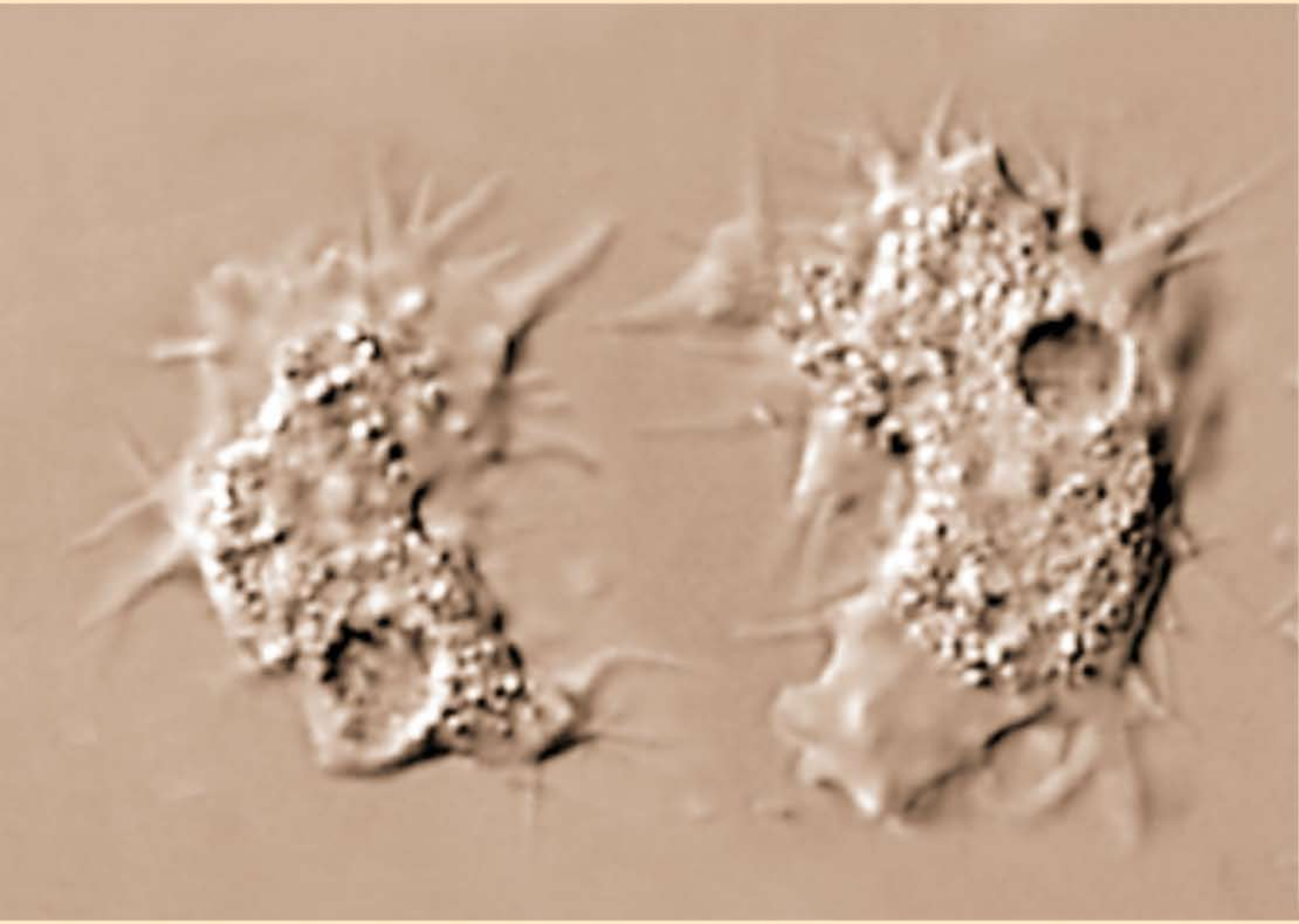
BIOLOGY CENTRE
OF THE ACADEMY OF SCIENCES
OF THE CZECH REPUBLIC, v.v.i.

Institute of Parasitology

50 years



BIENNIAL REPORT 2010–2011

Institute of Parasitology

Biology Centre of the Academy of Sciences
of the Czech Republic, v.v.i.
České Budějovice

Biennial Report

A Brief Survey of the Institute's Organisation and Activities

2010 – 2011

Contents

Structure of the Institute

(*As of 1 January 2012*)

Director
(***Tomáš SCHOLZ***)

Deputy Director
(***Jan Kopecký***)

Molecular Parasitology

- **Laboratory of Molecular Biology of Protists** (*Julius Lukeš*)
- **Laboratory of Evolutionary Protistology*** (*Miroslav Oborník*)
- **Laboratory of Functional Biology of Protists** (*Alena Zíková*)
- **Laboratory of Molecular Genetics of Nematodes** (*M. Asahina-Jindrová*)
- **Laboratory of Molecular Helminthology** (*Jan Dvořák*)

Folia Parasitologica
(*Tomáš Scholz*)

Administrative and technical services

Ticks and Tick-Borne Diseases

- **Laboratory of Molecular Ecology of Vectors and Pathogens*** (*Libor Grubhoffer*)
- **Laboratory of Vector Immunology** (*Petr Kopáček*)
- **Laboratory of Parasite Immunology** (*Jan Kopecký*)
- **Laboratory of Genomics and Proteomics of Disease Vectors** (*Michalis Kotsyfakis*)

Supporting Facilities

- **Laboratory of Electron Microscopy** (*Jana Nebesářová*)
- **Animal Facility** (*Tomáš Douda*)

Scientific Council

Miroslav Oborník (Chairman)
Libor Grubhoffer
Astrid Holzer
Petr Kopáček
Julius Lukeš
Alena Zíková

External members
Petr Horák
Petr Volf

Organismal and Evolutionary Parasitology

- **Laboratory of Fish Protistology** (*Astrid Holzer*)
- **Laboratory of Veterinary and Medical Protistology** (*Martin Kváč*)
- **Laboratory of Helminthology** (*Tomáš Scholz*)
- **Laboratory of Molecular Phylogeny and Evolution of Parasites** (*Václav Hypša*)

***Joint research unit of**
Institute of Parasitology and Faculty of Science, University of South Bohemia

Editorial

It is my honour to write an Editorial for another biennial report of the Institute of Parasitology, a research institution that forms part of the Biology Centre of the Academy of Sciences of the Czech Republic in České Budějovice. This report summarizes activities and achievements of the staff of this institution during the last two years, i.e. in 2010 and 2011. In June 2012, I will finish my duties as the Director of the Institute. Since I have served on this position for more than 10 years, I take this opportunity to briefly overview this decade. In addition, the Institute celebrates 50 years of its existence this year, which is a testament to its viability and ability to keep good-quality research at the international level.

Since 2002, the Institute of Parasitology (hereinafter referred to as IP) has undergone three peer-review evaluations, and it is my great pleasure to acknowledge that its rating has always been high. During the evaluation in 2004, one of the reviewers pointed out that the IP staff had not published a single paper in top journals such as *Nature* or *Science*. It was rather tough to hear this criticism, but ultimately it was correct.

I am really proud to acknowledge that our leading researchers, Julius Lukeš and Miroslav Oborník to name just two of them, took this challenge seriously, and as a result, three papers in *Nature* and two in *Science*, not speaking of articles in *Cell*, *PNAS*, *Lancet*, *Clinical Microbiology Reviews* and other highly influential journals have been published with co-authors from the IP.

Every year, publication output has been rising both in the number of papers (more than 100 articles annually in recent years) and in a total sum of impact factors (more than 300). Many of these papers are co-authored by our young colleagues, including graduate students and even some undergraduates.

In January 2011, the IP and its three teams, which represented three major research lines, got a very favourable rating from the Evaluation Committee, with two teams, namely Molecular Parasitology and Organismal & Evolutionary Parasitology, being rated with the highest score. Of the five research institutes that form the Biology Centre, the IP was the best rated one, which demonstrates that effort invested into a rigorous personal policy and differential support of individual teams based on their scientific achievements was the right strategy. However, it is obvious that there is still much to be improved, and the scientific output of many laboratories should be much higher to further increase the international recognition of the IP.

The IP also publishes the scientific journal *Folia Parasitologica*, which ranks among the respected periodicals in the field of whole-organism parasitology. I am much obliged to the previous Editor-in-Chief, Vladimír Bukva, and other editors (František Moravec and Libor Grubhoffer) who helped him in the difficult effort to publish an international journal by a non-commercial publisher and to keep its quality at a competitive level.

In the recent two years, researchers of the IP have been fairly successful in getting financial support from granting agencies in the Czech Republic and abroad, which enabled us to open new laboratories and to hire new staff, including foreigners. Our participation in EU projects has also increased, especially in Marie-Curie fellowships, but also in big teams supported by the 7th Framework Programme; this concerns mainly the laboratory of Libor Grubhoffer dealing with tick-borne diseases.

One of the most important activities of most IP employees is participation in undergraduate and graduate teaching, with close cooperation with the Faculty of Science at the University of South Bohemia. Key researchers are teachers and supervisors of students of all degrees, which makes it possible to include talented and motivated students into research teams in individual laboratories. Some of the best students were hired as researchers after they had completed successful postdoctoral stays abroad.

To conclude, I would like to thank all of the staff of the IP for their dedication and excellent results. Above all, my sincere thanks are due to the Deputy Director, Jan Kopecký, who has helped me very much, particularly being in charge of the IP during my numerous stays abroad during the last ten years, and to Eva Franková, Head of the Secretariat, who was keeping everyday life of the IP in good shape and mood.

I wish that the new Director after me will have as nice a time in his/her position as I had because I have learned very much. I also wish that visitors and foreign collaborators will find our institution worth collaborating with, full of open-minded researchers and enthusiastic students who will enjoy unravelling the secrets of the world of parasites and the intimate relationships between hosts and their pathogens.

Tomáš Scholz, Director

Mission statement

The Institute of Parasitology, Biology Centre of Academy of Sciences of the Czech Republic, v.v.i. (public research institution), performs research on human and animal parasites at the organismal, cellular and molecular levels. Its mission is to acquire, advance and disseminate knowledge of the biology and host relationships of parasitic unicellular eukaryotic microorganisms – protists, helminths and arthropods. The Institute pursues this goal through research, education and other activities at both the national and international levels. The results obtained have contributed to the prevention and control of human and animal parasitic diseases and have an impact on human health and agriculture, including fisheries.

The Institute of Parasitology was established in Prague in 1962, but was relocated to České Budějovice in South Bohemia in 1985. It is the principal institution in the Czech Republic devoted exclusively to parasitological research. The main research areas encompass molecular parasitology, ticks as disease vectors, and organismal and evolutionary parasitology.

Research areas

The mission of the Institute of Parasitology is primarily research in parasitology, with a focus on obtaining and presenting new information on the biology of the causative agents of parasitic diseases of man and animals. The main areas representing the priorities of the Institute's research are listed below:

1. **Molecular parasitology**
   - Functional genomics of the mitochondrion of the flagellate *Trypanosoma brucei*
   - Population structure of the causative agents of leishmaniosis in Europe
   - Secondary endosymbiosis and evolution of plastids
   - Discovery of drug targets to eliminate infectious diseases caused by *Trypanosoma* and *Leishmania* parasites
   - Genetic analysis of the nuclear receptor function in the model nematode *Caenorhabditis elegans*

2. **Biology of disease vectors**
   - Molecular and cellular factors of pathogen transmission in ticks
   - Immunology of host-vector interactions with respect to pathogen transmission
   - Molecular ecology of Lyme borreliosis and tick-borne encephalitis with respect to their antigenic structures and protein-carbohydrate interactions

3. **Organismal (whole-organism) and evolutionary parasitology**
   - Morphology, molecular taxonomy and pathogenicity of amphizoic amoebae
   - Life cycles, ultrastructure and phylogeny of myxosporeans
   - Cryptosporidia and microsporidia as emerging opportunistic parasites of man
   - Life cycles, biology, host specificity, phylogeny and host-parasite relationship of cryptosporidia and microsporidia
   - Systematics, biology and ecology of helminth parasites related to the aquatic environment
   - Parasite distribution and host specificity as the result of coevolution and host-switching
   - Molecular phylogeny of the bacteria associated with blood-feeding arthropods

Publishing

The Institute of Parasitology publishes the international journal *Folia Parasitologica*. It is issued quarterly and publishes contributions from all branches of parasitology.

Facilities and capabilities

The laboratories of the Institute of Parasitology are well equipped with instruments to perform a vast array of methods, such as scanning and transmission electron microscopy, histopathology, biochemistry, molecular biology, plus facilities for tissue and cell cultures. Its facilities make it possible to study host-parasite interactions at the organismal, cellular and molecular levels. The Institute of Parasitology's research activities are augmented by equipment available in other research institutes within the Biology Centre of the Academy of Sciences of the Czech Republic, v.v.i., in České Budějovice. The Institute also possesses an animal facility accredited for experiments with laboratory animals and it has been approved for work with genetically modified organisms.

The Institute of Parasitology maintains cultures of parasitic protists, cell lines and laboratory colonies of ticks and mosquitoes. Extensive collections of type and voucher materials (about 3,000 species of protists, helminths and parasitic arthropods) are also deposited at the Institute of Parasitology.

Education

The Institute of Parasitology has a close relationship with the Faculty of Science, University of South Bohemia in České Budějovice. The staff of the Institute is engaged in teaching activities in both MSc and PhD programs at the University. The practical research experience and preparation of theses of undergraduate and graduate students of the Faculty of Science are facilitated by the established research programs of the Institute.

The Institute of Parasitology is also involved in undergraduate and graduate teaching at the Charles University in Prague, Masaryk University in Brno and the University of Veterinary and Pharmaceutical Sciences in Brno. The Institute endorses doctoral programs in parasitology, molecular and cellular biology and zoology at the Faculty of Science of the University of South Bohemia, and it has also been licensed for doctoral studies in parasitology for the Faculty of Science, Charles University in Prague.

The Institute of Parasitology offers opportunities for postdoctoral and residency training in parasitology. The staff also organizes international training courses and its researchers participate as lecturers in parasitology courses abroad.

Other activities

An integral part of the Institute's activities is the organisation of scientific events such as international symposia and workshops. Scientists of the Institute provide expert opinions to national and international agencies, professional societies and grant agencies. Researchers of the Institute also serve as members of editorial and advisory boards of international journals, in addition to being referees of peer-reviewed journals.

Laboratory of Molecular Biology of Protists

Research scientists:	Prof. RNDr. **Julius LUKEŠ**, CSc. (head) RNDr. **Milan Jirků**, **Hassan Hashimi**, PhD RNDr. **Eva Horáková**, PhD, **Pavel Flegontov**, PhD
PhD students:	**Piya Changmai**, MSc. (Thailand), **Somsuvro Basu**, MSc. (India), **Zhenqiu Huang**, MSc. (China), RNDr. **Lucie Novotná**, RNDr. **Zdeněk Paris**, RNDr. **Pavel Poliak**, Mgr. **Tomáš Skalický**, Mgr. **Jiří Týč**, Ing. **Zuzana Vávrová**, RNDr. **Zdeněk Verner**
Technicians:	**Gabriela Ridvanová**, RNDr. **Eva Stříbrná** (**Černotíková**)
Undergraduate students:	Bc. **Lucie Kafková** (**Hanzálková**), Bc. **Julie Kovářová**, Bc. **Petr Růžička**, **Vojtěch David**, **Alexander Haindrich**, **Sabine Kaltenbrunner**, **Jiří Ťápal**

Research priorities

The primary interest is functional analysis of selected mitochondrial proteins of the kinetoplastid *Trypanosoma brucei*. Its mitochondrion is unique in many aspects and by knocking-down or knocking-in individual genes, we are trying to establish their functions. We have focused on (i) proteins involved in RNA editing and regulation of stability of mitochondrial transcripts, (ii) subunits of respiratory complexes, (iii) iron/sulfur cluster assembly proteins, and (iv) prohibitin. We are also interested in the evolution and biodiversity of parasitic kinetoplastid flagellates, as well as involved in the genotyping of European leishmaniases and designing new diagnostic approaches for their detection. Moreover, we are trying to improve a new expression system in *Leishmania tarentolae*.

Functional analysis of RNA editing in *Trypanosoma brucei*

We have generated knock-down cell lines of *T. brucei* procyclics, in which numerous RNA binding proteins are down-regulated by RNA interference. We have shown that these proteins exist in at least two complexes (MRP1/2 and MRB1), which are involved in RNA editing, RNA processing and stabilization of mitochondrial transcripts. In a collaborative effort, we study protein interactions within these complexes, but also try to understand how RNA molecules are bound to them.

