is a critically endangered eland subspecies of western Africa. In the area with the occurrence of the last free-living population of this subspecies, shoots of woody plants and fruits of several trees of high nutrition value were the main components of its diet. Large areas with a diversified structure of woody plants are necessary, therefore, to satisfy the nutritional demands of the western Derby eland. Comparison of diet between the free-living population and a population living in captivity showed that the reserve meets the feeding demands of this subspecies and that the ongoing recovery breeding program could help to save this subspecies before



The taking of beaver faeces by palpation of the rectum immediately after trapping the animal – the only possibility to obtain beaver faeces.

(Photo by J. Korbek)





The western Derby eland, a critically endangered species.

(Photo by M. Homolka)

its extinction. This study contributes to the creation of suitable conditions for its breeding in captivity and for the selection of conservation areas suitable for protection of the last free-living western Derby eland population.

HEJCMANOVÁ P, HOMOLKA M, ANTONÍNOVÁ M, HEJCMAN M, PODHÁJECKÁ V, 2010. Diet composition of western Derby eland

(*Taurotragus derbianus derbianus*) in the dry season in a natural and a managed habitat in Senegal using faecal analyses. *South African Journal of Wildlife Research* 40: 27–34.

KROJEROVÁ-PROKEŠOVÁ J, BARANČEKOVÁ M, HAMŠÍKOVÁ L, VOREL A, 2010. Feeding habits of reintroduced Eurasian beaver: spatial and seasonal variation in the use of food resources. *Journal of Zoology* 281: 183–193.

## (b) Fish as indicators of freshwater pollution

### The fish community as an indicator of river degradation

Despite significant water quality improvement over the last two decades, pollution remains a problem in a number of European river basins. As part of an international EU project modelling the impact of key pollutants on freshwater biodiversity (6th FP EU MODELKEY), we focused on fish and macrozoobenthos communities within the River Elbe (downstream of the town of Pardubice) and the Bílina stream. Relatively high fish species richness was documented in both rivers, though this included a high number of generalists. In the stretch of the River Elbe under study,

channelisation and regulation appear to be the most important determinants affecting fish community structure. The fish community of the Bílina, however, is strongly influenced by anthropogenic factors, such as a petrol refinery, sewage water and coal mining. The presence of a reservoir also changed the structure of the fish community and point source pollution resulted in a complete absence of fish in some stretches. Overall, the fish community indicated poor oxygen conditions in the stream, though the presence of xenobiotics was not found. Recovery of the fish community



(Left) Natural-like stretch of the River Elbe, upstream of Pardubice, which supports a diverse fish community. (Right) The channelised navigable stretch of the River Elbe in the Pardubice urban area limits the diversity of the fish community. (Photos by Z. Adámek)

over the longitudinal profile has been rather slow due to poor habitat diversity in the canalised river.

As part of the overall study, we examined the potential relationship between the physiological condition of a model fish (chub, *Leuciscus cephalus*) and exposure to chemical pollution and natural stressors (i.e. parasites). The results showed that chemical pollution or the presence of parasites were not the main factors affecting the physiological status of the fish; other factors, such as dissolved oxygen, habitat character and food resources, played a more important role. On the other hand, parasite communities did appear to be a good indicator of chemical pollution affecting the host.

Results from a long-term study (1992–2010) of trace metal contamination of fish in the River Morava (Danube basin) indicates that concentrations do not increase downstream as expected, but

that point sources of pollution appear to be more important. Concentrations of cadmium and lead were correlated with flood events, whereas concentrations of mercury remained relatively stable year to year. Very few samples reached the Czech hygienic limits. The Morava basin, therefore, is not a dangerous source of trace metals for the Danube.

JURAJDA P, JANÁČ M, VALOVÁ Z, STRECK G, 2010. Fish community in the chronically polluted middle Elbe River. *Folia Zoologica* 59: 157–168.

JURAJDA P, ADÁMEK Z, JANÁČ M, VALOVÁ Z, 2010. Longitudinal patterns in fish and macrozoobenthos assemblages reflect degradation of water quality and physical habitat in the Bílina river basin. *Czech Journal of Animal Science* 55: 123–136.

VALOVÁ Z, JURAJDA P, JANÁČ M, BERNARDOVÁ I, HUDCOVÁ H, 2010. Spatiotemporal trends of heavy metal concentrations in fish of the River Morava (Danube basin). *Journal of Environmental Science and Health Part A-Toxic/Hazardous Substances & Environmental Engineering* 45: 1892–1899.

WENGERM, ONDRAČKOVÁ M, MACHALAM, NEČA J, HYŘŠL P, ŠIMKOVÁ A, JURAJDA P, VON DER OHE P, SEGNER H, 2010. Assessing relationships between chemical exposure, parasite infection, fish health, and fish ecological status: a case study using chub (*Leuciscus cephalus*) in the Bílina River, Czech Republic. *Environmental Toxicology and Chemistry* 29: 453–466.