Analysis of dyskinetoplastic trypanosomes

The life cycle of *Trypanosoma brucei* involves a bloodstream stage (BS) in vertebrates and a procyclic stage (PS) in the tsetse fly vector. Partial (dyskinetoplastidy, Dk) or total loss (akinetoplastidy, Ak) of kinetoplast DNA (kDNA) locks the trypanosome in the BS form. Transmission between vertebrates becomes mechanical without PS and tsetse mediation. *Trypanosoma equiperdum* and *T. evansi* are agents of dourine and surra, diseases of horses, camels and water buffalos. We showed that both species are actually strains (subspecies) of *T. brucei*, which lost part (Dk) or all (Ak) of their kDNA. Currently, we are part of a consortium sequencing the genome of *T. b. evansi*. Furthermore, we are also analysing the mitochondrial proteome of *T. b. evansi*.

Evolution and biodiversity of Kinetoplastida

Using conserved rRNA and protein-coding gene sequences, we are mapping biodiversity of kinetoplastid flagellates infecting insects and vertebrates. Moreover, we would like to shed light on the evolution of hallmark features of kinetoplastids, such as the extremely complex mitochondrial (= kinetoplast) genome and RNA editing. We would also like to understand the process of dyskinetoplastidy (loss of kinetoplast DNA), in particular its extent in species pathogenic for horses (*Trypanosoma equiperdum*) and possibly also for man (*T. evansi*).

Diagnostics and epidemiology of European leishmaniasis

In a collaborative effort sponsored by the EU, we mapped the species composition and population structure of the *Leishmania donovani* complex. Our focus was mostly on strains isolated from patients in various countries of the Mediterranean, but we extended the analysis also to African and Indian strains. We have sequenced protein-coding genes and performed extensive RAPD analyses that provide novel information about geographic correlation, recombination and diversity of these pathogens. We have also designed species-specific and highly sensitive PCR assays that shall highly improve diagnostics of leishmaniases.

Selected publications

- Ammerman M.L., **Hashimi H.**, **Novotná L.**, **Číčová Z.**, Mcevoy S.M., **Lukeš J.**, Read L.K. 2011: MRB3010 is a core component of the MRB1 complex that facilitates an early step of the kinetoplastid RNA editing process. *RNA* 17: 865–877. [IF = 6.051]
- Alfonzo J.D., **Lukeš J.** 2011: Assembling Fe/S-clusters and modifying tRNAs: ancient co-factors meet ancient adaptors. *Trends in Parasitology* 27: 234–237. [IF = 4.906]
- Gray M.W., **Lukeš J.**, Archibald J.M., Keeling P.J., Doolittle W.F. 2010: Irremediable complexity? *Science* 330: 920–921. [IF = 31.364]
- Janouškovec J., Horák A., Oborník M., **Lukeš J.**, Keeling P.J. 2010: A common red algal origin of the apicomplexan, dinoflagellate, and heterokont plastids. *Proceedings of the National Academy of Sciences of the United States of America* 107: 10949–10954. [IF = 9.771]
- **Paris Z.**, **Changmai P.**, Rubio M.A.T., Zíková A., Stuart K.D., Alfonzo J.D., **Lukeš J.** 2010: The Fe/S cluster assembly protein Isd11 is essential for tRNA thiolation in *Trypanosoma brucei*. *Journal of Biological Chemistry* 285: 22394–22402. [IF = 5.328]

Research projects

- **Characterization of a novel protein complex involved in RNA processing and editing in the mitochondrion of *Trypanosoma brucei*.** Grant Agency of the Czech Republic (204/09/1667; P.I.: J. Lukeš; 2009–2012)
- **The role of *Trypanosoma brucei* RNA binding proteins in mitochondrial transcript processing.** Grant Agency of the Academy of Sciences of the Czech Republic (IAA500960705; P.I.: J. Lukeš; 2007–2010)
- **Model organisms as a key to the understanding of functions of disease-related human genes.** Ministry of Education, Youth and Sports (2B06129; P.I.: J. Lukeš; 2006–2011)
- **Genomic, transcriptomic and proteomic view of a photosynthetic algae *Chromera velia*, a evolutionary 'missing link' to the human malaria parasites.** Global collaborative grant, King Abdullah University of Science and Technology, Saudi Arabia (P.I.: A. Pain and J. Lukeš; 2010–2012)

Laboratory of Evolutionary Protistology

Joint Research Unit with Faculty of Science, University of South Bohemia, České Budějovice

Research scientists:	Doc. Ing. **Miroslav OBORNÍK**, PhD (head), Mgr. **Aleš Horák**, PhD, RNDr. **Eva Roubalová**, PhD
Research assistant:	Mgr. **Kateřina Jiroutová**, PhD
PhD students:	Mgr. **Jaromír Cihlář**, Mgr. **Luděk Kořený**, Mgr. **Jitka Kručinská**
Undergraduate students:	Bc. **Martina Jonáková**, Bc. **Tomáš Vodička**, Bc. **Kateřina Voráčová**, **Julie Kovářová**

Research priorities

Laboratory of Evolutionary Protistology (LEP) (formerly Laboratory of Molecular Taxonomy) was established in 2000 as a joint unit of the Institute of Parasitology and Faculty of Biological Sciences (now Faculty of Science), University of South Bohemia. At present the laboratory is designed to study evolution of protists and related algae. LEP is supported by the Ministry of Education, Youth and Sports of the Czech Republic (6007665801) and grants covering particular projects.

Tetrapyrrole synthesis and its role in plastid evolution

Tetrapyrrole biosynthesis ranks among the most fundamental pathways in living systems. It serves for the synthesis of heme, a molecule central to the oxidative and energy metabolism, and chlorophyll formation in photoautotrophs. Chlorophyll is an essential photosynthetic pigment that is synthesized via the same pathway as heme, with an exception of the last step, when the magnesium (chlorophyll) instead of iron (heme) is incorporated into the tetrapyrrole ring. It appears that the synthesis is mosaic, being composed of enzymes of various origins, and that such composition reflects the evolutionary origins of an organism. We have studied the synthesis in complex algae *Euglena gracilis* (Excavata: Euglenozoa) and *Chromera velia* (Chromalveolata: Chromerida). We suggested that the specific stage with two separated tetrapyrrole pathways is present in the evolution of complex plastids. In such phase one pathway shows mitochondrial and cytosolic location, while the entire second pathway is located to the plastid. We propose that it is the loss of the tetrapyrrole pathway located in mitochondrion and cytosol that generally leads to the essentiality of the plastid possessing the only tetrapyrrole pathway in the cell. The plastid cannot be lost anymore or the organism has to find some other (external) source of the heme. The pathway can serve as a indicator of plastid evolution.

Genomics of chromerid algae

Chromerid algae have been so far isolated from corals in Australia. The two species described up to date, *Chromera velia* and recently *Vitrella brassicaformis* (in 2012) are being sequenced in cooperation with KAUST (Saudi Arabia). In addition to the already sequenced plastid genomes of both chromerid algae, we are currently finishing the mitochondrial genome, and both nuclear genomes are closed to be fully sequenced as well. We are supposed to substantially participate on the annotation of these genomes.

Diatom genomics and metabolomics

We have participated on the annotations of two diatom genomes (*Thalassiosira pseudonana* and *Phaeodactylum tricornutum*). The knowledge of these genomes led to the discovery of urea cycle in diatoms, which is supposed to enable diatoms for fast nitrogen uptake and thus may stand behind their high evolutionary success. We have also got an insight into the endosymbiotic gene transfer in these secondary algae, particularly concerning sequential changes during this process and possible obstacles in phylogenetic analysis of such sequences.

Circadian rhythms in *Chromera velia*

Most of organisms on Earth possess internal mechanism utilized to orientate in the time. We have studied the possible presence of genes associated with circadian clocks in secondary alga *Chromera velia* and observed if their regulation is dependent on light regime or not. We have identified at least two cryptochrome genes transcription of which is obviously driven by internal oscillator.

Selected publications

- Allen A.E., Dupont C.L., **Oborník M.**, **Horák A.**, Nunes-Nesi A., McCrow J.P., Zheng H., Johnson D.A., Hu H., Fernie A.R., Bowler C. 2011: Evolution and metabolic significance of the urea cycle in photosynthetic diatoms. *Nature* 473: 203–209. [IF = 36.101]
- Janouškovec J., **Horák A.**, **Oborník M.**, Lukeš J., Keeling P.J. 2010: A common red algal origin of the apicomplexan, dinoflagellate, and heterokont plastids. *Proceedings of the National Academy of Sciences of the United States of America* 107: 10949–10954. [IF = 9.771]
- **Jiroutová K.**, **Kořený L.**, Bowler C., **Oborník M.** 2010: A gene in the process of endosymbiotic transfer. *PLoS ONE* 5: e13234. [IF = 4.411]
- **Kořený L.**, Lukeš J., **Oborník M.** 2010: Evolution of the heme synthetic pathway in kinetoplastid flagellates: an essential pathway that is not essential after all? *International Journal for Parasitology* 40: 149–156. [IF = 3.822]
- **Kořený L.**, Sobotka R., Janouškovec J., Keeling P.J., **Oborník M.** 2011: Tetrapyrrole synthesis of photosynthetic chromerids is likely homologous to the unusual pathway of apicomplexan parasites. *Plant Cell* 23: 3454–3462. [IF = 9.396]

Research Projects

- **Heme synthesis in Euglenozoa.** Grant Agency of the Czech Republic (206/08/1423, P.I.: M. Oborník, 2008–2010)
- **Genomic, transcriptomic and proteomic view of a photosynthetic algae, (Chromerida), and evolutionary „missing link" to the human malaria parasites.** King Abdulah University of Science and Technology (project FIC/2010/09, Saudi Arabia, 2010–2013)
- ***Chromera velia* – newly discovered live photosynthetic ancestor of parasites of the group Apicomplexa.** Grant Agency of the Academy of Sciences of the Czech Republic (IAA601410907, Co-P.I.: M. Oborník, 2009–2012)

Laboratory of Functional Biology of Protists

Research scientist:	RNDr. **Alena ZÍKOVÁ**, PhD (head)
Research assistant:	**Brian Panicucci**, BSc.
PhD students:	Mgr. **Karolína Šubrtová**, Mgr. **Michaela Veselíková**
Undergraduate students:	**Martina Aistleitner**, **Monika Fraňková**, **Matthias Guggenberger**, **Zuzana Kotrbová**, **Hana Váchová**

Research priorities

Trypanosoma brucei and *Leishmania* spp. are unicellular parasites that cause a significant disease burden in the developing world, affecting the lives of millions. From the pharmacological perspective, unique metabolic processes and protein complexes with singular structure, composition and essential function are of particular interest. Specifically, we study unique properties of the mitochondrial respiratory complexes in both of these evolutionary important protists. Furthermore, we are screening chemical compounds synthesized by collaborators that inhibit enzymes of the purine salvage pathway, thus validating this pathway as a drug target.

Mitochondrial respiratory chain of *T. brucei*

Mitochondrial (mt) protein complexes undergo significant alterations as the parasite alternates between its insect vector and mammalian host. For example, the F_0F_1ATP synthase produces ATP in the insect stage but consumes this molecule in the mammalian bloodstream stage of the parasite in order to maintain the essential mt membrane potential. We are exploring various avenues that allow us to inhibit the essential hydrolytic activity of this enzyme because such an inhibitor should be lethal for the parasite but harmless for the host mammalian cells utilizing the conventional ATP synthase activity of this complex. Our group has identified a small mitochondrial protein, TbIF1, which specifically inhibits the ATPase activity of this complex. Thus, we are actively defining the binding interface between the complex enzyme and TbIF1 so that it can be targeted by structure-based drug design. Furthermore, we are attempting to determine if a compound that leads to mt membrane depolarization in the infectious stage does indeed target the ATP synthase. Finally, in an attempt to better understand the unique characteristics of this important enzyme, we described two novel subunits of the *T. brucei* F_0F_1-ATP synthase/ATPase that are important for the proton pumping activity of the complex.

Mitochondrial respiratory chain of *Leishmania* sp.

During *Leishmania* differentiation from the insect promastigote stage to the mammalian amastigote stage, the parasite shifts its energy metabolism from glucose catabolism to fatty acid oxidation, which coincides with the up-regulation of the proteins involved in oxidative phosphorylation. Thus, increased mt activity may play a crucial role in the survival of amastigotes inside the host cells. Furthermore, it has also been shown that *Leishmania* cells with a decreased cytochrome c oxidase activity are less virulent or non-virulent *in vivo*. This observation raises important questions: Can cytochrome c oxidase be exploited as a potential drug target? Can *Leishmania* with a genetically altered complex IV activity be used as a genetically attenuated vaccine? To study essential genes in this RNAi-lacking organism we are implementing a new

methodology to control protein expression through the regulated degradation of a targeted protein of interest. Once this methodology is established, we plan to determine the role of novel cytochrome c oxidase subunits within this complex and how they specifically affect the parasite's virulence.

Purine salvage pathway in *T. brucei* and *Leishmania* spp.

Another important focus of the lab includes the essential enzymes of the purine salvage pathway. In contrast to mammals, unicellular parasites are unable to synthesize purines *de novo* and instead rely on the purine salvage pathway to recycle purines. There is a substantial number of identified enzymes that are involved in the cleaving, assembling and interconverting of nucleosides in these parasites. However, N-ribosyltransferases are widely considered to be the best chemotherapeutic targets. We are currently screening selective compounds against *T. brucei* and *Leishmania* and we have found several promising candidates. Using genetic methods, we are validating that N-ribosyltransferases are actually the targets of these compounds. This important discovery will allow us to further design more potent and selective inhibitors of this parasitic enzyme.

Selected publication

- Acestor N., **Zíková A.**, Dalley R.A., Anupama A., Panigrahi A.K., Stuart K.D. 2011: *Trypanosoma brucei* mitochondrial respiratome: composition and organization in procyclic form. *Molecular & Cellular Proteomics* 10: 1–14. [IF = 8.354]

Research Projects:

- **Functional analysis of two novel subunits of the F_0F_1-ATP synthase complex in *Trypanosoma brucei*.** Grant Agency of the Czech Republic (204/09/P563; P.I.: A. Zíková, 2009–2011)
- **Determining the function of an essential protein, MIX, within the cytochrome c oxidase of Kinetoplastida.** Grant Agency of the Academy of Sciences of the Czech Republic (KJB500960901; P.I.: A. Zíková, 2009–2011)
- **Comprehensive analysis of F_0F_1-ATP synthase in parasitic protozoa.** EMBO Installation Grant (2010-1965; 2010–2012)

Laboratory of Molecular Genetics of Nematodes

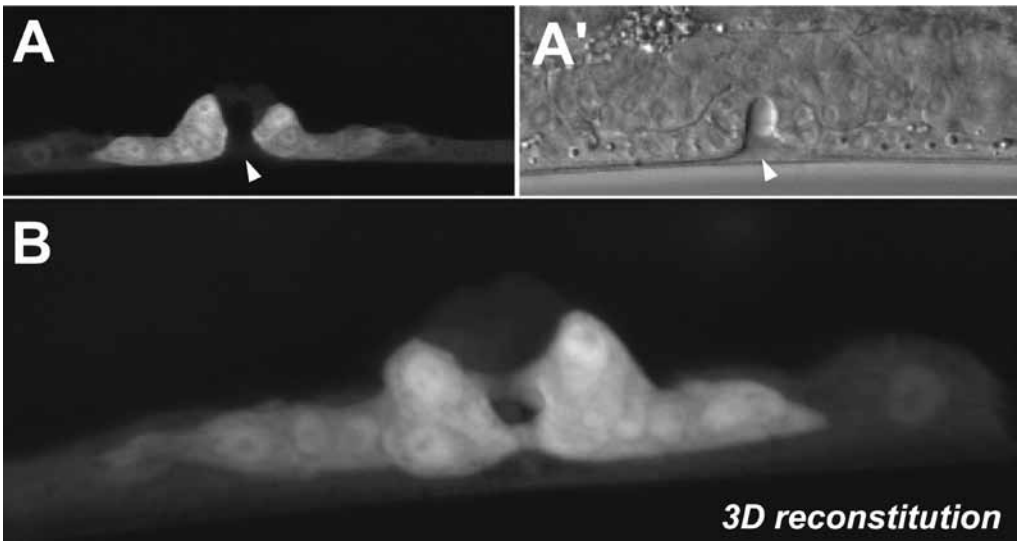
Research scientist:	**Masako ASAHINA-JINDROVÁ**, PhD (head)
PhD student:	**Nagagireesh Bojanala**, MSc.
Undergraduate students:	Bc. **Alexandr Pospěch**, Bc. **Marion Sieber**, BSc., **Dominik Farka**, **Quynh Nguyen**

Research priorities

Organogenesis at the cellular level involves a complex interplay of cell fate acquisition, cell cycle control, remodelling of adherens junctions, cell migrations and cell fusions. Thus, this process is tightly regulated temporarily as well as spatially. Tissue-specific regulatory programs governed by nuclear receptors (NRs) are a critical component of metazoan development and homeostasis with aberrations in these programs leading to pathophysiology. We are using the simplicity and powerful genetics of *Caenorhabditis elegans* to deconvolute how regulatory inputs differentially converge on NRs in specific cell and tissue-types. The single *C. elegans* NR5A family receptor, NHR-25, coordinates diverse tissue-specific developmental events such as molting, seam cell differentiation, fat metabolism, cell fate decisions and vulva formation. In our laboratory, we study the molecular mechanism how a single transcription factor regulates various biological processes in tissue- or cell-context dependent manner.