Dr. G. Streck (UFZ Leipzig) collects a waste water sample from the WWTP outlet into the River Elbe at Pardubice-Srnojedy. (Photo by J. Huml)



## Toxicity of environmental pollutants for young fishes

We studied the effect of nitrite, and the toxicity of Diazinon 60 EC, dimethyl sulfoxide (DMSO) and polyaluminium chloride (PAX-18), on the early-life stages of common carp *Cyprinus carpio* and tench *Tinca tinca*. On the basis of accumulated mortality in the experimental groups of carp embryos and larvae, lethal concentrations of nitrite were estimated at  $29dLC_{50} = 88 \text{ mg.l}^{-1} \text{ NO}_2^-$ ; lowest-observed-effect concentration (LOEC) =  $28 \text{ mg.l}^{-1} \text{ NO}_2^-$ ; and no-observed-effect concentration (NOEC) =  $7 \text{ mg.l}^{-1} \text{ NO}_2^-$ . Fulton's weight condition factor values were significantly lower in fish from all experimental groups compared with a control. No significant negative effects of nitrite at the concentrations tested ( $0.7\text{--}330 \text{ mg.l}^{-1} \text{ NO}_2^-$ ; at  $10 \text{ mg.l}^{-1} \text{ Cl}^-$ ) were demonstrated on hatching or embryo viability, but significant differences in early ontogeny among groups were noted. Diazinon 60 EC (organophosphate insecticide, active substance diazinon) at a concentration of  $10 \text{ mg.l}^{-1}$  is not dangerous for the embryos and larvae of tench and carp. At the highest concentration tested ( $3,000 \text{ mg.l}^{-1}$ ), total mortality was observed within the first 15 days of exposure. DMSO is an important polar aprotic solvent and is used as an auxiliary substance in toxicity tests on aquatic organisms, usually at concentrations of 0.2 and  $0.5 \text{ ml.l}^{-1}$ . DMSO exposure at all tested concentrations (0.2, 0.5, 1.0 and  $5.0 \text{ ml.l}^{-1}$ ) did not result in any lethal effect or abnormalities in carp embryos and larvae compared to the control over the entire test period (29 days). The preparation PAX-18, with its active ingredient polyaluminium chloride (9% Al), is a coagulation agent that is used mainly to

precipitate phosphates in order to prevent surface water eutrophication and incidences of cyanobacteria. Its NOEC on common carp embryos and larvae was  $10 \text{ mg.l}^{-1}$  ( $0.9 \text{ mg.l}^{-1} \text{ Al}$ ), while its LOEC was  $50 \text{ mg.l}^{-1}$  ( $4.5 \text{ mg.l}^{-1} \text{ Al}$ ). The lethal concentration of PAX-18 found in acute toxicity tests on common carp was 7–14 times higher than the concentration that is usually applied to water ( $5\text{--}10 \text{ mg.l}^{-1} \text{ Al}$ ).

- KROUPOVÁ H, PROKEŠ M, MÁCOVÁ S, PEŇÁZ M, BARUŠ V, NOVOTNÝ L, MÁCHOVÁ J, 2010. Effect of nitrite on early-life stages of common carp (*Cyprinus carpio* L.). *Environmental Toxicology and Chemistry* 29: 535–540.
- MÁCOVÁ S, MÁCHOVÁ J, PROKEŠ M, PLHALOVÁ L, ŠÍROKÁ Z, DLESKOVÁ K, DOLEŽELOVÁ P, SVOBODOVÁ Z, 2009. Polyaluminium chloride (PAX-18) – acute toxicity and toxicity for early development stages of common carp (*Cyprinus carpio*). *Neuroendocrinology Letters* 30(Suppl. 1): 192–198.
- MÁCHOVÁ J, PROKEŠ M, KROUPOVÁ H, SVOBODOVÁ Z, MÁCOVÁ S, DOLEŽELOVÁ P, VELÍŠEK J, 2009. Early ontogeny, growth and mortality of common carp (*Cyprinus carpio*) at low concentrations of dimethyl sulfoxide. *Acta veterinaria Brno* 78: 505–512.
- MÁCHOVÁ J, PROKEŠ M, PEŇÁZ M, BARUŠ V, KROUPOVÁ I, 2010. Toxicity of Diazinon 60 EC for embryos and larvae of tench, *Tinca tinca* (L.). *Reviews in Fish Biology and Fisheries* 20: 409–415.

## (c) Trophic ecology of mammals

### The role of large herbivores in forest and agricultural habitats

Large herbivores play an important role in various ecosystems, especially due to their impact on forest vegetation and field crops. They are also the reason for a long-running clash between hunters and foresters as regards their management. The study of herbivore diet, therefore, is necessary to resolve not only this conflict, but also to lay the groundwork for rational balanced management and conservation plans for various herbivore species.

The diet composition of deer species is a good indicator of food resource usage, applicable in protection of young tree stands in natural and artificial forest regeneration. Broadleaved trees, a highly consumed and attractive diet component, are especially endangered by browsing. Natural regeneration of these species is almost impossible in areas with a high proportion of coniferous species, even if the abundance of herbivores in these areas is low. Thus, the successful regeneration of highly palatable tree species does not depend only on the reduction of the resident herbivore population, but also on the presence of other food resources and thorough protection of saplings.

The influence of herbivores on sunflower, maize, wheat, and winter barley was studied by the monitoring of deer browsing and also experimentally by simulation of browsing. The results showed that the browsing of herbivores, especially during the early stages of growth, significantly influences the yield and quality of seeds. The application of the results of these studies can help to reduce the damage to agricultural plants by suitable placement of various field crops with regards to their palatability and vulnerability to browsing.

KROJEROVÁ-PROKEŠOVÁ J, BARANČEKOVÁ M, ŠUSTR P, HEURICH M, 2010. Feeding patterns of red deer along altitudinal gradient in the Bohemian Forest: the effect of habitat and season. *Wildlife Biology* 16: 173–184.