Mechanism of action of NHR-25 in vulval morphogenesis

Organogenesis of the vulva is a paradigm developmental event where multiple cell signalling pathways interplay. Ancient pathways such as EGF/Ras/MAPK signalling, Wnt/beta-catenin



Expression of the transgene *nhr-25promoter::GFP::unc54 3'utr* in vulva cells of *Caenorhabditis elegans*. A – confocal image of the active *nhr-25* promoter in migrating vulval cells visualized by GFP expression, A' – DIC image of the same tissue. Arrowheads indicated the vulval invagination. B – 3D reconstitution of the confocal images (Imaris).

signalling have been known to have essential roles for vulval morphogenesis. We found that NHR-25 is required for proper cell-fate acquisition and migration during vulva differentiation. Attenuation of *nhr-25* function causes wide range of vulval morphological defects as proper coordination of other signaling pathways is disturbed. To see how NHR-25 can regulate the multitute of biological processes through various pathways, we examined post-translational modification of NHR-25 and discovered that NHR-25 is SUMOylated and the single SUMO gene in *C. elegans*, smo-1, genetically interacts with *nhr-25*. These data suggest that the molecular mechanism of NHR-25 action is far more intriguing and important for fine-tuning of target gene regulation.

Roles of NHR-25 in microRNA heterochronic pathway

Precise timing is essential for animal development. Its alteration, known as heterochrony, causes morphogenetic defects. Yet, little is known about the relationship between timing regulation and execution in terms of molecular action in the cell. Nuclear receptors play multiple roles in animal development, and NHR-25, an ancient member of the family, is involved in morphogenesis of various tissues of the worm *C. elegans*. We demonstrated that NHR-25 genetically interacts with the pathway of heterochronic genes including downstream targets of the *let-7* microRNAs. NHR-25 together with the heterochronic genes modulates the timing of tissue-specific gene expression, cell fusion, cell division and cuticle formation.

Selected publications

- Hada K., **Asahina M.**, Hasegawa H., Kanaho Y., Slack F.J., Niwa R. 2010: The nuclear receptor gene nhr-25 plays multiple roles in the *Caenorhabditis elegans* heterochronic gene network to control the larva-to-adult transition. *Developmental Biology* 344: 1100–1109. [IF = 4.094]
- Seetharaman A., Cumbo P., **Bojanala N.**, Gupta B.P. 2010: Conserved mechanism of Wnt signaling function in the specification of vulval precursor fates in *C. elegans* and *C. briggsae*. *Developmental Biology* 346: 128–139. [IF = 4.094]

Research projects

- **Crosstalk between nuclear receptor and Wnt signaling in *C. elegans*.** Grant Agency of the Czech Republic (204/07/0948, P.I.: M. Asahina-Jindrová; 2007–2011)
- **Intercellular signalling in development and disease.** Grant Agency of the Czech Republic (204/09/H058; P.I.: V. Bryja; Co-I.: M. Asahina-Jindrová; 2009–2012)
- **Model organisms as a key to understand function of genes essential for human health.** MODELGEN Ministry of Education, Youth and Sports (NPV II 2B06129, P.I.: J. Lukeš and M. Jindra; Co-I.: M. Asahina-Jindrová; 2006–2011)

Laboratory of Molecular Helminthology

Research scientist:	RNDr. **Jan DVOŘÁK**, PhD (head)
Technician:	**Irena Husáková**
Undergraduate students:	Bc. **David Opavský**, **Iveta Červenková**, **Marie Kropšová**, **Mirka Kříhová**

Research priorities

Schistosomiasis caused by trematode parasites, *Schistosoma* blood flukes, represents one of the most serious chronic infection in the developing world with more than 200 million people infected and many more at risk. The ability of schistosomes to survive in the mammalian hosts for decades is due to their various modulatory mechanisms. Our interest is in their protein molecules which can actively influence host physiology. Disrupting of these mechanisms by specific drug/vaccine treatment targeting parasite molecules may lead to potential diseases treatment. Such modulatory factors of schistosomes can serve as instrumental molecules for pharmacology. Our research is focused on the studies of proteolytic enzymes and macromolecular protease inhibitors from *Schistosoma mansoni*. Proteases (proteolytic enzymes, peptidases, peptide hydrolases) provide essential functions in all life forms including parasitic organism. So far, very little is known about many groups of proteolytic enzymes which can be found in the *S. mansoni* genome. Besides relatively well characterized enzymes associated with skin invasion and blood digestion, there are groups of proteases that were surprisingly neglected. Many of these enzymes share significant homology with various mammalian proteolytic regulatory factors. Main goal of our project is to identify and describe proteases and macromolecular inhibitors from *S. mansoni* expressed during infection of their mammalian hosts. We hypothesize that these molecules play

Adults (male and female) of *Schistosoma mansoni*.

significant role in host-parasite interactions. Our work includes various laboratory techniques in molecular biology, biochemistry and immunochemistry and confocal microscopy.

Selected publications

- **Dvořák J.**, Beckmann S., Lim K.-C., Engel J.C., Grevelding C.G., McKerrow J.H., Caffrey C.R. 2010: Biolistic transformation of *Schistosoma mansoni*: studies with modified reporter-gene constructs containing regulatory regions of protease genes. *Molecular and Biochemical Parasitology* 170: 37–40. [IF = 2.875]
- Franta Z., Sojka D., Frantová H., **Dvořák J.**, Horn M., Srba J., Talacko P., Mareš M., Schneider E., Craik C.S., McKerrow J.H., Caffrey C.R., Kopáček P. 2011: IrCL1 – The haemoglobinolytic cathepsin L of the hard tick, *Ixodes ricinus*. *International Journal for Parasitology* 41: 1253–1262. [IF = 3.822]
- Kašný M., Mikeš L., Dolečková K., Hampl V., **Dvořák J.**, Novotný M., Horák P. 2011: Cathepsins B1 and B2 of *Trichobilharzia* spp., bird schistosomes causing cercarial dermatitis. In: M.D. Robinson and J.P. Dalton (Eds.), Cysteine Proteases of Pathogenic Organisms. Landes Biosciences and Springer Science + Business Media, Austin, USA. Book Series *Advances in Experimental Medicine and Biology* 712: 136–154.
- Štefanič S., **Dvořák J.**, Horn M., Braschi S., Sojka D., Ruelas D., Suzuki B., Lim K.-C., Hopkins S.D., McKerrow J.H., Caffrey C.R. 2010: RNA interference in *Schistosoma mansoni* schistosomula: selectivity, sensitivity and operation for larger-scale screening. *PLoS Neglected Tropical Diseases* 4 (10): e850. [IF = 4.752]

Research projects

- **Trypsin proteases of blood fluke *Schistosoma mansoni.*** Ministry of Education, Youth and Sports (KONTAKT ME grant – American Science Information Center; ME10011, P.I.: Jan Dvořák; 2010 –2012).

Laboratory of Molecular Ecology of Vectors and Pathogens

Joint Research Unit with Faculty of Science, University of South Bohemia, České Budějovice

Research scientists:	Prof. RNDr. **Libor GRUBHOFFER**, CSc. (*head*) **Nataliia Rudenko**, PhD
PhD students:	Mgr. **Tereza Chrudimská**, Mgr. **Jiří Černý**, RNDr. **Jarmila Dupejová**, Mgr. **Diana Hierwegová**, Mgr. **Jana Plchová** (**Horáčková**), Mgr. **Václav Hönig**, Mgr. **Kinga Skop**, Mgr. **Ján Štěrba**, Mgr. **Hana Tykalová** (**Šťastná**)
Research assistants:	**Maryna Golovchenko**, MSc., Ing. **Gabriela Loosová**
Undergraduate students:	Bc. **Radka Hobizalová**, BSc., Bc. **Veronika Dorňáková**, Bc. **Jiří Havran**, Bc. **Patrik Kilián**, Bc. **Lucie Ouředníková**, BSc., Bc. **Renata Strouhalová**, Bc. **Martin Strnad**, BSc., Bc. **Zuzana Šimonová** (**Kohoutová**), BSc., Bc. **Zuzana Vavrušková**, Bc. **Vendula Vetišková**, **Lenka Čapková**, **Eva Drsková**, **Paula Helebrandová**, **Lucie Jedličková**, **Kateřina Leštinová**, **Helena Mondeková**, **Markéta Opekarová** (**Marková**), **David Pech**, **Martin Strnad**, **Zuzana Radičová** (**Tesařová**), **Rita Urbanová**, **Adriana Walnerová**, **Hana Zavadilová**
Laboratory worker:	**Zuzana Němcová**

Research priorities

Our group studies molecular and cellular factors involved in the mechanism of pathogen transmission by ticks and of the tick immunity. Lyme borreliosis spirochaetes, as well as the tick-borne encephalitis virus (TBEV), are the main focus of research, with respect to protein-carbohydrate interactions, and their interaction with the inner environment of the tick *Ixodes ricinus*.

Molecular ecology, epidemiology and biogeography of Lyme disease spirochaetes and tick-borne encephalitis

We performed an extensive study on the epidemiology of tick-borne pathogens in ticks from South Bohemia and other regions of the Czech Republic. A similar study, focusing on mapping of ticks and tick-borne diseases, was performed in collaboration with the Ludwig-Maximilian University in Munich, Germany (EU founded project). Another study aims to identify new species in the *Borrelia burgdorferi* sensu lato complex in isolates from South Bohemia and from southeastern USA. Our results showed high variability of genospecies in both regions and we identified several new *B. burgdorferi* s.l. genospecies. In addition, we identified *B. bissettii* in isolates from Czech patients which broadens the spectrum of the possible Lyme disease causative agents.

Glycobiology of ticks

We study both the glycans/glycoproteins and the saccharide-binding proteins (lectins), namely fibrinogen-related proteins. We analysed the *N*-glycomes of the tick life-stages and several organs of the adult ticks, including the tick saliva. Complex *N*-glycans containing core-fucose (both α1,3- and α1,6-bound fucose) and sialic acid were identified in tick tissues. Moreover, glycans of two tick

hemolymph proteins were described. Expression of the enzymes participating in *N*-glycosylation is currently analysed as well. We identified new fibrinogen-related proteins (FRePs, potential lectins) in several tick species. Among others, heme-storage protein hemelipoglycoprotein showed positive reaction with antibodies directed against other tick FRePs even though hemelipoglycoprotein amino acid sequence does not show significant similarity to the tick FRePs.

Molecular virology of tick-borne encephalitis

Selected aspects of the life cycle of TBEV and its interaction with the host cells are studied, with the focus on a better understanding of the natural cellular counter-measures against TBEV. One of our targets is a study of capping process in TBEV and the role of viral NS5 protein in this mechanism. We have shown that cap-independent translation allows continued translation of TBEV RNA in the conditions of the cellular translation shutdown. Another topic is the innate host cell antiviral response triggered by the TBEV infection. We have shown that host antiviral proteins OASL and viperin are strongly induced on the mRNA level upon the infection in human cells of neural origin. We want to find out if they exhibit an antiviral effect against TBEV infection and determine its mechanism.

Tick antimicrobial proteins

The team identified novel tick antimicrobial proteins, defensins and similar molecules, in several tick species. Two defensins from the tick *I. ricinus* were further studied in regard of their activity against Gram-positive and Gram-negative bacteria and also against viruses and protozoa. Currently, our laboratory works on identification and characterization of other antimicrobial proteins in ticks.

Selected publications

- **Chrudimská T.**, Slaninová J., **Rudenko N.**, Růžek D., **Grubhoffer L.** 2011: Functional characterization of two defensin isoforms of the hard tick *Ixodes ricinus*. *Parasites & Vectors* 4: e63. [IF = 2.130]
- **Dupejová J.**, **Štěrba J.**, Vancová M., **Grubhoffer L.** 2011: Hemelipoglycoprotein from the ornate sheep tick, *Dermacentor marginatus*: structural and functional characterization. *Parasites & Vectors* 4: e4. [IF = 2.130]
- **Horáčková J.**, **Rudenko N.**, **Golovchenko M.**, **Grubhoffer L.** 2010: Der-p2 (*Dermatophagoides pteronyssinus*) allergen-like protein from the hard tick *Ixodes ricinus* – a novel member of ML (MD-2-related lipid-recognition) domain protein family. *Parasitology* 137: 1139–1149. [IF = 2.522]
- **Rudenko N.**, **Golovchenko M.**, **Grubhoffer L.**, Oliver J.H. Jr. 2011: *Borrelia carolinensis* sp. nov., a new species of *Borrelia burgdorferi* sensu lato complex isolated from rodents and a tick from the south-eastern USA. *International Journal of Systematic and Evolutionary Microbiology* 61: 381–383. [IF = 1.930]
- **Rudenko N.**, **Golovchenko M.**, Oliver J.H. Jr. , **Grubhoffer L.** 2011: Chapter 96th, Borrelia. In: D. Liu (Ed.), Molecular Detection of Human Bacterial Pathogens. CRC Press, Taylor and Francis Group, Boca Raton, Florida, USA, pp. 1155–1168.

Research projects

- **POSTICK – Training Network on Ticks and Tick-Borne Diseases.** FP7-PEOPLE-ITN Marie-Curie project (P.I.: L. Grubhoffer; 2010–2013)
- **Antimicrobial peptides in the immune system of competent and noncompetent vectors of the *Borrelia burgdorferi* spirochetes.** Grant Agency of the Czech Republic (302/11/1901; P.I.: L. Grubhoffer; 2011–2013)
- **ANTIGONE – ANTIcipating the GlobalOnset of Novel Epidemics.** FP7 HEALTH project (278976; P.I.: L. Grubhoffer; 2011–2016**)**
- **Interaction of Lyme borreliosis spirochetes and salivary glands of *Ixodes ricinus* tick: the role of borrelia OspC protein.** Grant Agency of the Czech Republic (206/09/1782; P.I.: L. Grubhoffer; 2009–2011)
- **Molecular pathogenesis of tick-borne encephalitis.** Grant Agency of the Czech Republic (524/08/1509; P.I.: L. Grubhoffer; 2008–2010)

Laboratory of Vector Immunology

Research scientists:	RNDr. **Petr KOPÁČEK**, CSc. (head) RNDr. **Daniel Sojka**, PhD, RNDr. **Lenka Grunclová**, PhD (maternity leave), RNDr. **Veronika Urbanová (Burešová)**, PhD (maternity leave), RNDr. **Pavla Bartošová**, PhD (2010), RNDr. **Radek Šíma**, PhD (since 2011), RNDr. **Petra Dufková**, PhD (2011)
PhD students:	RNDr. **Zdeněk Franta**, RNDr. **Helena Frantová (Pěničková)**, Mgr. **Jan Perner**
Undergraduate students:	Bc. **Petr Franta**, Bc. **Jana Kadlecová**, Bc. **Jana Schrenková**, **Markéta Absolonová**, **Marko Dachev**, **Jitka Konvičková**, **Matěj Kučera**, **Petr Rathner**, **Martin Šmíd**

Research priorities

Reverse genetic approach to assess function of molecules involved in the tick innate immunity, pathogen transmission and blood digestion of the hard tick *Ixodes ricinus*. Development of anti-tick vaccine.