BARANČEKOVÁ M, KROJEROVÁ-PROKEŠOVÁ J, ŠUSTR P, HEURICH M, 2010. Annual changes in roe deer (*Capreolus capreolus* L.) diet in the Bohemian Forest, Czech Republic/Germany. *European Journal of Wildlife Research* 56: 327–333.

KAMLER J, HOMOLKA M, BARANČEKOVÁ M, KROJEROVÁ-PROKEŠOVÁ J, 2010. Reduction of herbivore density as a tool for reduction of herbivore browsing on palatable tree species. *European Journal of Forest Research* 129: 155–162.

VEJRAŽKA K, CERKAL R, KAMLER J, DVOŘÁK J, KNOTOVÁ D, 2009. The grain quality losses of wheat and barley caused by stress of simulated game browsing. *Cereal Research Communications* 37(Suppl. 1): 655–658.

KAMLER J, HOMOLKA M, CERKAL R, HEROLDVÁ M, KROJEROVÁ-PROKEŠOVÁ J, BARANČEKOVÁ M, DVOŘÁK J, VEJRAŽKA K, 2009. Evaluation of potential deer browsing impact on sunflower (*Helianthus annuus*). *European Journal of Wildlife Research* 55: 583–588.



Overabundant large herbivore mammals change the structure of the vegetation on clearings and prevent the forest regeneration.

(Photo by M. Homolka)

## Primate digestion

We studied the effect of low- and high-fibre diet on chimpanzee faecal microflora and its fermentation capacity. Our results indicated that faecal microbial populations of captive chimpanzees are not capable of extensive fibre fermentation; however, there was a positive effect of fibre content on production of short-chain fatty acids. Changes in fermentation activities were associated with changes in bacterial populations. A much more complex eubacterial population structure, represented by many bands, was observed for both diets as compared with the less variable archaeal population. *Eubacterium biforme* was the domi-

nant bacteria observed during the high-fibre diet, while new or yet-to-be-sequenced species of mycoplasmas dominated during the low-fibre diet.

KIŠIDAYOVÁ S, VÁRADYOVÁ Z, PRISTAŠ P, PIKNOVÁ M, NIGUTOVÁ K, PETRŽELKOVÁ KJ, PROFOUSOVÁ I, SCHOVANCOVÁ K, KAMLER J, MODRÝ D, 2009. Effects of high- and low-fiber diets on fecal fermentation and fecal microbial populations of captive chimpanzees. *American Journal of Primatology* 71: 548–557.



The diet of chimpanzees in captivity and in wild may differ, which causes differences in the composition of faecal microflora. (Photo by K. J. Petrželková)

## 4. OTHER ACTIVITIES

### | Conferences and popularization activities

**Conference “Zoologické dny 2009” [Zoological Days 2009], Brno, February 12-13, 2009**

**Conference “Zoologické dny 2010” [Zoological Days 2010], Prague, February 11-12, 2010**

“Zoologické dny” (= Zoological days) is a traditional and very popular meeting of Czech and Slovak zoologists that has been organised in Brno almost every year by the Institute of Vertebrate Biology AS CR (and its ancestors) since 1969. New pages in the history of the conference began to be written in 2008. Following a vote of conference

participants in 2007, it was decided that the conference will be organised in Brno every odd year and, in even years, this traditional meeting will be organised in other Czech and Slovak towns in co-operation with partner academic institutions. This decision has proved very lucky as both the number of participants and quality of presentations has increased dramatically since 2008.

The first such conference (i.e. outside Brno) took place at the University of South Bohemia in České Budějovice in 2008. This conference was dedicated to the 80<sup>th</sup> birthday of prof. Zdeňek Veselovský, the famous Czech ethologist and long-term director of Prague ZOO. We welcomed almost 400 zoologists and the whole conference showed that the decision on change of location was very positive. The increasing quality and importance of the “Zoologické dny” conference was confirmed over the next two years when approximately 450 and 500 participants came to Brno and Prague, respectively. The organisational partnership with the University of South Bohemia (2008) and the Czech University of Life Sciences (2010) has helped to increase the overall quality of the conference, which has now become a serious scientific event, important for the zoological community of both the Czech and Slovak Republics.

A student competition is organised every year and students present a significant part of all posters and lectures (total number of presentations in 2008 – 103 lectures and 159 posters; 2009 – 104 lectures and 176 posters; 2010 – 126 lectures and 183 posters). The OLYMPUS Company is a long-term sponsor of prizes for the competition.

For more information see <http://zoo.ivb.cz/>



The conference “Zoological Days” became the most popular meeting of Czech and Slovak zoologists with more than 500 participants in last years.

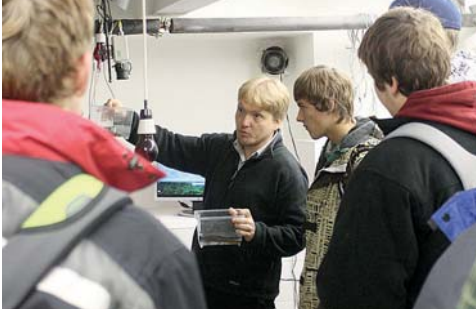
(Photos by M. Promerová)





## Open door days

Over the course of Science and Technology Week, the Academy of Sciences of the Czech Republic opens its doors to the public in a series of “Open Houses”. Around 200 visitors every year take the opportunity to discover more about the research carried out in our Institute



During the “Open door days”, the laboratories, collections, popularization lectures and breeding facilities attract many students from high schools and other public every year.