The complement-like molecules in *Ixodes ricinus* and their role in the innate immunity and pathogen transmission

We have demonstrated for the first time that the hard ticks *Ixodes* spp. possess all four groups of known invertebrate thioester-containing proteins (TEPs). The genome of *I. scapularis* contains three α2-macroglobulin-type pan-protease inhibitors named as *A2M1*, *A2M2* and *A2M3* (formerly IsAM1, 2 and 4), three molecules related to complement C3 component, designated as *C3-1*, *C3-2*, *C3-3* (formerly IsAM 5, 6 and 7), molecule of insect thioester-containing protein type TEP named TEP (IsAM3) and two molecules of the macroglobulin-complement related type *MCR1* and *MCR2* (IsaM8 and IsAM9). This finding promotes ticks as an exceptional model for further research on the origin and function of the primordial complement system. By using RNA interference-mediated gene silencing in the European sheep-tick *I. ricinus* we demonstrated the central role of a C3-3 like molecule in the phagocytosis of Gram negative bacteria and revealed non-redundant roles of *A2M1* and *A2M2* in the engulfment of *Chryseobacterium indologenes* and TEP in the phagocytosis of the model bacterium *Escherichia coli*.

Digestive peptidases in the gut of the tick *I. ricinus*

We have described the digestive machinery of the *I. ricinus* during the course of blood-feeding on the host. The dynamic profiling of concentrations, activities and mRNA expressions of the major hemoglobinolytic enzymes revealed that the *de novo* synthesis of peptidases triggers the dramatic increase of the hemoglobinolytic activity along the feeding period. These results suggest that the egressing proteolytic system in the early stage of feeding might be efficiently impaired by antibodies present in the blood of vaccinated host. We have further performed a detailed functional and biochemical characterization of two enzymes that initiate hemoglobin cleavage in the tick gut, namely cathepsin L (IrCL1) and cathepsin D (IrCD1). The vaccination

experiments performed with recombinant digestive peptidases revealed the most promising results when the cocktail of all five major peptidases (cathepsins B, L, C, D and legumain) was used as a vaccine.

Development of ferritin 2-based vaccine for the tick control

Previously we have demonstrated that targeting tick iron metabolism pathway is a promising approach for an efficient tick control. We have further focused on the most promising component of the pathway, namely the secreted ferritin 2, which is responsible for transportation of non-heme iron from the tick gut to the peripheral tissues. In co-operation with the Laboratory of José de la Fuente (Ciudad Real, Spain and Oklahoma State University, Stillwater, USA) we have demonstrated that vaccination of rabbits with recombinant ferritin 2 from *I. ricinus* and vaccination of cattle with recombinant ferritin 2 from *Rhipicephalus microplus* significantly impaired the tick feeding ability and further reproduction. These promising results initiated an applied research in the co-operation with the Czech company Bioveta a.s. with the ultimate goal to develop a commercial ferritin 2-based anti-tick vaccine.

Selected publications

- **Burešová V.**, **Hajdušek O.**, **Franta Z.**, Loosová G., **Grunclová L.**, Levashina E.A., **Kopáček P.** 2011: Functional genomics of tick thioester-containing proteins reveal the ancient origin of the complement system. *Journal of Innate Immunity* 3: 623–630. [IF = 2.614]
- **Franta Z.**, **Frantová H.**, **Konvičková J.**, Horn M., **Sojka D.**, Mareš M., **Kopáček P.** 2010: Dynamics of digestive proteolytic system during blood feeding of the hard tick *Ixodes ricinus*. *Parasites & Vectors* 3: 119. [IF = 2.130]
- **Franta Z.**, **Sojka D.**, **Frantová H.**, Dvořák J., Horn M., Srba J., Talacko P., Mareš M., Schneider E., Craik C.S., McKerrow J.H., Caffrey C.R., **Kopáček P.** 2011: IrCL1 – the haemoglobinolytic cathepsin L of the hard tick, *Ixodes ricinus*. *International Journal for Parasitology* 41: 1253–1262. [IF = 3.822]
- **Hajdušek O.**, Almazán C., Loosová G., Villar M., Canales M., Grubhoffer L., **Kopáček P.**, de la Fuente J. 2010: Characterization of ferritin 2 for the control of tick infestations. *Vaccine* 28: 2993–2998. [IF = 3.572]
- **Kopáček P.**, **Hajdušek O.**, **Burešová V.**, Daffre S. 2010: Tick Innate Immunity. In: K. Söderhäll (Ed.), Invertebrate Immunity. *Advances in Experimental Medicine and Biology* 708, Landes Biosciences and Springer Science + Business Media, New York, pp. 137–162. [IF = 1.379]

Research projects

- **The digestive system of ticks – the target for rational development of vaccine against ticks and tick-borne pathogens.** Grant Agency of the Academy of Sciences of the Czech Republic (IAA600960910; P.I.: P. Kopáček; 2009–2012)
- **Aspartic hemoglobinase IrCD – the component of gut protease complex of the tick *Ixodes ricinus*.** Grant Agency of the Academy of Sciences of the Czech Republic (KJB600960911; P.I.: D. Sojka; 2009–2010)
- **Functional genomics of the complement-like molecules in the tick *Ixodes ricinus*.** Grant Agency of the Czech Republic (P506/10/2136; P.I.: P. Kopáček; 2010–2012)
- **Structural proteomics of proteolytic systems in ticks.** Grant Agency of the Czech Republic (P207/10/2183; Co-P.I.: P. Kopáček; 2010–2012)
- **Endocytosis of the host hemoglobin in tick gut cells.** Grant Agency of the Czech Republic (GPP502/11/P682; P.I.: D. Sojka; 2011–2013)
- **Development of a vaccine protecting against transmission of tick-borne diseases based on the Ferritin 2 for the veterinary and human use.** Ministry of Industry and Trade (FR-TI3/156; co-P.I.: P. Kopáček; 2011–2014)

Laboratory of Parasite Immunology

Research scientists:	Prof. RNDr. **Jan KOPECKÝ**, CSc. (*head*) **Jaroslava Lieskovská**, PhD, RNDr. **Daniel Růžek**, PhD, RNDr. **Jiří Salát**, PhD
PhD students:	RNDr. **Jindřich Chmelař**, RNDr. **Helena Langhansová (Horká)**
Research assistant:	Bc. **Veronika Slavíková**
Technicians:	**Jan Erhart**, **Eva Výletová**
Laboratory worker:	**Lenka Marešová**
Undergraduate students:	Bc. **Eva Gregorová**, Bc. **Adéla Harcubová**, Bc. **Šárka Koudelková**, BSc., Bc. **Jana Páleníková**, Bc. **Martin Palus**, Bc. **Martina Slámová**, Bc. **Eva Slepičková**, **Lucie Brejchová**, **Markéta Hejníková**, **Helena Huspeková**, **Iva Pokorná**, **Šárka Pospíšilová**, **Barbora Svobodová**, **Jana Širmarová**, **Carmen Ziebermayr**

Research priorities

Immunomodulatory effects of *Ixodes ricinus* tick saliva on the host and their role in tick-borne pathogen transmission. Interaction of tick-borne encephalitis virus with the host and pathogenesis of the infection.

Effects of tick saliva on signalling pathways in dendritic cells stimulated with *Borrelia*

Type I interferons (IFN-α and IFN-β) are crucial determinants of the host immune response and tick saliva modulates this response, thus facilitating the transmission of tick-borne pathogens. We examined the effect of *Ixodes ricinus* tick saliva on IFN-β signalling in murine dendritic cells using lipopolysaccharide (LPS) and *Borrelia afzelii* spirochetes as inducers. Activated dendritic cells secret IFN that activates Signal Transducer and Activator of Transcription 1 (STAT-1). Our results show that *Borrelia*-induced activation of STAT-1 was suppressed by tick saliva. As the amount of secreted IFN-β was not influenced by tick saliva, the results indicated that saliva affected the interferon pathway at the IFN receptor or downstream of it. By using recombinant IFN-β, we showed that tick saliva attenuates IFN-triggered STAT-1 activation. Tick saliva also inhibited LPS-induced IFN-β production suggesting that saliva interferes with the activation of the pathway that mediates IFN-β induction.

Effect of tick saliva on immune interactions between *Borrelia* and dendritic cells

Interaction between mouse dendritic cells (DCs) and *Borrelia afzelii* spirochaetes was monitored on three different levels: phagocytosis of spirochaetes by DCs, production of cytokines by *Borrelia*-stimulated DCs and the ability of *Borrelia*-exposed DCs to activate specific CD4+ T lymphocytes. The effect of *I. ricinus* tick saliva on each of these interactions was examined. Tick saliva was shown to decrease the number of phagocytosing DCs. The ability of *Borrelia*-exposed DCs to induce both proliferation and IL-2 production by specific CD4+ T cells was significantly reduced by tick saliva. We have also shown an inhibitory effect of tick saliva on the production of both Th1 (TNF-α and IL-6) and Th2 (IL-10) cytokines by DCs.

Tick saliva modulates infection of dendritic cells with the tick-borne encephalitis virus

To examine the effects of the virus on dendritic cell biology, we cultured dendritic cells with two tick-borne encephalitis virus strains of different virulence in the presence of *I. ricinus* tick saliva. Tick saliva treatment increased proportion of virus-infected cells, led to a decrease in virus-induced TNF-α and IL-6 production and to reduced virus-induced apoptosis. Our data indicate that tick saliva modulates virus-mediated alterations in dendritic cells, thus probably being involved in the early infection process in the host.

Breakdown of the blood-brain barrier during tick-borne encephalitis in mice is not dependent on CD8+ T-cells

Tick-borne encephalitis (TBE) virus causes severe encephalitis with serious sequelae in humans. Changes in permeability of the blood-brain barrier (BBB) in two animal models infected with TBE virus were investigated by measuring fluorescence in brain homogenates after intraperitoneal injection of sodium fluorescein, a compound that is normally excluded from the central nervous system. We demonstrate here that TBE virus infection, in addition to causing fatal encephalitis in mice, induces considerable breakdown of the BBB. The increased BBB permeability was in association with dramatic upregulation of proinflammatory cytokine/chemokine mRNA expression in the brain, and was independent on migration of CD8(+) T-cells to the brain parenchyma during TBE.

Selected publications

- Chmelař J., Oliveira C.J., Řezáčová P., Francischetti I.M., Kovářová Z., Pejler G., Kopáček P., Ribeiro J.M., Mareš M., **Kopecký J.**, Kotsyfakis M. 2011: A tick salivary protein targets cathepsin G and chymase and inhibits host inflammation and platelet aggregation. *Blood* 117: 736–744. [IF = 10.558]
- **Fialová A.**, Cimburek Z., Iezzi G., **Kopecký J.** 2010: *Ixodes ricinus* tick saliva modulates tick-borne encephalitis virus infection of dendritic cells. *Microbes and Infection* 12: 580–585. [IF = 2.726]
- Kotsyfakis M., **Horká H.**, **Salát J.**, Andersen J.F. 2010: The crystal structures of two salivary cystatins from the tick *Ixodes scapularis* and the effect of these inhibitors on the establishment of *Borrelia burgdorferi* infection in a murine model. *Molecular Microbiology* 77: 456–470. [IF = 4.819]
- **Růžek D.**, **Salát J.**, Singh S.K., **Kopecký J.** 2011: Breakdown of the blood-brain barrier during tick-borne encephalitis in mice is not dependent on CD8+ T-cells. *PLoS ONE* 6: e20472. [IF = 4.411]
- **Růžek D.**, Yakimenko V.V., Karan L.S., Tkachev S.E. 2010: Omsk haemorrhagic fever. *Lancet* 376: 2104–2113. [IF = 33.633]

Research projects

- **Research Centre for Molecular Ecology of Vectors and Pathogens.** Ministry of Education, Youth and Sports (LC06009; P.I.: J. Kopecký; 2006–2011)
- **Identification of tick salivary molecules facilitating transmission of *Borrelia burgdorferi* using RNA interference.** Grant Agency of the Academy of Sciences of the Czech Republic (IAA600960811; P.I.: J. Kopecký; 2008–2010)
- **Effect of tick saliva cystatins on Th9 cells and the development of experimental asthma.** Grant Agency of the Czech Republic (P302/11/J029; P.I.: J. Kopecký; 2011–2013)
- **Differences in clinical course of tick-borne encephalitis in host and their genetic determination.** Grant Agency of the Czech Republic (P502/11/2116; P.I.: D. Růžek; 2011–2015)
- **Role of the blood-brain barrier in tick-borne encephalitis neuropathogenesis.** Grant Agency of the Czech Republic (P302/10/P438; P.I.: D. Růžek; 2010–2012)

Laboratory of Genomics and Proteomics of Disease Vectors

Research scientists:	**Michalis KOTSYFAKIS**, PhD (head) RNDr. **Jindřich Chmelař**, PhD, **Alexandra Schwarz**, PhD, **James J. Valdés**, PhD
PhD student:	Mgr. **Veronika Dorňáková**
Administration associate:	RNDr. **Petra Rozkošná**
Undergraduate students:	Bc. **Jan Kotál**, BSc., **Barbora Singerová**

Research priorities

Our research activity focuses on:

- applying genomic and proteomic technologies in order to uncover salivary or midgut effectors that contribute to arthropod vectorial capacity;
- vertebrate proteolytic cascades that are regulated by arthropod salivary secretion in the sites of disease vector infestation, facilitating blood meal uptake and/or pathogen transmission;
- demonstrating the pharmacological action of arthropod salivary proteins in the vertebrate host (hemostasis, vascular biology, immunomodulation) and in disease treatment.

Our research projects aim:

- to explore the basic mechanisms contributing to pathogen transmission by disease vectors as the conceptual basis for the development of novel methods/tools for disease control;
- to test recombinant arthropod salivary proteins in human disease animal models for their pharmacological action and their potential as drug candidates;
- to uncover the structural basis behind the stringent target specificity of arthropod salivary proteins.

Arthropod salivary serpins

Platelet aggregation and acute inflammation are key processes in vertebrate defence to a skin injury and two serine proteases, cathepsin G and chymase, mediate both mechanisms. In a collaborative effort and working with a mouse model of acute inflammation, we revealed that an exogenous salivary protein of *Ixodes ricinus*, the vector of Lyme disease pathogens in Europe, extensively inhibits oedema formation and influx of neutrophils in the inflamed tissue. We named this tick salivary gland secreted effector as *I. ricinus* serpin-2 (IRS-2) and we show that it primarily inhibits cathepsin G and chymase, while it affects thrombin activity in higher molar excess. The inhibitory specificity of IRS-2 was explained using the protein crystal structure. Moreover, we disclosed the ability of IRS-2 to inhibit cathepsin G-induced and thrombin-induced platelet aggregation. We also contributed to the characterization of a human factor Xa (FXa) inhibitor named as Alboserpin; it is the major salivary gland anticoagulant from *Aedes albopictus*, the yellow fever vector. Alboserpin displays stoichiometric and tight binding to FXa (picomolar range). Notably, Alboserpin was also found to interact with phosphatidylcholine and phosphatidylethanolamine, but not with phosphatidylserine. Accordingly, Alboserpin blocks prothrombinase activity and increases both prothrombin time and activated partial thromboplastin time *in vitro* or *ex vivo*. Furthermore, Alboserpin prevents thrombus formation in the carotid artery and increases bleeding in a dose-dependent manner.

Ixodes scapularis salivary cystatins

Two secreted cystatins from *Ixodes scapularis* salivary glands were characterised and named as sialostatin L and sialostatin L2. Using an *in vivo* animal model for acute inflammation we attributed an immunomodulatory action of the proteins to the vertebrate host. Sialostatins are the first cystatins described to date that display a highly specific affinity for a relatively limited number of human cathepsins and having produced their crystals, we demonstrated the structural basis for their stringent specificity. Moreover, sialostatin L2, but not sialostatin L, facilitates *Borrelia* transmission in mice.

Salivary antigens of *Triatoma infestans*

Chagas disease is among the six most important tropical diseases in the world and endemic in Latin America. Chagas disease is not fully controlled yet and re-emergence of triatomines is a continuous threat in many areas. Therefore, new methodologies are required to detect re-emerging *T. infestans* populations at an early stage and for sustained, long-term monitoring of previously endemic Chagas disease regions. Salivary proteins elicit an antibody response in their hosts and this can be used to measure exposure of vertebrate hosts to triatomines. Hence, anti-saliva antibody responses of chickens and guinea pigs to *T. infestans* salivary proteins were characterised and highly immunogenic antigens were identified. rTiSP14.6, a 14.6 kDa salivary protein of *T. infestans*, was synthesised as recombinant protein and evaluated successfully to be a triatomine-specific epidemiological marker for the detection of low numbers of triatomine species in peridomestic habitats.