*(Photos by M. Promerová and J. Albrechtová)*



## Membership in international organisations

Scientist	Organization
Adámek Z.	European Aquaculture Society
Albrecht T.	American Society of Naturalists International Society for Behavioral Ecology (ISBE)
Baruš V.	Sociedad Cubana de Parasitología Animal, honorary chairman
Bryja J.	Steering Committee of the European Science Foundation (ConGen)
Čapek M.	IOC Standing Committee on Ornithological Nomenclature
Červený J.	Ad Hoc Group for Environmental Problems of COST (Council for Research and Development, EU) Czech National Committee of the MAB Programme Working Group for Large Carnivores Initiative for Europe
Gvoždík L.	American Society of Naturalists Society for Integrative and Comparative Biology Society for the Study of Amphibians and Reptiles Steering Committee of European Science Foundation (ThermAdapt)
Hájková P.	IUCN Species Survival Commission – Otter Specialists Group
Hubálek Z.	ECDC (European Centre for Disease Prevention and Control)
Jurajda P.	Fisheries Society of the British Isles
Koubek P.	Working Group for Large Carnivores Initiative for Europe
Mendel J.	Society for Conservation Biology
Ondračková M.	European Association of Fish Pathologists
Piálek J.	European Society for Evolutionary Biology Society for the Study of Evolution
Procházka P.	Deutsche Ornithologen-Gesellschaft
Reichard M.	Association for the Study of Animal Behaviour British Ecological Society International Society for Behavioral Ecology (ISBE) Fisheries Society of the British Isles
Sládek V.	American Association of Physical Anthropologists
Vinkler M.	International Society for Behavioral Ecology International Society of Developmental and Comparative Immunology Society for Experimental Biology
Vošlajerová B.	International Mammalian Genome Society
Zima J.	Czech National Committee of the IUBS IUCN Species Survival Commission – Insectivores Specialists Group International Sorex araneus Cytogenetics Committee IUCN Species Survival Commission – Rodents Specialists Group Societas Europaea Mammalogica International Federation of Mammalogists (Conservation Committee) Education Group ALLEA (All European Academies) New 7 Wonders of Nature, Panel of Experts
<b>Total 20</b>	<b>41</b>



## | Membership in editorial boards

Scientist	Journal
Adámek Z.	Aquaculture International (Kluwer, Netherlands) Conspectus Scientificus Agriculturae (Zagreb, Croatia)
Baruš V.	Transactions of the Zoological Society of India Helminthologia
Blahák P.	Folia Zoologica (managing editor)
Čapek M.	International Studies on Sparrows
Glosová L.	Folia Zoologica (managing editor)
Gvoždík L.	Folia Zoologica
Honza M.	Folia Zoologica
Hubálek Z.	Cryobiology Folia Parasitologica
Jurajda P.	Folia Zoologica
Koubek P.	Folia Zoologica
Reichard M.	Evolutionary Ecology
Slabáková H.	Folia Zoologica
Zima J.	Hystrix – Italian Journal of Mammalogy Folia Zoologica (editor-in-chief) Acta Theriologica Scoplia ISRN Zoology Comparative Cytogenetics
<b>Total</b>	<b>10</b>
	<b>17</b>

## | Education and teaching activities

### Teaching at universities

Lecturer	Subject	2009–2010 hours	Faculty/ University
Adámek Z.	Fish farming	26	1
	Ichthyology and fish farming	24	5
Albrecht T.	Modern statistical methods I and II	40	6
	Evolutionary ecology of birds	12	6
	Ecology and genetics of behaviour	20	6
	Animal biology	4	6
Bryja J.	Molecular ecology	24	1
	Genetical methods in zoology	24	1
	Tutorials in vertebrate zoology	48	1
Čapek M.	Ornithology	40	1
Červený J.	Field course of zoology	60	2
	Game biology	26	7
Honza M.	Ecology of birds	26	1
Hubálek Z.	Fundamentals of microbiology	30	1
	Microbial zoonoses and sapronoses	30	1
	Tutorials in microbiology	60	1
Jurajda P.	Ecology of fishes	26	1
Koubek P.	Game biology	26	1
	Game biology	26	7
	Methods in field zoology	26	1
Lusk S.	Ichthyology	36	1
Mendel J.	Bioinformatics	10	3
Prokeš M.	Ichthyology	2	3
Reichard M.	Biogeography	26	1
Rudolf I.	Microbial zoonoses and sapronoses – laboratory course	28	1
Sládek V.	Biological anthropology <sup>2</sup>	54	4
	Biological anthropology for archeologists <sup>1</sup>	65	4
	Biological anthropology for archeologists <sup>2</sup>	65	4
	Human variability and adaptability	54	4
	Locomotor system <sup>1</sup>	65	4
	Tutorials in anthropology	13	4
Svobodová J.	Animal ecology	14	7
	Biodiversity	3	7
	Ecological methods	8	7
	Field course of nature preservation	42	7
	Field course of zoology	17	7
	General ecology	28	7
	Zoology	52	7

Lecturer	Subject	2009–2010 hours	Faculty/ University	
Tkadlec E.	Life history	30	5	
	Population ecology	45	5	
	Scientific methodology	30	5	
	Time series in ecology	15	5	
	Tutorials (MSc students)	30	5	
	Tutorials (PhD students)	20	5	
Vinkler M.	Behavioural ecology and genetics	8	6	
	General parasitology for teachers	4	6	
Zima J.	Biodiversity	26	1	
	Biodiversity	26	6	
	Field course of zoology	42	6	
	Genetical methods in zoology	12	6	
	Vertebrate zoology	13	6	
Zukal J.	Behavioral ecology	45	1	
	Ethology	45	1	
	Field course of zoology	22	1	
	Chiropterology	22	1	
<b>Total</b>	<b>18</b>	<b>52</b>	<b>1499</b>	<b>7</b>