Selected publications

- Calvo E., Mizurini D.M., Sa-Nunes A., Ribeiro J.M., Andersen J.F., Mans B.J., Monteiro R.Q., **Kotsyfakis M.**, Francischetti I.M. 2011: Alboserpin, a factor Xa inhibitor from the mosquito vector of yellow fever, binds heparin and membrane phospholipids and exhibits antithrombotic activity. *Journal of Biological Chemistry* 286: 27998–28010. [IF = 5.328]
- **Chmelař J.**, Oliveira C.J., Řezáčová P., Francischetti I.M., Kovářová Z., Pejler G., Kopáček P.**,** Ribeiro J.M., Mareš M., Kopecký J., **Kotsyfakis M.** 2011: A tick salivary protein targets cathepsin G and chymase and inhibits host inflammation and platelet aggregation. *Blood* 117: 736–744. [IF = 10.558]
- **Kotsyfakis M.**, Horká H., Salát J., Andersen J.F. 2010: The crystal structures of two salivary cystatins from the tick *Ixodes scapularis* and the effect of these inhibitors on the establishment of *Borrelia burgdorferi* infection in a murine model. *Molecular Microbiology* 77: 456–470. [IF = 4.819]
- **Schwarz A.**, Juarez J.A., Richards J., Rath B., Machaca V.Q., Castro Y.E., Málaga E.S., Levy K., Gilman R.H., Bern C., Verastegui M., Levy M.Z. 2011: Anti-triatomine saliva immunoassays for the evaluation of impregnated netting trials against Chagas disease transmission. *International Journal for Parasitology* 41: 591–594. [IF = 3.822]
- **Schwarz A.**, Medrano-Mercado N., Billingsley P.F., Schaub G.A., Sternberg J.M. 2010: IgM-antibody responses of chickens to salivary antigens of *Triatoma infestans* as early biomarkers for low-level infestation of triatomines. *International Journal for Parasitology* 40: 1295–1302. [IF = 3.822]

Research projects

- **Development of recombinant salivary antigens of *Triatoma infestans* for the detection of low-level infestation of triatomines**. Grant Agency of the Czech Republic (302/11/P798; P.I.: A. Schwarz; 2011–2013)
- **Rickettsial immunity during tick transmission.** NIH Prime Award (S-00498; P.I.: M. Kotsyfakis; 2011–2016)
- **Exploring the salivary transcriptome of *Ixodes ricinus*, the Lyme disease vector in Europe, and the potential role of its cystatins in pathogen transmission.** Marie Curie EU-Reintegration grant (GA-2010-268177; P.I.: M. Kotsyfakis; 2010–2014)

Laboratory of Fish Protistology

Research scientists:	**Astrid HOLZER**, PhD (head since 1. 3. 2011) Prof. MVDr. **Iva Dyková**, DrSc. (till 31. 12. 2011), RNDr. **Ivan Fiala**, PhD, RNDr. **Pavla Bartošová**, PhD, RNDr. **Miloslav Jirků**, PhD, RNDr. **Martin Kostka**, PhD, RNDr. **Jiří Lom**, DrSc. (passed away on 9 April 2010)
PhD students:	RNDr. **Tomáš Tyml**, RNDr. **Alena Kodádková**
Research assistant:	RNDr. **Hana Pecková**
Laboratory worker:	**Ivana Reitingerová**
Undergraduate students:	**Martina Cinková**, **Marie Hlavničková**

Research priorities

Our main interests are eukaryotic microorganisms infecting fish and amphibians, including all aspects of their structure, biology, life cycles, host-parasite relationships, ecology and especially their phylogeny and evolution. Our two main focuses are on myxozoans and amoeboid organisms. We furthermore carry out research into a range of parasitic protists that create economic and health consequences for the aquaculture industry, in collaboration with various institutions worldwide.

Myxozoa

The description, molecular characterisation and comparative analysis of myxozoan parasites from fish and frogs, sampled in different continents, has allowed for unique insights into inter- and intraspecific divergences, ecology, biogeography, phylogeny and evolution.

One particular study focused on myxozoan diseases entering naïve amphibian populations, which is a key threatening process contributing to the precipitous global decline of biodiversity. This research investigated the translocation of *Myxidium* spp. into endemic Australian frog populations by introduction of the cane toad. rDNA sequence distances confirmed their independent evolutionary trajectory and thus support the enemy-release hypothesis and suggest that the cane toad may have played an important spill-back role in parasite emergence and may have facilitated their dissemination.

Phylogenetic relationships and evolutionary trends within the phylum Myxozoa were studied on the basis of SSU and LSU rDNA sequences and, for the first time, using sequences of a gene with independent evolution (elongation factor 2, EF2). Alongside phylogenetic studies we tried to trace the history of myxozoan character evolution using 15 morphological and 5 bionomical characters, and we succeeded in the disclosure of ancestral morphotypes and demonstrated their extreme morphological plasticity over the course of evolution.

Pathological changes induced by myxozoans were described in detail in fish important for fisheries (spotted seatrout) and aquaculture (sharpsnout seabream), but also in small, terrestrial mammals, i.e. shrews. The pathological alterations observed reached from epithelial slouthing and pericholangitis over severe cardiac lesions to previously unknown xenoma-like formations induced by the parasites.

Amoebic organisms

Light microscopical, ultrastructural and molecular methods have been used to describe several members of our large collection of amphizoic amoebae, which were isolated from different aquatic organisms and habitats, and some of which were identified as important pathogens. We described a new genus, *Grellamoeba*, as well as several new species belonging to the genera *Neoparamoeba*, *Stenamoeba* and *Vexillifera*.

Mixed infections of histophagous ciliates and *Neoparamoeba* spp. were diagnosed in gill tissue of farmed turbot and Atlantic salmon during a study of amoebic gill disease. Amoeba trophozoites belonging to the genus *Neoparamoeba* were also isolated from moribund individuals of long-spined sea urchins *Diadema antillarum* off the coast of Tenerife, Spain. These echinoderms showed lesions resembling sea urchin bald disease on their testes (16 out of 56 examined). Eight amoeba strains, established from 10 primary isolates from the sea urchins, were identified as *Neoparamoeba branchiphila*, which has previously been isolated from fish suffering amoebic gill disease in fish (AGD). The results of this study together with data on agents of sea urchin mortalities reported to date justify the hypothesis that free-living amoebae play an opportunistic role in *D. antillarum* mortality. The enlargement of the dataset of SSU rDNA sequences furthermore brought new insights into the phylogeny of *Neoparamoeba* species.

Selected publications

- Alama-Bermejo G., Raga J.A., **Holzer A.S.** 2011: Host-parasite relationship of *Ceratomyxa puntazzi* n. sp. (Myxozoa: Myxosporea) and sharpsnout seabream *Diplodus puntazzo* (Walbaum, 1792) from the Mediterranean with first data on ceratomyxid host specificity in sparids. *Veterinary Parasitology* 182: 181–192. [IF = 2.331]
- **Dyková I.**, **Kostka M.**, **Pecková H.** 2010: *Grellamoeba robusta* gen. n., sp. n., a possible member of the family Acramoebidae Smirnov, Nassonova et Cavalier-Smith, 2008. *European Journal of Protistology* 46: 77–85. [IF = 2.322]
- **Dyková I.**, Lorenzo-Morales J., **Kostka M.**, Valladares B., **Pecková H.** 2011: *Neoparamoeba branchiphila* infections in moribund sea urchins *Diadema* aff. *antillarum* in Tenerife, Canary Islands, Spain. *Diseases of Aquatic Organisms* 95: 225–231. [IF = 1.572]
- **Fiala I.**, **Bartošová P.** 2010: History of myxozoan character evolution on the basis of rDNA and EF-2 data. *BMC Evolutionary Biology* 10: e228. [IF = 3.702]
- Hartigan A., **Fiala I.**, **Dyková I.**, **Jirků M.**, Okimoto B., Rose K., Phalen D.N., Šlapeta J. 2011: A suspected parasite spill-back of two novel *Myxidium* spp. (Myxosporea) causing disease in Australian endemic frogs found in the invasive cane toad. *PLoS ONE* 6: e18871. [IF = 4.411]

Research projects

- **Phylogenetic analysis of mitochondrial genome of Myxozoa and *Polypodium hydriforme*.** Grant Agency of the Czech Republic (204/09/P519; P.I.: I. Fiala; 2009–2011)
- **Generic and species characterisation of fish-isolated amoebae focused on molecular markers as tools for diagnosis of amoebae in tissue lesions.** Grant Agency of the Czech Republic (524/09/0137; P.I.: I. Dyková; 2009–2011)
- **Biology and phylogeny of sphaerosporid myxosporeans from economically important fish: application of molecular tools.** Grant Agency of the Czech Republic (506/11/P724; P.I.: P. Bartošová; 2011–2013)
- **Opening new chapter: diversity, biology and phylogeny of Myxozoa parasitizing Amphibia.** Grant Agency of the Czech Republic (506/10/2330; P.I.: M. Jirků; 2010–2013)

Laboratory of Veterinary and Medical Protistology

Research scientists:	Doc. Ing. **Martin KVÁČ**, PhD (head) Doc. RNDr. **Oleg Ditrich**, CSc. (till December 2011) Prof. MVDr. **Břetislav Koudela**, CSc. (part time; till Dec. 2010) Prof. MVDr. **David Modrý**, PhD (part time) RNDr. **Bohumil Sak**, PhD Prof. RNDr. **Jiří Vávra**, DrSc. (part time)
PhD students:	Ing. **Karel Němejc***, Ing. **Veronika Rašková***, Ing. **Pavla Wagnerová***
Research assistant:	RNDr. **Dana Květoňová**
Undergraduate students:	Bc. **Marie Jalovecká**, Bc. **Martina Jeníková**, Bc. **Alena Kodádková**, Bc. **Michaela Kotková**, Bc. **Linda Matoušová**, Bc. **Lenka Moravcová**, Bc. **Barbora Uhlířová***, **Martina Bicanová***, **Lenka Černá**[+], **Lucie Honsová**[+], **Nikola Hromadová***, **Alžběta Jarolímová***, **Michaela Kestřánová***, **Gabriela Křivánková**[+], **Vladimír Kural***, **Martina Loudová**, **Petra Machovcová**[+], **Michaela Maroušová***, **Lucie Munzarová**[+], **Jana Muzikářová***, **Anna Mynářová**, **Eva Myšková**, **Markéta Pelikánová**, **Renáta Smetanová**[+], **Pavel Verbíř***, **Markéta Vopalecká**, **Petra Zajíčková**[+]

Research priorities

The focus of this group is to determine the zoonotic sources of emerging parasitic diseases, especially the opportunistic nature of the occurrence of cryptosporidia and microsporidia in immunodeficient (e.g. AIDS) and immunocompetent patients and animals.

Microsporidiosis in immunocompetent hosts

We found that 20% from HIV-positive persons, 33% from persons with occupational exposure to animals, and also 10% from healthy persons were serologically positive for the presence of antibodies against *Enterocytozoon bieneusi*, the most prevalent human microsporidium. Subsequently, we detected the 42% occurrence of *Encephalitozoon* spp. and *Enterocytozoon bieneusi* in asymptomatic healthy people living in the Czech Republic. Four genotypes of *Encephalitozoon* spp. and seven *E. bieneusi* genotypes, including three novel genotypes, were determined. The highest prevalence was recorded for individuals older than 50 years. In the other studies performed on naturally infected budgerigars and subsequently in humans we found the intermittent pattern of microsporidia spore shedding, suggesting the latent course of infection without any clinical signs. Finally, we documented the case report of brain abscess caused by *E. cuniculi* genotype I in an immunocompetent patient, whose live was saved by prompt diagnosis.

*Faculty of Agriculture; [+]Faculty of Health and Social Studies

Infections in wild great apes in different stages of habituation

We did not find any differences in parasite prevalence in European ZOOs and African sanctuaries. Except for *Encephalitozoon cuniculi*, which was the most prevalent microsporidial agents in all groups of apes, *Enterocytozoon bieneusi* has been also observed. We detected 11 new genotypes of *E. bieneusi*, of which 5 could be probably host/ape specific. All isolates of *G. intestinalis* belong to assemblage A including 4 new strains. Molecular analyses revealed the presence of human pathogenic cryptosporidia, namely: *C. parvum*, *C. meleagridis*, and *C. muris*. Great apes, which were kept in ZOOs and sanctuaries or those which have been habituated, were six, five or two times more often infected with *Giardia intestinalis*, microsporidia or *Cryptosporidium* spp. respectively, compared to unhabituated groups of apes.

Age specificity of swine *Cryptosporidium* spp.

Two species of *Cryptosporidium* are commonly identified in pigs: *Cryptosporidium suis* and *Cryptosporidium* pig genotype II. Since their detection is routinely based on molecular methods, which are generally hampered by low sensitivity to mixed infections, we constructed species-specific primers, which could improve our understanding of epidemiology of pig specific *Cryptosporidium* spp. We showed that sensitivity of our novel primers was identical to genus-specific primers, but significantly more (up to 30%) mixed infections were detected using them. Moreover, the up to now hidden age specificity of swine *Cryptosporidium* spp. was revealed by the means of these novel primers; *C. suis* was primarily detected among pre-weaned piglets, while *Cryptosporidium* pig genotype II was only detected among older pigs from the 6th week of age.

Selected publications

- **Ditrich O.**, Chrdle A., **Sak B.**, Chmelík V., Kubale J., Dyková I., **Kváč M.** 2011: *Encephalitozoon cuniculi* genotype I as a causative agent of brain abscess in an immunocompetent patient. *Journal of Clinical Microbiology* 49: 2769–2771. [IF = 4.220]
- Feng Y., Yang W., Ryan U., Zhang L., **Kváč M.**, **Koudela B.**, **Modrý D.**, Li N., Fayer R., Xiao L. 2011: Development of a multilocus sequence typing tool for *Cryptosporidium muris* and *Cryptosporidium andersoni*. *Journal of Clinical Microbiology* 49: 34–41. [IF = 4.220]
- Pomajbíková K., Petrželková K.J., Profousová I., Petrášová J., Kišidayová S., Varádyová Z., **Modrý D.** 2010: A survey of entodiniomorphid ciliates in chimpanzees and bonobos. *American Journal of Physical Anthropology* 142: 42–48. [IF = 2.693]
- **Sak B.**, Brady D., **Pelikánová M.**, **Květoňová D.**, Rost M., Kostka M., Tolarová V., Hůzová Z., **Kváč M.** 2011: Unapparent microsporidial infection among immunocompetent humans in the Czech Republic. *Journal of Clinical Microbiology* 49: 1064–1070. [IF = 4.220]
- **Sak B.**, Kučerová Z., **Kváč M.**, **Květoňová D.**, Rost M., Secor W.E. 2010: Seropositivity for *Enterocytozoon bieneusi*, Czech Republic. *Emerging Infectious Diseases* 16: 335–337. [IF = 6.859]

Research projects

- **Impact of increased contact with humans on diversity and ecology of protozoan parasites of African great apes.** Grant Agency of the Czech Republic (206/09/0927 P.I.: D. Modrý, I. Co-I.: K. Petrželková, II. Co-I.: M. Kváč, III. Co-I.: I. Čepička; 2009–2011)
- **Diversity, biology and phylogeny of *Cryptosporidium* spp. parasitizing in rodents.** Ministry of Education, Youth and Sports (KONTAKT II LH 11061 P.I.: M. Kváč; 2011–2014)
- **Anti-inflammatory activity of extracts isolated from selected Indonesian plants and their effect on opportunistic parasitoses.** Grant Agency of the Czech Republic (505/11/1163 P.I.: K. Doležal, I. Co-I.: I. Foitová, II. Co-I.: B. Sak; 2011–2015)

Laboratory of Helminthology

Research scientists:	Prof. RNDr. **Tomáš SCHOLZ**, CSc. (head) **María Isabel Blasco Costa**, PhD (Spain, since March 2010), RNDr. **Anna Faltýnková**, PhD (maternity leave), **Aneta Kostadinova**, PhD (Bulgaria), RNDr. **Roman Kuchta**, PhD, **Céline Levron**, PhD (France, till December 2011), RNDr. **František Moravec**, DrSc., RNDr. **Mikuláš Oros**, PhD, RNDr. **Martina Orosová**, PhD (both Slovakia; till May 2011)
PhD students:	**Anirban Ash**, MSc. (India), RNDr. **Jan Brabec**, **Simona Georgieva**, MSc. (Bulgaria, since January 2011), RNDr. **Dagmar Jirsová**, **Carlos A. Mendoza-Palmero**, MSc. (Mexico), Mgr. **Miroslava Soldánová**
Research assistants:	Ing. **Radmila Řepová** (part time), Ing. **Blanka Škoríková**
Technician:	**Martina Borovková**
Laboratory worker:	**Drahoslava Sukdoláková**
Undergraduate students:	Bc. **Andrea Bednářová**, Bc. **Alena Burianová**, Bc. **Petra Rozkošná**, Bc. **Petra Šarounová**, Bc. **Lenka Šípková**, Bc. **Jana Zikmundová**, **Rebecca Brown** (Glasgow – Erasmus), **Kateřina Hrubá**, **Michaela Jíchová**, **Kateřina Leštinová**, **Pavla Šedivá**

Research priorities

Morphology, including ultrastructure, systematics and phylogeny of endoparasitic helminths, especially tapeworms (Cestoda) and nematodes (Nematoda) parasitic in freshwater and marine fish, and trematode taxonomy and ecology of larval stages in freshwater molluscs and fish.

Diversity of helminths parasitizing teleost fish

Morphological and taxonomic evaluation of extensive materials of parasitic flatworms (Cestoda, Digenea and Monogenea) and nematodes (Nematoda), parasites of freshwater and marine fish, made it possible to provide new data on species richness, systematics, host specificity and geographical distribution of numerous taxa, many of them having been described as new for science. Biodiversity studies have been focused on hot spots of teleost diversity and ecosystems under high anthropogenic pressure, such as Africa, Amazonia, New Caledonia, South East Asia and the Mediterranean.

Evolution of basal tapeworms (Cestoda)

Using combination of morphological, electron microscopical and molecular methods, the evolutionary history of the presumably most basal groups of tapeworms (Cestoda) has been studied. Several species-rich genera of monozoic (nonsegmented) tapeworms (Caryophyllidea) have been revised and their phylogenetic relationships have been assessed based on comparative analyses of nuclear and mitochondrial genes. New techniques, such as high-pressure freezing, which were not applied previously in helminthology, have been tested as to their suitability for comparative and phylogenetic studies.

Trematode taxonomy and community ecology

A series of studies on trematode communities in populations of *Lymnaea stagnalis* and *Radix auricularia* from eutrophic environments (fishponds in South Bohemia and lakes in the River Ruhr catchment in Germany) demonstrated increased, nutrient-mediated levels of parasitism. In both study systems notable differentiation in community structure among localities resulting from differences in parasite flow was detected, which indicates the action of top-down effects of habitat context (i.e. size, function and management, and productivity and water quality, respectively) on trematode transmission pathways and abundance.

Selected publications

- **Levron C.**, Miquel J., **Oros M.**, **Scholz T.** 2010: Spermatozoa of tapeworms (Platyhelminthes, Eucestoda): advances in ultrastructural and phylogenetic studies. *Biological Reviews* 85: 523–543. [IF = 6.574]
- **Moravec F**. 2010: Some aspects of the taxonomy, biology, possible evolution and biogeography of nematodes of the spirurine genus *Rhabdochona* Railliet, 1916 (Rhabdochonidae, Thelazioidea). *Acta Parasitologica* 55: 144–160. [IF = 1.144]
- **Scholz T.**, **Brabec J.**, Králová-Hromadová I., **Oros M.**, Bazsalovicsová E., Ermolenko A., Hanzelová V. 2011: Revision of *Khawia* (Cestoda: Caryophyllidea), parasites of cyprinid fish, including a key to their identification and molecular phylogeny. *Folia Parasitologica* 58: 197–223. [IF = 1.533]
- **Soldánová M.**, **Kostadinova A.** 2011: Rapid colonisation of *Lymnaea stagnalis* by larval trematodes in eutrophic ponds in central Europe. *International Journal for Parasitology* 41: 981–990. [IF = 3.822]
- Wicht B., Yanagida T., **Scholz T.**, Ito A., Jiménez J.A., **Brabec J.** 2010: Multiplex PCR for differential identification of broad tapeworms (Cestoda: *Diphyllobothrium*) infecting humans. *Journal of Clinical Microbiology* 48: 3111–3116. [IF = 4.220]

Research projects

- **A survey of the tapeworms (Cestoda: Platyhelminthes) from the vertebrate bowels of the Earth.** National Science Foundation, USA (Planetary Biodiversity Inventory, P.I. – Coordinator: J.N. Caira, University of Connecticut, Storrs; Co-P.I.: T. Scholz; 2008–2012)
- **Research Centre "Ichthyoparasitology".** Ministry of Education, Youth and Sports (LC522; P.I.: T. Scholz; P.I. – Coordinator: M. Gelnar, Masaryk University, Brno; 2005–2010)
- **PARAPOPGENE – Comparative genetic patterns in parasite populations and species: the search for structuring force.** FP7-PEOPLE-2009_IOF (Marie Curie Action; project No. 252124; P.I.: M.I. Blasco-Costa; 2010–2013)
- **Revision of monozoic tapeworms (Cestoda: Caryophyllidea): a key to understanding the evolution of cestodes?** Grant Agency of the Czech Republic (524/08/0885; P.I.: T. Scholz; 2008–2012)
- **Trematode communities in molluscs as a model system to forecast the impact of climate change in freshwater ecosystems in Central Europe.** Grant Agency of the Czech Republic (P505/10/1562; P.I.: A. Faltýnková; 2010–2013)
- **Eggs and early larval stages of tapeworms (Cestoda): new ultrastructural tools for diagnostics and phylogenetic studies.** Grant Agency of the Czech Republic (506/10/1994; P.I.: C. Levron; 2010–2011)
- **Host-parasite relationships and evolution of parasitism.** Grant Agency of the Czech Republic (206/09/H026 – project to support PhD studies; P.I.: T. Scholz; 2009–2012)
- **Origin and homology of attachment organs in lower tapeworms (Eucestoda).** Grant Agency of the Academy of Sciences of the Czech Republic (KJB600960902; P.I.: R. Kuchta; 2009–2011)
- **Parásitos del atún rojo atlántico oriental (*Thunnus thynnus*) en poblaciones naturales y en cautividad. Comunidades y patologias asociadas.** Ministerio de Ciencia e Innovación (AGL2010-20892; P.I. A. Kostadinova; P.I. – Coordinator: F.E. Montero, University of Valencia, Spain; 2011–2013)

Laboratory of Molecular Phylogeny and Evolution of Parasites

Research scientists:	Prof. RNDr. **Václav HYPŠA**, CSc. (head) RNDr. **Jan Štefka**, PhD
PhD students:	RNDr. **Tomáš Chrudimský**, MVDr. **Jana Kvičerová**, RNDr. **Eva Nováková**, RNDr. **Jana Martinů**
Technicians:	**Lenka Štifterová**, Mgr. **Jaroslav Šoun**, PhD.
Undergraduate students:	Bc. **Filip Husník**, Bc. **Anna Mácová**, Bc. **Tereza Marvanová**, **Michaela Matějková**, **Tomáš Svozil**

Research priorities

Our research is mainly focused on molecular phylogenetic analysis of the origin, evolution and relationships of parasitic and symbiotic organisms. It further involves investigation into their co-evolution, biogeography and other bionomical features, including intraspecific variability and genealogy. The research is carried out on several models of parasitic and symbiotic associations.

Phylogeny and evolution of symbiotic bacteria

We performed a complex phylogenetic analysis of a phylogenomic set within Enterobacteriaceae. The analysis included 50 bacterial taxa, each represented by DNA sequences of 69 genes, and its main aim was to investigate origin of symbionts within enterobacteria. This question is currently one of the frequently discussed issues connected to the evolution of symbiotic bacteria – several studies indicate that monophyletic origin of the obligate mutualists is a methodological artifact caused by degeneration of symbiotic genomes. Therefore, we based the analysis on a complex approach which included several new methods designed to overcome these difficulties (new evolutionary models, data recoding, selective removing of the data, etc.). The results confirmed a tendency of these methods to arrange the symbionts into a polyphyletic assembly. They also indicate that during the evolution of enterobacteria the symbiotic lineages originated independently at least within four different groups.

Phylogenetic studies on rodent-associated *Eimeria*

Coccidian oocysts from faeces of 46 individuals of the garden dormouse, *Eliomys quercinus* (Rodentia: Gliridae), were morphologically and molecularly characterized. Both morphological and sequence data (18S rDNA and ORF 470) showed low variability, indicating that all samples represent a single species. By comparison with published morphological descriptions of coccidia from glirid rodents, we determined that the samples represent *Eimeria myoxi*. Molecular data suggest that this species does not fall within the two known rodent-specific groups but branches as a third independent lineage. However, its exact position in respect to other eimerian clusters could not be established due to the lack of phylogenetic information at this taxonomic level for the 18S rRNA and ORF 470 genes. Based on these results, we provide a re-description of *E. myoxi*, which contains morphological and molecular characteristics sufficient for its unequivocal identification.

Origin of *Ligula intestinalis* in northern Africa

Genealogy and population stucture of the cestode *Ligula intestinalis* from Europe and northern Africa were analysed using molecular data. The results show that the African samples include autochthonous as well as recently introduced populations. Coalescence-based analyses further supported genetic flow from Europe to Africa. Epidemiological survey suggests strict host specificity of autochthonous and introduced populations to African and European (introduced) hosts, respectively.

Selected publications

- **Husník F.**, **Chrudimský T.**, **Hypša V.** 2011: Multiple origins of endosymbiosis within the Enterobacteriaceae (γ-Proteobacteria): convergence of complex phylogenetic approaches. *BMC Biology* 9: e87. [IF = 5.203]
- Kilian P., Růžek D., Danielová V., **Hypša V.**, Grubhoffer L. 2010: Nucleotide variability of Ťahyňa virus (Bunyaviridae, Orthobunyavirus) small (S) and medium (M) genomic segments in field strains differing in biological properties. *Virus Research* 149: 119–123. [IF = 2.905]
- **Kvičerová J.**, Mikeš V., **Hypša V.** 2011: Third lineage of rodent eimerians: morphology, phylogeny and re-description of *Eimeria myoxi* (Apicomplexa: Eimeriidae) from *Eliomys quercinus* (Rodentia: Gliridae). *Parasitology* 138: 1217–1223. [IF = 2.522]
- Skuce P., Stenhouse L., Jackson F., **Hypša V.**, Gilleard J. 2010: Benzimidazole resistance allele haplotype diversity in United Kingdom isolates of *Teladorsagia circumcincta* supports a hypothesis of multiple origins of resistance by recurrent mutation. *International Journal for Parasitology* 40: 1247–1255. [IF = 3.822]
- **Štefka J.**, Hoeck P.E.A., Keller L.F., Smith V.S. 2011: A hitchhikers guide to the Galapagos: co-phylogeography of Galapagos mockingbirds and their parasites. *BMC Evolutionary Biology* 11: e284. [IF = 3.702]

Research project

- **Population structure and evolutionary relationships of the intracellular parasite *Hemolivia mauritanica* (Sergent and Sergent, 1904).** Grant Agency of the Czech Republic (GAP506/11/1738; Co-P.I. V. Hypša; 2011–2014).

Supporting facility

Laboratory of Electron Microscopy

Research scientists:	Ing. **Jana NEBESÁŘOVÁ**, CSc. (*head*) RNDr. **Marie Vancová**, PhD (part time)
Technicians:	Mgr. **Tomáš Bílý** (part time), Ing. **Anna Heydová** (till 2011), Mgr. **Jan Langhans**, Mgr. **Martina Tesařová**, **Petra Masařová**, **Jiří Vaněček**
Undergraduate students:	Mgr. **Lenka Bučinská**, Bc. **Jason Dean**, Bc. **Veronika Eiblová**, Bc. **Eliška Korandová**, Bc. **Denisa Martykánová**

The Laboratory of Electron Microscopy is a supporting facility of the Institute of Parasitology that provides electron microscopic services for the research groups at the Biology Centre, other institutes of the Academy of Sciences, the Faculty of Science of the University at South Bohemia and occasionally other institutions.

Laboratory offers a broad spectrum of methods commonly used for preparation of biological specimens. For ultrastructure studies, chemical methods of specimen treatment are usually used in combination with microwave irradiation. The cryofixation with the high pressure freezer followed by freeze substitution is used for the best preservation of specimen ultrastructure. For immunolocalisation of target molecules by means of colloidal gold as a label, mainly post-embedding methods are used for ultrathin sections of samples embedded in LR White and Lowicryl resins or for thawed cryo-sections.

Technical equipment

- **Transmission electron microscopes**
  - JEOL TEM 2100F (2012), 200 kV, fully equipped for tomography and STEM
  - JEOL 1010 (1996) equipped with SSC camera MegaView 3 and image acquisition software analySIS 3.1
  - Philips 420 (1985) with cryo-holder and BIO scan CCD camera with Digital Micrograph of GATAN acquisition software
  - Low voltage electron microscope LV EM 5 (2002), Delong Instruments, Inc.
- **Scanning electron microscopes**
  - JEOL 7401F (2005) with cryo-attachment ALTO 2500 GATAN
  - JEOL 6300 (1993)
- **Ultramicrotomes Leica** with and without cryo-chamber
- **High Pressure Freezer Leica EM Pact2** – a system for vitrifying samples up to 200 μm in thickness without the artifacts of chemical fixation
- **Automatic freeze substitution system Leica EM AFS** for substitution and low temperature embedding after cryofixation and for the PLT technique

Selected publications and other outcomes:

- Dupejová J., Štěrba J., **Vancová M.**, Grubhoffer L. 2011: Hemelipoglycoprotein from the ornate sheep tick, *Dermacentor marginatus*: structural and functional characterization. *Parasites & Vectors* 4: e4. [IF = 2.130]
- **Vancová M.**, Šlouf M., **Langhans J.**, Pavlová E., **Nebesářová J.** 2011: Application of colloidal palladium nanoparticles for labeling in electron microscopy. *Microscopy and Microanalysis* 17: 810–816. [IF = 3.259]
- Hozák P., Šlouf M., **Nebesářová J.**, Moša M., Krivjanská M. 2011: Set of mutually distinguishable nanoparticles for multiple immunolabelling. Czech utility model No. 21711.
- Šlouf M., Novotný F., Hozák P., **Nebesářová J.** 2011: Set of three microscopy distinguishable nanoparticles with gold surfaces for multiple immunolabelling. Czech utility model No. 21823.
- Šlouf M., Šloufová I., Hozák P., **Nebesářová J.** 2011: Set of three microscopy distinguishable nanoparticles with gold surfaces for multiple immunolabelling. Czech utility model No. 21822.

Research projects

- **New nanoparticles for ultrastructural diagnostics.** Programme "Nanotechnologies for Society" Academy of Sciences of the Czech Republic (KAN200520704, Co-I.: J. Nebesářová; 2007–2011).

  The project aims to develop a set of nanoparticles sized 5–15 nm with various shapes or elemental composition suitable for ultrastructural cytochemistry. The result is a set of five distinguishable electron-stable nanoparticles for multiple ultrastructural labellings in biomedicine and biology.
- **Glycoprotein analysis of *Ixodes ricinus* salivary glands.** Grant Agency of the Academy of Sciences of the Czech Republic (KJB600960906, P.I.: M. Vancová, 2009–2011).

  N-glycans isolated from tissues and developmental stages of ticks were described and compared. In fed females, sialic acid and core alfa 1,3-fucose residues were confirmed and localized. Glycan structures of isolated hemlipoglycoprotein were identified.

Collaboration within projects not related directly to the Institute's research plan

- **Scientific collaboration in the identification of impurities in components through the scanning electron microscope.** Robert Bosch Company, České Budějovice, 2010–2011.
- **Scientific collaboration in the ultrastructural characterisation of special polymers in the transmission electron microscope.** Viscofan Company, České Budějovice, 2011.
- **Scientific collaboration in the development and validation of the method using cryo-field emission SEM for the evaluation for the Cyclosporin cps formulations.** Teva Czech Industry Company, České Budějovice, 2010–2011.

Special activities

Collections of parasitic organisms

A collection of cryopreserved cultures of blood flagellates and amphizoic amoebae is maintained at the Laboratory of Fish Protistology. An extensive collection of helminths, curator of which is František Moravec, is available for comparative studies to helminthologists from various countries. It comprises about 3 000 species from around the world, including numerous type specimens.

A collection of holotypes and paratypes of about 300 species of parasitic arthropods, on 430 microscopic slides, is deposited at the Institute, as well as a large collection of several thousand specimens of parasitic mites and fleas from mammals, birds and reptiles, and a small collection of ticks in alcohol. The Institute maintains laboratory colonies of ticks (8 species), mosquitoes (4 species, 5 lines) and arboviruses (33 species and strains).

More information can be found at http://www.paru.cas.cz/en/collections/.