<sup>1</sup> Faculty of Science, Masaryk University, Brno

<sup>2</sup> Department of General Zoology, University of Essen

<sup>3</sup> Faculty of Agronomy, Mendel University of Agriculture and Forestry, Brno

<sup>4</sup> Faculty of Humanities, University of West Bohemia, Plzeň

<sup>5</sup> Faculty of Science, Palacký University, Olomouc

<sup>6</sup> Faculty of Science, Charles University, Prague

<sup>7</sup> Faculty of Forestry, Wildlife and Wood Sciences, Czech University of Life Sciences, Prague

## Undergraduate students (bachelors) working in the Institute and/or supervised by the Institute's fellows in 2009–2010

Student	Supervisor/ Consultant	2009	2010	Thesis defended	Faculty/ Univ.
Bainová Z.	Vinkler M.	+	+	2010	3
Bartáková K.	Gvoždík L.	+	+		1
Bartáková V.	Bryja J.		+		1
Baslerová P.	Procházka P.		+		1
Bayerlová M.	Martínková N.	+		2009	1
Beková M.	Hubálek Z.	+		2009	1

Student	Supervisor/ Consultant	2009	2010	Thesis defended	Faculty/ Univ.
Beňo R.	Požgayová M.		+		1
Bílková B.	Vinkler M.		+		3
Blažková B.	Albrecht T.		+		1
Bolcková T.	Honza M.	+	+	2010	1
Dočekalová P.	Jurajda P.	+	+	2010	1
Gabrielová B.	Albrecht T.	+		2009	3
Gettová L.	Hájková P.	+		2009	4
Halová L.	Procházka P.		+		1
Hloušková M.	Bryja J.		+		1
Hubáčková L.	Bryja J.	+	+	2010	1
Jandová M.	Bryja J.		+		1
Kalousová B.	Petrželková K.	+	+		1
Kašparová P.	Bryja J.		+		1
Klajblová K.	Hubálek Z.	+		2009	1
Klíma O.	Lusk S.	+		2009	1
Kopperová K.	Zukal J.		+		1
Králová T.	Bryja J.	+	+	2010	1
Kubíčková L.	Šikutová S.	+		2009	1
Kurdíková V.	Gvoždík L.		+		2
Machová S.	Mendel J.	+	+		1
Marek V.	Gvoždík L.	+	+		1
Maršálková K.	Krojerová J.	+	+	2010	1
Michálková R.	Albrecht T.	+		2009	3
Michálková V.	Ondračková M.	+	+	2010	1
Moravec J.	Martínková N.		+		1
Morongová K.	Honza M.	+		2009	1
Nováčková K.	Barančková M.	+	+		1
Opatová P.	Bryja J.	+	+		1
Paclíková H.	Vinkler M.		+		1
Pečnerová P.	Martínková N.	+	+		1
Píše R.	Rudolf I.	+		2009	1
Polcrová P.	Hubálek Z.	+		2009	1
Polčák D.	Gvoždík L.		+		1
Poplová J.	Vinkler M.		+		3

Student	Supervisor/ Consultant	2009	2010	Thesis defended	Faculty/ Univ.
Přesličková I.	Vinkler M.		+		3
Příkryl D.	Procházka P.	+	+		1
Schrommová V.	Heroldová M.	+		2009	1
Slaninková E.	Rudolf I.	+		2009	1
Slováčková I.	Ondračková M.	+	+	2010	1
Sommerová K.	Bryja J.	+	+		1
Straková P.	Hubálek Z.		+		1
Strnadová M.	Vošlajerová B.		+		1
Šlapanský L.	Jurajda P.	+	+	2010	1
Štěpina J.	Jurajda P.	+	+	2010	1
Štrom V.	Reichard M.	+		2009	1
Šulc M.	Procházka P.	+	+	2010	3
Švehlík P.	Homolka M.	+	+	2010	1
Těšíková J.	Bryja J.		+		1
Tříška P.	Martínková N.	+		2009	1
Venclíková K.	Svobodová P.	+		2009	1
Větrovcová H.	Krojerová J.		+		1
Vlčková K.	Petrželková K.	+	+		1
Vrábel D.	Hubálek Z.		+		1
Zouhar P.	Heroldová M.	+	+		1
<b>Total 60</b>		<b>39</b>	<b>44</b>	<b>28</b>	

## Undergraduate students (masters) working in the Institute and/or supervised by the Institute's fellows in 2009–2010

Student	Supervisor/ Consultant	2009	2010	Thesis defended	Faculty/ Univ.
Bainová H.	Vinkler M.	+	+		3
Bainová Z.	Vinkler M.		+		3
Bayerlová M.	Martínková N.	+	+		1
Bažant M.	Piálková J.	+	+		5
Beková M.	Hubálek Z.	+	+		1