Publishing and editorial activities

FOLIA PARASITOLOGICA – an international journal

Editor-in-Chief: Vladimír Bukva (till December 2011)

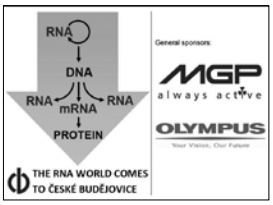
Assistant Editors: Libor Grubhoffer (arthropod vectors and transmitted agents of disease) – – till December 2011
Jiří Lom (parasitic protozoa) – till April 2010
Julius Lukeš (parasitic protozoa) – since April 2010
František Moravec (helminths) – till December 2011

Editorial Assistant: Dana Hanzliková Vašková

Folia Parasitologica is an international journal for parasitology, publishing articles written in English. It was founded in 1953 as an annual edition. Since 1966, it has been published four times a year. The Editor-in-Chief and three Assistant Editors from the Institute of Parasitology are aided by an international Board of Editorial Advisors, consisting of 35 highly regarded scientists, overwhelming majority of them being foreign parasitologists. Each manuscript is rigorously reviewed by at least two referees who are known for excellence in their field of expertise. As a result of this demanding review process, the rejection rate was 67% in 2010–2011. Folia has a wide international authorship: in 2010–2011, around 80% of senior authors of published papers were from abroad. The Impact Factor of Folia was 1.533 for 2010, reflecting the journal's good position among international parasitology periodicals.

Folia is desk-top edited, figure reproduction being the only operation entrusted to a commercial printer. Final printing is on high-quality glossy paper of A4 size, allowing for the excellent reproduction of line drawings and B&W/colour photographs. Folia is widely indexed/abstracted in key biological databases such as BIOSIS (Biological Abstracts, Biological Abstracts/RRM, Abstracts of Entomology, Zoological Record), CAB (Helminthological and Protozoological Abstracts, Review of Medical and Veterinary Entomology, Tropical Diseases Bulletin), ISI (Current Contents/Agriculture, Biology & Environmental Sciences, Science Citation Index Expanded, Web of Knowledge) and NLM (MEDLINE). Full text of articles can be downloaded from the Folia website, ProQuest Biology/Medicine Journals or CABI Full Text databases.

RNA Club



The eight annual RNA club was held on Friday 5 November in České Budějovice in 2010. This year, there were about 80 participants, mostly students and young post doctoral fellows. Furthermore, there were contributions from as far away as the University of Salzburg, Austria, and Oxford University, U.K. A total of 13 talks and 36 poster presentations were given. The topics ranged from RNA processing to ribosomal and microRNA biogenesis, localization of RNAs in the mouse embryo and RNPs in the Cajal bodies. Techniques discussed ranged from classical molecular and cell biology techniques as well as biochemical methods and NMR-spectroscopy. We were fortunate to have two keynote talks from Frédéric Allain from the Institute of Molecular Biology at the Elgenössische Technische Hochschule, Zürich Switzerland and Jernej Ule from the Medical Research Council Laboratory of Molecular Biology in Cambridge, UK. There were five prizes that were awarded for the best contributions from students and/or young post doctoral researchers – two prizes for registration fees and travel support for the 2011 RNA Society Meeting in Kyoto, Japan and three memberships to the RNA Society.

18th International Ecdysone Workshop

The 18th International Ecdysone Workshop was held on 19–23 July 2010 at the Biology Centre, ASCR, Ceske Budejovice (organizers: M. Jindra and M. Asahina-Jindrová). The conference merged traditional insect endocrinology with the frontiers of *Drosophila* functional genetics. Topics included invertebrate steroid and juvenile hormone signalling, hormone biosynthesis, neuroendocrine regulation, insulin and growth control, and reproduction and development studied in various insects, nematodes, marine arthropods, and rats. A total of 120 scientists from 21 countries delivered 55 oral and 36 poster presentations.

List of the Institute's employees by professional classification (2010–2011)

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Publication activities

2010

Chapters in monographs

1. **LUKEŠ J.**, **HASHIMI H.**, **VERNER Z.**, **ČÍČOVÁ Z.** 2010: The remarkable mitochondrion of trypanosomes and related flagellates. In: W. de Souza (Ed.), Structures and Organelles in Pathogenic Protists. Microbiology Monographs 17. Springer-Verlag, Berlin, pp. 228–252.
2. **CHMELAŘ J.**, FRANCISCHETTI I.M.B., **KOTSYFAKIS M.** 2010: Salivary protease inhibitors with non anti-hemostatic function. In: R.M. Kini, K.J. Clemetson, F.S. Markland, M.A. McLane and T. Morita (Eds.), Toxins and Hemostasis. Springer Science + Business Media, Dordrecht, pp. 153–164.
3. **RŮŽEK D.**, YAKIMENKO V.V., KARAN L.S., TKACHEV S.E., **GRUBHOFFER L.** 2010: Omsk hemorrhagic fever virus. In: D. Liu (Ed.), Molecular Detection of Human Viral Pathogens. CRC Press, Boca Raton, Florida, pp. 231–239.
4. **KOPÁČEK P.**, **HAJDUŠEK O.**, **BUREŠOVÁ V.**, DAFFRE S. 2010: Tick Innate Immunity. In: K. Söderhäll (Ed.), Invertebrate Immunity. Advances in Experimental Medicine and Biology 708, Landes Biosciences and Springer Science + Business Media, New York, pp. 137–162. [IF = 1.379]

Papers in journals with impact factor

1. **ASH A.**, DE CHAMBRIER A., **SCHOLZ T.**, KAR P.K. 2010: Redescription of *Vermaia pseudotropii* (Cestoda: Proteocephalidea), a hyperapolytic freshwater tapeworm. Revue Suisse de Zoologie 117: 665–677. [IF = 0.426]
2. BERTOLINO S., HOFMANNOVÁ L., GIRARDELLO M., **MODRÝ D.** 2010: Richness, origin and structure of an *Eimeria* community in a population of eastern cottontail (*Sylvilagus floridanus*) introduced into Italy. Parasitology 137: 1179–1186. [IF = 2.522]
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Patents

1. HOZÁK P., ŠLOUF M., **NEBESÁŘOVÁ J.**, MOŠA M., KRIVJANSKÁ M. 2011: Set of mutually distinguishable nanoparticles for multiple immunolabelling. Czech utility model No. 21711.

2. ŠLOUF M., NOVOTNÝ F., HOZÁK P., **NEBESÁŘOVÁ J.** 2011: Set of three microscopy distinguishable nanoparticles with gold surfaces for multiple immunolabelling. Czech utility model No. 21823.

3. ŠLOUF M., ŠLOUFOVÁ I., HOZÁK P., **NEBESÁŘOVÁ J.** 2011: Set of three microscopy distinguishable nanoparticles with gold surfaces for multiple immunolabelling. Czech utility model No. 21822.

International activities

Cooperation with foreign research institutions

Research area: Molecular parasitology

- Bayerische Julius Maximilians Universität, Institute für Pharmazie und Lebensmittelchemie, Würzburg, Germany (U. Holzgrabe)
- CNRS UMR8186, Ecole Normale Supérieure, Paris, France (C. Bowler)
- Comenius University, Faculty of Science, Bratislava, Slovakia (A. Horváth)
- Dalhousie University, Halifax, Canada (J. Archibald, M. Gray, A. Roger)
- Hubrecht Institute, Utrecht, The Netherlands (H. Korswagen)
- Illinois Natural History Survey, University of Illinois, Champaign-Urbana, USA (L. Solter)
- Justus Liebing University, Institute of Parasitology, Giessen, Germany (C.G. Grevelding)
- MRC Mitochondrial Biology Unit, Cambridge, UK (J.E. Walker)
- Muséum National d'Histoire Naturelle, Paris, France (J. Schrevel)
- Ohio State University, Columbus, USA (J. Alfonzo)
- Philipps University, Marburg, Germany (R. Lill, A. Poetik)
- Seattle Biomedical Research Institute and University of Washington, Seattle, USA (K. Stuart)
- State University of New York, Buffalo, USA (L. Read)
- Technical University Munich, Center for Integrated Protein Science Munich, Freisig, Germany (S. Verhelst)
- University of British Columbia, Vancouver, Canada (P.J. Keeling, B.R. Green)
- University of California, Riverside, USA (D.A. Maslov)
- University of California, San Francisco, USA (K. Ashrafi, K.R. Yamamoto)
- University of California, Sandler Center for Drug Discovery, San Francisco, USA (J.H. McKerrow, C.R. Caffrey)
- University of Edinburgh, Institute of Immunology and Infectious Research, UK (A. Schnaufer)
- University of Lancaster, Lancaster, UK (M.L. Ginger)
- University of Montreal, Department of Biochemistry, Québec, Canada (G. Burger)
- University of Tsukuba, Japan (R. Niwa)
- University of Zurich, Institute of Parasitology, Zurich, Switzerland (S. Stefanic)
- Walter and Eliza Hall Institute of Medical Research, Melbourne (E. Handman)

Research area: Ticks as disease vectors

- Baxter Innovations GmbH, Orth/Danube, Bacteriology and Preclinical Testing, Austria (I. Livey)
- Catholic University Leuven, Rega Institute for Medical Research, Belgium (E. de Clercq)
- CEH Institute of Virology and Environmental Microbiology, Oxford, UK (P.A. Nuttall, G. Paesen)
- Centre for Cellular and Molecular Biology, Hyderabad, India (S.K. Singh)
- CNRS, Université de Strasbourg, Strasbourg Cedex, France (E.A. Levashina, J.A. Hoffmann)
- Georgia Southern University, Institute of Parasitology and Arthropodology, USA (J.H. Oliver, Jr.)
- Ibis Biosciences, (Abbott Molecular), San Diego, USA (M. Eshoo)
- Indiana University, National Centre of Glycomics and Glycoproteomics, USA (M.V. Novotný)
- Institute of Chemical Biology and Fundamental Medicine, Siberian Branch of the Russian Academy of Sciences, Novosibirsk, Russia (S.E. Tkachev)
- Institute of Virology, Slovak Academy of Sciences, Bratislava, Slovakia (V. Hajnická)

- Institute of Zoology, Slovak Academy of Sciences, Bratislava, Slovakia (M. Kazimírová, M. Stanko)
- Johannes Gutenberg-University Mainz, Germany (E. Schmitt)
- Johannes Kepler University, Linz, Austria (N. Mueller)
- Ludwig-Maximilians-University, Comparative Tropical Medicine and Parasitology, Munich, Germany (K. Pfister, L. Passos)
- National Institutes of Health, Washington, DC, USA (J. Valenzuela, J. Anderson, J. Ribeiro)
- Robert Koch-Institut, Berlin, Germany (O. Donoso Mantke, M. Niedrig)
- Spiez Laboratory, Spiez, Switzerland (C. Beuret)
- University Medical Center Göttingen, Germany (M. Weidmann)
- University of Arizona, Tucson, Centre for Insect Science, USA (C. Bender)
- University of California, Berkeley, USA (R. S. Lane)
- University of California, Sandler Center for Drug Discovery, San Francisco, USA (C.R. Caffrey, J.H. McKerrow)
- University of Castilla-La Mancha, Ciudad Real, Spain (J. de la Fuente)
- University of Edinburgh, Edinburgh, UK (L. Sekey-Bell, J. Fazakerley)
- University of Glasgow, Glasgow, UK (J. Gilleard, A. Tait)
- University of Ljubljana, Institute of Microbiology and Immunology, Ljubljana, Slovenia (E. Ružić-Sabljić)
- University of Neuchâtel, Switzerland (B. Betchart, P. Guerin, L. Gern)
- University of Reading, UK (T. Gritsun)
- University of Utrecht, The Netherlands (F. Jongejan)

Research area: Organismal and evolutionary parasitology

- Autonomous University of Barcelona, Department of Animal and Plant Biology and Ecology, Barcelona, Spain (A. Pérez-del-Olmo)
- Center for Disease Control and Prevention, Atlanta, USA (L. Xiao, V. Cama, E.W. Secor, Z. Kučerová)
- Center for Food Safety, University of Georgia, Griffin, USA (Y. Ortega)
- College of Charleston, Department of Biology, Charleston, USA (I. de Buron)
- ECOSUR, Chetumal, Mexico (D. González-Solís)
- Institut de Recherche pour le Développement, Nouméa, New Caledonia (J.-L. Justine)
- Institute for Biology of Inland Waters, Russian Academy of Sciences, Borok, Russia (L.G. Poddubnaya)
- Institute of Ecology and Biological Resources, Vietnamese Academy of Sciences, Hanoi, Vietnam (Tran Thin Binh)
- Institute of Zoology, Slovak Academy of Sciences, Slovakia (M. Stanko)
- Murdoch University, Murdoch, Australia (R.P. Hobbs)
- Muséum d'Histoire Naturelle, Genève, Switzerland (A. de Chambrier, J. Mariaux)
- Parasitological Institute, Slovak Academy of Sciences, Košice, Slovakia (V. Hanzelová)
- The Natural History Museum, London, UK (D.T.J. Littlewood, P.D. Olson)
- Université de Montpellier 2, Montpellier, France (S. Morand)
- Universitet de Barcelona, Facultat de Farmacia, Barcelona, Spain (J. Miquel)
- University of Bologna, Department of Veterinary Public Health and Animal Pathology, Italy (M. Caffara)
- University of Bristol, School of Biological Sciences, UK (W. Gibson)
- University of Cape Town, Department of Zoology, Rondebosch, South Africa (C.C. Reed)
- University of Connecticut, Storrs, USA (J.N. Caira)
- University of Duisburg-Essen, Faculty of Biology, Department of Applied Zoology/Hydrobiology, Essen Germany (B. Sures)
- University of the Free State, Bloemfontein, South Africa (J. Van As, L. Basson)

- University of La Laguna, Institute of Tropical Diseases and Public Health of the Canary Islands, Spain (J. Lorenzo-Morales)
- University of Malaya, Institute of Ocean and Earth Sciences, Kuala Lumpur, Malaysia (M. Freeman)
- University of Ottawa, Department of Biology, Ottawa, Canada (N. Corradi)
- University of Sydney, Faculty of Veterinary Science, Sydney, New South Wales, Australia (J. Šlapeta)
- University of Valencia, Cavanilles Institute of Biodiversity and Evolutionary Biology, Spain (J.A. Raga)
- University of Valencia, Department of Zoology & Cavanilles Institute of Biodiversity and Evolutionary Biology (F.E. Montero)
- University of Tasmania, School of Aquaculture, Launceston, Tasmania, Australia (B. Nowak)
- University of Tokyo, Graduate School of Agricultural and Life Sciences, Tokyo, Japan (H. Yokoyama)
- University of Veterinary Medicine and Pharmacy in Košice, Košice, Slovakia (B. Malčeková, A. Valenčáková)
- Vet & Micro Science, North Dakota State University, Fargo, USA (J. McEvoy)
- Wroclaw Medical University, Wrocław, Poland (M. Wesolowska)

Membership in international organisations

Masako Asahina-Jindrová
- Member of the American Society for Cell Biology
- Member of the Genetics Society of America

Jan Dvořák
- International Proteolysis Society

Iva Dyková
- Regional Officer of the European Association of Fish Pathologists

Maryna Golovchenko
- Adjunct member of the James Oliver, Jr. Institute of Arthropodology and Parasitology at the Georgia Southern University

Libor Grubhoffer
- Member of the Organizing Committee for the EMBO Workshops on the Molecular and Population Biology of Mosquito and other Disease Vectors
- Adjunct member of the James Oliver, Jr. Institute of Arthropodology and Parasitology at the Georgia Southern University
- President of the National Committee of the International Union of Biological Sciences

Astrid Holzer
- Member of the British Society for Parasitology
- Member of the Fisheries Society of the British Isles

Michail Kotsyfakis
- Member of the American Society of Biochemistry and Molecular Biology

Julius Lukeš
- Vice President of the International Society for Evolutionary Protistology
- Vice President of the International Society of Protistologists
- Fellow of the Canadian Institute for Advanced Research

František Moravec
- Honorary Member of the Society of Slovak Parasitologists

Jana Nebesářová

- European Microscopy Society

Miroslav Oborník

- Member of the International Society for Evolutionary Protistology

Nataliia Rudenko

- Adjunct member of the James Oliver, Jr. Institute of Arthropodology and Parasitology at the Georgia Southern University

Daniel Růžek

- Member of the International Scientific Working Group on Tick-Borne Encephalitis

Tomáš Scholz

- Corresponding member of the Natural History Museum, Geneva, Switzerland

Jiří Vávra

- International Society of Protistologists

Membership on editorial boards

Acta Parasitologica (Poland): ***F. Moravec***, ***T. Scholz***

Acta Protozoologica (Poland): ***J. Vávra***

American Journal of Blood Research (USA): ***M. Kotsyfakis*** (associate editor)

European Journal of Protistology (Germany): ***J. Lom***

Helminthologia (Slovakia): ***F. Moravec***

Journal of Eukaryotic Microbiology (USA): ***J. Lukeš***, ***J. Vávra*** (board of reviewers)

Journal of Fish Diseases (UK): ***A. Holzer***, ***J. Lom***

Journal of Parasitology (USA): ***T. Scholz*** (Assistant Editor)

Kinetoplastid Biology and Disease (UK): ***J. Lukeš***

Parasites and Vectors: ***A. Kostadinova***

Protistology (Russia): ***J. Lukeš***

Systematic Parasitology (UK): ***A. Kostadinova***, ***F. Moravec***, ***T. Scholz***

Ticks and Tick-borne Diseases (Germany): ***J. Kopecký***

World Journal of Virology (China): ***D. Růžek***

Wiadomości Parazytologiczne (Poland): ***T. Scholz***

Folia Parasitologica (Czech Republic):

V. Bukva (Editor-in-Chief till December 2011)
L. Grubhoffer (Assistant Editor till December 2011)
L. Lom (Assistant Editor till April 2010)
J. Lukeš (Assistant Editor since April 2010)
F. Moravec (Assistant Editor till December 2011)
I. Dyková
T. Scholz (Editor-in-Chief since January 2012)
A. Kostadinova (Assistant Editor since January 2012)
J. Vávra

Teaching activities

The mission of the Institute of Parasitology is primarily to perform basic research. However, participation of the staff in teaching is an integral part of its activities. In addition, teaching is essential for further development of the Institute. Therefore, most of the key scientists participate in teaching, both by giving lectures and supervising graduate and undergraduate students.