Student	Supervisor/ Consultant	2009	2010	Thesis defended	Faculty/ Univ.
Blažková P.	Bryja J.	+		2009	5
Fornůšková A.	Bryja J.	+		2009	1, 10
Gabrielová B.	Albrecht T.	+	+		3
Gettová L.	Hájková P.	+	+		4
Hadamová M.	Gvoždík L.	+	+		1
Hájková A.	Zima J.	+	+		3
Havlátová L.	Ondračková M.	+	+		1
Hlaváčová Z.	Homolka M.	+	+		1
Chovanec D.	Bryja J.		+		1
Jelínek V.	Procházka P.	+	+	2010	3
Kalinová Z.	Koubek P.	+		2009	9
Kazdová K.	Hubálek Z.	+	+		1
Kotasová K.t	Albrecht T.	+	+		3
Králová T.	Bryja J.		+		1
Krejčí P.	Hubálek Z.		+		1
Měráková E.	Gvoždík L.	+	+		1
Michálková R.	Albrecht T.	+	+		3
Michálková V.	Ondračková M.		+		1
Morongová K.	Honza M.	+	+		1
Mrkvičková H.	Albrecht T.	+		2009	3
Mwanahamisi I.M.	Bryja J.	+	+		1
Pecková R.	Homolka M.	+	+		1
Petrášová I.	Reichard M.	+		2009	1
Píše R.	Rudolf I.	+	+		1
Rudá M.	Martínková N.	+		2009	4
Růžicová M.	Petrželková K.	+	+		7
Rybníkář J.	Prokeš M.	+	+	2010	11
Řežucha R.	Reichard M.	+	+	2010	1
Shovancová K.	Petrželková K.	+	+		1
Schrommová V.	Heroldová M.	+	+		1
Sládkovičová V.	Hájková P.	+	+	2010	4
Slováčková I.	Ondračková M.		+		1
Smetanová Z.	Koubek P.	+	+		1

Student	Supervisor/ Consultant	2009	2010	Thesis defended	Faculty/ Univ.
Soudková M.	Albrecht T.	+	+		3
Šamajová P.	Gvoždík L.	+	+		1
Štoviček O.	Albrecht T.	+	+	2010	3
Šulc M.	Procházka P.		+		3
Švehlík P.	Homolka M.		+		1
Tříška P.	Martínková N.	+	+		1
Urbánková S.	Mendel J.	+	+		2
Venclíková K.	Rudolf I.	+	+		1
Vrtílek M.	Reichard M.	+	+	2010	1
Žáček F.	Zukal J.	+	+		1
<b>Total 48</b>		<b>40</b>	<b>42</b>	<b>12</b>	

### PhD students working in the Institute and/or supervised by the Institute's fellows in 2009–2010

Student	Supervisor/ Consultant	2009	2010	Thesis defended	Faculty/ Univ.
Bartoňová E.	Lusková V.	+	+		1
Bednářová J.	Zukal J.	+	+		1
Brunner H.	Zima J.	+	+		3
Břehová J.	Piálek J.	+	+		3
Čepelka L.	Heroldová M.		+		1
Čížková D.	Bryja J.	+	+		1
Doli A.	Koubek P.		+		3
Dufková P.	Piálek J.	+	+		5
Ďureje L.	Piálek J.	+	+		1
Fainová D.	Bryja J.	+	+		5
Fornůsková A.	Bryja J.	+	+		1,8
Francová K.	Ondračková M.	+	+		1
Hiadlovská Z.	Vošlajerová B.	+	+		1
Honig V.	Hubálek Z.	+	+		5
Hulová Š.	Bryja J.	+	+		5
Javůrková V.	Albrecht T.	+	+		3
Jelínek V.	Procházka P.		+		3

Konečná M.	Reichard M.	+		2009	1
Konečný A.	Bryja J.	+		2009	1,8
Koubínová D.	Zima J.		+		3
Martínková D.	Albrecht T.	+	+		3
Mašová Š.	Baruš V.	+	+		1
Mazoch V.	Bryja J.	+	+		5
Patzenhauerová H.	Bryja J.	+	+		1
Petrášová J.	Petrželková K.	+	+		6
Poláková R.	Bryja J.	+	+		1
Pomajbíková K.	Petrželková K.	+	+		6
Požgayová M.	Honzka M.	+	+	2010	1
Profousová I.	Petrželková K.	+	+		6
Promerová M.	Bryja J.	+	+		1
Rybníkář J.	Prokeš M.		+		11
Řežucha R.	Reichard M.		+		1
Smolinský R.	Gvoždík L.	+	+		1
Svobodová P.	Hubálek Z.	+	+		1
Sychra J.	Adámek Z.	+	+		1
Tomášek O.	Albrecht T.	+	+		3
Vacek J.	Koubek P.		+		6
Vinkler M.	Albrecht T.	+	+		3
Vrtílek M.	Reichard M.		+		1
Všetičková L.	Adámek Z.	+	+		1
Wasimuddin	Bryja J.		+		1
Zemanová B.	Bryja J.	+	+		1
<b>Total</b>	<b>42</b>	<b>33</b>	<b>40</b>	<b>3</b>	

- 1 Faculty of Science, Masaryk University, Brno
- 2 Faculty of Science, Palacký University, Olomouc
- 3 Faculty of Science, Charles University, Prague
- 4 Faculty of Science, Komenský University, Bratislava
- 5 Faculty of Science, University of South Bohemia
- 6 Faculty of Forestry and Wood Technology, Mendel University in Brno
- 7 Faculty of Veterinary Medicine, University of Veterinary and Pharmaceutical Sciences Brno
- 8 Université Montpellier II, France
- 9 Faculty of Forestry, Wildlife and Wood Sciences, Czech University of Life Sciences, Prague
- 10 Université de Rennes, France
- 11 Faculty of Agronomy, Mendel University in Brno

## | EDITORIAL ACTIVITIES

The Institute publishes the international journal *Folia Zoologica* jointly with the Faculty of Environmental Sciences, Czech University of Life Sciences in Prague. The journal has a tradition longer than 80 years, and it is currently covered by many reference journals, including the Elsevier Bibliographic Databases (Scopus) and ISI Web of Knowledge by Thomson Reuters.

### **Publisher and address of Editorial Office:**

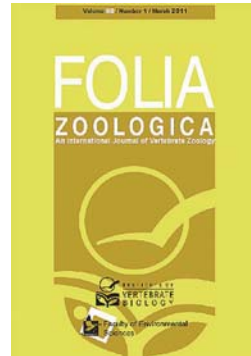
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e-mail: [editorfz@brno.cas.cz](mailto:editorfz@brno.cas.cz)

### **Editors-in-Chief:**

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### **Managing Editor:**

Lenka GLOSOVÁ, Brno, e-mail: [editorfz@brno.cas.cz](mailto:editorfz@brno.cas.cz)



## Aims & Scopes

*Folia Zoologica* publishes articles containing original insight into various aspects of vertebrate zoology that are not published and not under consideration for publication elsewhere. The journal welcomes significant papers presenting new and original data of more than regional significance. Studies testing explicitly formulated hypotheses are preferred to those presenting primarily descriptive results. Review papers are particularly welcomed and should deal with topics of general interest or of current importance, being synthetic rather than comprehensive in emphasis.

The journal is published quarterly and one volume usually consists of four issues. However, additional issues can be published occasionally as supplements. There is no page charge except of monographs, supplemental issues, and colour pages.

Abstracts of articles published in *Folia Zoologica* are available on [http://www.ivb.cz/pubser\\_en.htm](http://www.ivb.cz/pubser_en.htm) and <http://isi17.isiknowledge.com>; full papers are distributed by ProQuest <http://www.proquest.com/> and EBSCO.

In 2009 and 2010, eight regular issues, one supplement, and one monograph were published. Altogether, 94 full papers appeared in the two previous volumes of *Folia Zoologica*, covering various areas of mammalogy, ornithology, herpetology, and ichthyology.

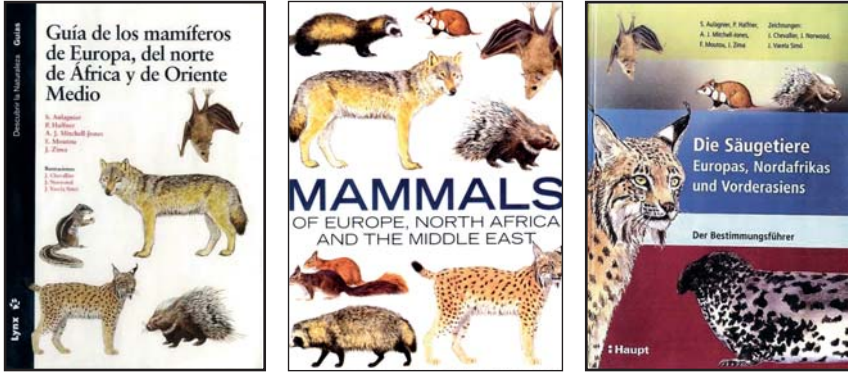
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## | BOOKS CO-AUTHORED OR CO-EDITED BY THE INSTITUTE'S FELLOWS



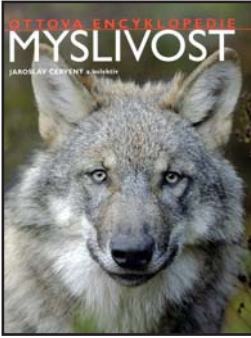
AULAGNIER S, HAFFNER P, MITCHELL-JONES AJ, MOUTOU F, ZIMA J, 2009. Guía de los mamíferos de Europa, del norte de África y de Oriente Medio. Lynx Edicions, Barcelona, 272 pp. ISBN 978-84-96553-52-1.

AULAGNIER S, HAFFNER P, MITCHELL-JONES AJ, MOUTOU F, ZIMA J, 2009. Mammals of Europe, North Africa and the Middle East. A&C Black Publishers, London, 272 pp. ISBN 978-1-4081-1399-8.

AULAGNIER S, HAFFNER P, MITCHELL-JONES AJ, MOUTOU F, ZIMA J, 2009. Die Säugetiere Europas, Nordafrikas und Vorderasiens. Haupt Verlag, Bern, 272 pp. ISBN 978-3-258-07506-8.

This book contains a complete account of all mammalian species distributed over the western Palearctic, excluding cetaceans. The region covered includes Europe, North Africa and the Middle East, with a major part of Asia Minor. The book also represents a new guide to European mammals. Brief characteristics of each species are provided, along with colour illustrations and black and white figures of discriminant traits. The book is aimed at both professional zoologists and amateurs. [Available in French, Spanish, English and German]





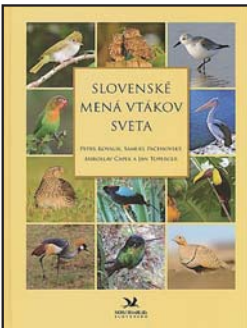
ČERVENÝ J, KAMLER J, KHOLOVÁ H, KOUBEK P, MARTÍNKOVÁ N, 2010. *Myslivost: Ottova encyklopedie*. 2nd rev. ed. Ottovo nakladatelství, Praha, 591 pp. ISBN 978-80-7360-895-8.

This publication covers: The history of hunting, legislation of the Czech Republic and EU, hunting and nature protection, game and landscape, biology of game birds, biology of game mammals, tracks, genetics of game, nutrition of game, diseases of game, importance of game in ecosystems, game management, hunting, hunting trophies, hunting statistics, kynology, falconry, hunting hipology, game research, and weapons and optics.



HORÁČEK I, UHRIN M (eds), 2010. *A tribute to bats*. Lesnická práce, Kostelec nad Černými lesy, 400 pp. ISBN 978-80-87154-44-1.

This book presents a mosaic of texts and pictures that reminds us that bats have been a focus of scientific and conservation interest in our country and that a lot of reliable information concerning these fascinating animals is available here. The survey of distribution status for all bat species occurring in the territory of the former Czechoslovakia, and the almost complete bibliography of bat research literature that has arisen from this region and/or refers to its local bat fauna, are perhaps of particular interest in this respect. Other sections deal with the history and current trends of studies of Czech and Slovak bats, followed by a selection of brief research papers that supplement the texts with some pertinent examples.



KOVALÍK P, PAČENOVSKÝ S, ČAPEK M, TOPERCER J, 2010. *Slovenské mená vtákov sveta*. SOS/BirdLife Slovensko, Bratislava, 396 pp. ISBN 978-80-970481-0-5.

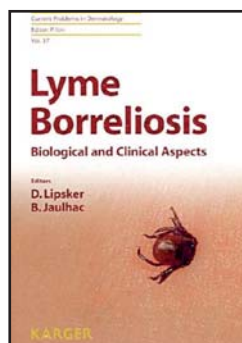
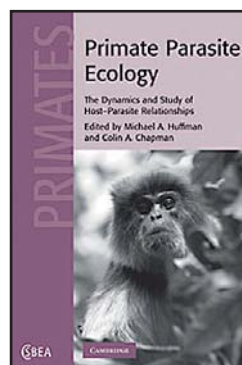
*Slovak Names for the Birds of the World* is the first complete list of Slovak names for all known extant and recently extinct birds of the world. It defines roughly 13,000 Slovak species names, and also several thousand names for orders, families, subfamilies and genera. Prior to the compilation of this list, more than 3,000 Slovak names of bird taxa had already been published. In order to ensure the widest possible acceptance and stability, the list is probably the first to undergo extensive review by both experts and public (during discussions held on several Internet forums). The purpose of the book is to provide Slovak names for all living bird taxa and to overcome the problems associated with the use of two alternatives for Slovak bird names. The recommended names have been approved by the Board of the Slovak Ornithological Society/BirdLife Slovakia as an authorised list of recommended Slovak bird names.

DUPAIN J, NELL C, PETRŽELKOVÁ KJ, GARCIA P, MODRÝ D, PONCE FG, 2009. Gastrointestinal parasites of bonobos in the Lomako Forest, Democratic Republic of Congo. In Huffman M, Chapman C (eds), *Primate parasite ecology: the dynamics and study of host-parasite relationships*. Cambridge University Press, Cambridge: 297-310. ISBN 978-0-521-87246-1.

K. Petrželková, author of a chapter in this book studied parasites of bonobos (*Pan paniscus*) in the Lomako Forest, Equator Province, Democratic Republic of Congo. In studying 87 faecal samples of bonobos, she identified five species of intestinal parasite, including one entodiniomorph ciliate (*Trogodytella* sp.) and five nematodes (*Trichuris* sp., hookworms, *Strongyloides fuelleborni*, *Oesophagostomum* sp., and *Ascaris* sp.). In addition, four different types of unidentified eggs were found, three of them being trematodes and one a nematode. Exclusion of the ciliate *Trogodytella*, which is a possible symbiont of African apes, leaves *Oesophagostomum* sp. as the most prevalent real parasite. Most of the animals were infected with one to three parasites. If we exclude the suggested symbiont ciliate, most animals were infected by two or less parasite species.

HUBÁLEK Z, 2009. Epidemiology of Lyme borreliosis. In Lipsker D, Jaulhac BB (eds), *Lyme borreliosis – biological and clinical aspects*. Karger, Basel: 31-50. ISBN 978-3-8055-9114-0.

Lyme borreliosis (LB) is the most frequent ixodid tick-borne human disease in the world, with an estimated 85,500 patients annually (underlying data presented in the review: Europe c. 65,500; North America c. 16,500; Asia c. 3,500; North Africa c. 10). This chapter summarises up-to-date knowledge on facts and factors important in the epidemiology of LB over the world. Individual paragraphs briefly describe geographic (latitudinal and altitudinal) distribution and incidence rates of LB in individual countries; seasonal distribution of the disease; effects of patient's age, sex, and profession; comparison of urban vs. rural settings; weather effects on LB incidence; risk factors for LB acquisition by humans, and risk assessment. The chapter ends with a recommendation for a more thorough epidemiological surveillance for LB, including morbidity notification in additional countries where it has not yet been fully implemented.



## | AWARDS

In 2009, Markéta Ondračková was awarded the Otto Wichterle Prize for her studies on various aspects on fish and parasite ecology. Her current research interest is concentrated on parasite communities in fish hosts, ecological aspects of host-parasite interactions in juvenile fish, the effect of parasite infection on fish behaviour, the role of environmental factors on fish reproduction success, and parasitism and ecology of introduced species. She is also involved in projects on fish parasite fauna carried out in Bangladesh and Senegal.







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