The students actively participate in research projects of the Institute. Most students are from the University of South Bohemia in České Budějovice, especially its Faculty of Science (FS), but also from other faculties (Faculty of Agriculture – FA; Faculty of Health and Social Studies – FHS) and universities, such as Charles University in Prague, Masaryk University in Brno and the University of Veterinary and Pharmaceutical Sciences in Brno.

In order to facilitate scientific cooperation and participation of students in the research performed at the Institute, the Laboratory of Molecular Ecology of Vectors and Pathogens (head L. Grubhoffer) and the Laboratory of Evolutionary Protistology (head M. Oborník) have been established jointly with the University of South Bohemia. These laboratories have been supported by the Institutional Research Project of the Faculty of Science (MSM 6007665801).

List of PhD theses

(Faculty of Science, unless otherwise stated)

2010

- **Pavla Bartošová**: Phylogenetic analyses of myxosporeans based on the molecular data.
  Supervisor: Ivan Fiala
- **Jindřich Chmelař**: Transcriptomic and functional analysis of salivary proteins from the tick *Ixodes ricinus*.
  Supervisor: Jan Kopecký, *consultant: Michalis Kotsyfakis*
- **Zdeněk Paris**: The impact of iron-sulfur assembly on the mitochondrial tRNA import in *Trypanosoma brucei*.
  Supervisor: Julius Lukeš, *consultant: J. Alfonzo*, Ohio State University, Columbus, Ohio, USA

2011

- **Helena Horká**: The role of tick saliva and tick salivary cystatins in the transmission of *Borrelia burgdorferi* and the cystatin effect on experimental asthma in mice.
  Supervisor: Jan Kopecký, *consultant: Michalis Kotsyfakis*
- **Luděk Kořený**: Evolution of the tetrapyrrole synthesis in eukaryotes.
  Supervisor: Miroslav Oborník
- **Miroslava Soldánová**: Composition and structure of larval trematode communities in model freshwater pulmonate gastropods in eutrophic environments in Central Europe.
  Supervisor: Aneta Kostadinova, *consultant: Anna Faltýnková*
- **Zdeněk Verner**: Mitochondrial energy metabolism in *Trypanosoma brucei*.
  Supervisor: Julius Lukeš

List of MSc. theses

2010

- **Lenka Bučinská**: Analyses of glycoproteins from the salivary glands of the tick *Ixodes ricinus*.
  Supervisor: Marie Vancová
- **Jaromír Cihlář**: Molecular characterization of novel photosynthetic protozoan phylum from corals.
  Supervisor: Miroslav Oborník
- **Eva Černotíková**: Molecular phylogeny of selected species of suborder Spirurina from fishes inferred from SSU rRNA gene sequences.
  Supervisor: František Moravec
- **Petra Drobníková**: Vitellogenesis in caryophyllidean cestodes.
  Supervisor: Magdaléna Bruňanská, *consultant: Tomáš Scholz*
- **Martina Jeníková**: Age specificity of *Cryptosporidium* spp. infecting pigs.
  Supervisor: Martin Kváč
- **Patrik Kilián**: Genetic variability in field strains of Ťahyňa virus.
  Supervisor: Libor Grubhoffer, *consultant: Daniel Růžek*
- **Linda Matoušová**: Testing of effects of the *o*-phosphonatomethylcholine and its analogues against *Leishmania*.
  Supervisor: Oleg Ditrich
- **Lucie Novotná**: Functional analysis of subunit MRB3010 of the mitochondrial binding complex 1 in *Trypanosoma brucei*.
  Supervisor: Hassan Hashimi
- **Pavel Poliak**: Study of mitochondrial processing peptidases in procyclic *Trypanosoma brucei*.
  Supervisor: Julius Lukeš
- **Alexandr Pospěch**: Attempts on chromatin immunoprecipitation with *C. elegans* nuclear receptor NHR-25.
  Supervisor: Masako Asahina-Jindrová
- **Petra Rozkošná**: Monogenea of the cichlid fishes from Peruvian Amazonia.
  Supervisor: Tomáš Scholz
- **Petr Růžička**: Experimental examination of EFL and MATX eukaryotic horizontal gene transfers: co-existence of mutually exclusive transcripts predates functional rescue.
  Supervisor: Julius Lukeš
- **Martina Slámová**: The effect of tick saliva on the interactions between *Borrelia afzelii* spirochetes and murine dendritic cells.
  Supervisor: Jan Kopecký, *consultant: Anna Fialová (Skallová)*
- **Eva Slepičková**: Anti-chemokine properties of salivary gland extract of *Ixodes ricinus*.
  Supervisor: Jan Kopecký, *consultant: Jiří Salát*
- **Martina Tesařová**: Ultrastructural changes in human neural cells after infection with tick-borne encephalitis.
  Supervisor: Jana Nebesářová
- **Tomáš Tyml**: Myxosporean infections in shrews (Soricidae).
  Supervisor: Iva Dyková
- **Jiří Týč**: Functional analysis of prohibitin in *Trypanosoma brucei*.
  Supervisor: Julius Lukeš
- **Michaela Veselíková**: Characterization of a putative methyltransferase MT420 in *Trypanosoma brucei*.
  Supervisor: Alena Zíková
- **Tomáš Vodička**: Molecular identification and phylogeny of *Chlorella* spp. production strains utilized in algal biotechnologies.
  Supervisor: Miroslav Oborník

2011

- **Andrea Bednářová**: Life strategies of flukes (Digenea) with focus on the cercarial developmental stage.
  Supervisor: Anna Faltýnková
- **Alena Burianová**: Revision of African bothriocephalid cestodes.
  Supervisor: Roman Kuchta
- **Veronika Dorňáková**: Identification and characterization of histidine-rich peptides from hard ticks *Ixodes ricinus* and *Ixodes scapularis*.
  Supervisor: Nataliia Rudenko, *consultant: Marina Golovchenko*
- **Jarmila Dupejová**: Hemelipoglycoprotein from the *Dermacentor marginatus* hemolymph: purification and biochemical characterization.
  Supervisor: Libor Grubhoffer, *consultant: Ján Štěrba*
- **Veronika Eiblová**: The possibilities of using nanoparticles of various metals as the markers for immunocytochemical labelling in field emission scanning electron microscopy.
  Supervisor: Jana Nebesářová
- **Eva Gregorová**: The influence of vaccination with saliva of the tick *Ixodes ricinus* on the transmission of *Borrelia burgdorferi* and cytokine profile of the host.
  Supervisor: Jan Kopecký
- **Jiří Havran**: Detection of Lyme disease spirochetes in clinical samples by PCR-based methods and optimalization of conditions borrelia cultivation conditions from samples of patients with LB symptoms.
  Supervisor: Nataliia Rudenko, *consultant: Marina Golovchenko*
- **Eliška Korandová**: Possibilities of using nanoparticles of different metals as markers for immunolabeling in the low voltage electron microscope.
  Supervisor: Jana Nebesářová
- **Michaela Kotková**: The course of microsporidiosis caused by *Encephalitozoon cuniculi* in immunocompetent and immunodeficient mice.
  Supervisor: Bohumil Sak, *consultant: Martin Kváč*
- **Tereza Marvanová**: Population structure and genealogy of lice *Hoplopleura*.
  Supervisor: Václav Hypša
- **Lenka Moravcová**: The susceptibility of different strains of *Mus musculus musculus* and *Mus musculus domesticus* to the *Cryptosporidium* mouse genotype I infection.
  Supervisor: Bohumil Sak
- **Jan Perner**: Phenotyping of a glutamate dehydrogenase a null mutant of *Plasmodium falciparum*.
  Supervisor: Sylke Müller, University of Glasgow (Erasmus Programme)
- **Tomáš Skalický**: Functional analysis of Ssc1 and Iba57 proteins in *Trypanosoma brucei*.
  Supervisor: Julius Lukeš
- **Renata Strouhalová**: Genome changes of tick-borne encephalitis virus in variants with different passage history and biological properties.
  Supervisor: Libor Grubhoffer, *consultant: Václav Hönig*
- **Lenka Šípková**: Spermatological characters in Bothriocephalidea (Cestoda).
  Supervisor: Céline Levron
- **Kateřina Voráčová**: Isolation of intact plastids of the secondary alga *Chromera velia* and treatment of the alga with rifampicin.
  Supervisor: Miroslav Oborník
- **Pavla Wagnerová**: Endoparasites of horses. (FA)
  Supervisor: Martin Kváč

List of BSc. theses

2010

- **Miroslav Barankiewicz**: Ecology of blood protists in frogs *Pelophylax ridibundus*.
  Supervisor: Miloslav Jirků
- **Marta Cinková**: Assessment of the mitochondrial data for the phylogenetic relationships of Myxosperea.
  Supervisor: Ivan Fiala
- **Lenka Černá**: Opportunistic parasites in patients of geriatric facilities. (FHS)
  Supervisor: Oleg Ditrich
- **Lucie Hanzálková**: Functional analysis of two subunits of the putative Mitochondrial RNA Binding complex 1 in *Trypanosoma brucei*.
  Supervisor: Hassan Hashimi
- **Adéla Harcubová**: Vaccines against ticks.
  Supervisor: Jan Kopecký
- **Markéta Hejníková**: Methods of purification Lyme of diseases spirochete – *Borrelia burgdorferi* sensu lato.
  Supervisor: Jan Kopecký
- **Marie Hlavničková**: Phylogenetic relationships of species of the family Ceratomyxidae (Myxozoa).
  Supervisor: Ivan Fiala
- **Nikola Hromadová**: Intraspecies variability of *Cryptosporidium parvum* infecting calves. (FA)
  Supervisor: Martin Kváč
- **Filip Husník**: Molecular phylogeny of intracellular symbiotic Gammaproteobacteria in insects.
  Supervisor: Václav Hypša
- **Julie Kovářová**: Heme detection in parasitic protists of the group Trypanosomatidae.
  Supervisor: Luděk Kořený
- **Anna Mácová**: Coccidia in rodents of the genus *Apodemus*.
  Supervisor: Jana Kvičerová
- **Jana Páleníková**: Dynamics of *Borrelia burgdorferi* sensu stricto transmission from the tick *Ixodes ricinus* to the host.
  Supervisor: Helena Horká
- **David Pech**: Determination of amino acid sequence of hemelipoglycoprotein from tick *Dermacentor marginatus* by mass spectrometry.
  Supervisor: Libor Grubhoffer, *consultant: Ján Štěrba*
- **Martin Strnad**: Interaction of *Borrelia burgdorferi* spirochetes with the salivary glands of *Ixodes ricinus* and with tick cells *in vitro* observed by immunoflurescence microscopy.
  Supervisor: Libor Grubhoffer, *consultants: Ján Štěrba* and *Marie Vancová*
- **Barbora Svobodová**: Lipopolysaccharide contamination of recombinant proteins and its significance for immunological studies.
  Supervisor: Jan Kopecký
- **Jana Širmarová**: The influence of *Ixodes ricinus* saliva on the antiviral effect of interferons.
  Supervisor: Jan Kopecký, *consultant: Jaroslava Lieskovská*
- **Zuzana Vavrušková**: Occurrence of ticks and tick-borne pathogens in a urban park area of České Budějovice.
  Supervisor: Libor Grubhoffer, *consultant: Václav Hönig*
- **Adriana Walnerová**: Cloning of the gene coding for outer surface protein C form the Lyme borreliosis spirochete.
  Supervisor: Libor Grubhoffer, *consultant: Ján Štěrba*
- **Petra Zajíčková**: Opportunistic parasites of the patients with transplants and other immunosupressed individuals. (FHS)
  Supervisor: Oleg Ditrich
- **Carmen Ziebermayr**: Detection of pilocarine in tick saliva and its effect on the host immunity.
  Supervisor: Jan Kopecký, *consultant: Petr Šimek* (Institute of Entomology, BC)

- **Markéta Absolonová**: IrAM4: Partial characterisation of a molecule similar to α_2-macroglobulin from a tick *Ixodes ricinus*.
  Supervisor: Lenka Grunclová
- **Tamara Buchberger**: Mass spectometry of proteins.
  Supervisor: Libor Grubhoffer
- **Lenka Čapková**: Tick-borne encephalitis virus in an urban area of České Budějovice (Czech Republic).
  Supervisor: Libor Grubhoffer
- **Helena Huspeková**: The transmission of significant pathogens activated by tick saliva.
  Supervisor: Jan Kopecký
- **Michaela Jíchová**: The hosts and the geographical distribution of the tapeworm *Bothriocephalus acheilognathi* (Cestoda: Bothriocephalidea).
  Supervisor: Roman Kuchta
- **Jan Kotál**: Towards the functional characterization of a "cysteine rich" protein family member from *Ixodes ricinus*.
  Supervisor: Michalis Kotsyfakis
- **Gabriela Křivánková**: Opportunistic parasites in alcoholics. (FHS)
  Supervisor: Oleg Ditrich
- **Martina Loudová**: Biology and genetic variability of *Cryptosporidium* mouse genotype I.
  Supervisor: Martin Kváč
- **Petra Machovcová**: The occurrence of cryptosporidia in children. (FHS)
  Supervisor: Oleg Ditrich
- **Denisa Martykánová**: The possibilities of multiple immunolabelling of biological samples in a scanning electron microscope.
  Supervisor: Jana Nebesářová
- **Eva Myšková**: Paleoparasitological analysis of organic sediments at the archeological locality in Národní třída, Prague.
  Supervisor: Oleg Ditrich
- **Quynh Nguyenová**: Analysis of NHR-25 function on yolk expression in *C. elegans*.
  Supervisor: Masako Asahina-Jindrová
- **Zuzana Radičová**: Important proteins of tick as inspiration for biomedicine.
  Supervisor: Libor Grubhoffer
- **Petr Rathner**: IrAM9 – a member of a thioester-containing protein family from the hard tick *Ixodes ricinus*.
  Supervisor: Petr Kopáček
- **Jana Schrenková**: Immunolocalization of the digestive peptidases in the nymf of the hard tick *Ixodes ricinus* during feeding and throughout metamorphosis.
  Supervisor: Petr Kopáček
- **Marion Sieber**: Promoter analysis of lin-3::gfp transgene in *Caenorhabditis elegans*.
  Supervisor: Masako Asahina-Jindrová
- **Barbora Singerová**: Characterization of two members from the multigenic family of one-domain Kunitz-inhibitors from the tick *Ixodes ricinus*.
  Supervisor: Jindřich Chmelař
- **Renáta Smetanová**: Occurrence of microsporidia found in various groups of patients (children). (FHS)
  Supervisor: Oleg Ditrich
- **Halina Steblová**: Characterization of new isolates within the genus *Chromera* (Chromerida: Alveolata).
  Supervisor: Miroslav Oborník
- **Petra Šarounová**: Effect of temperature on emergence of cercariae of model freshwater trematodes.
  Supervisor: Aneta Kostadinova
- **Barbora Isatou Uhlířová**: Cryptosporidiosis of small ruminants. (FA)
  Supervisor: Martin Kváč

- **Markéta Vopalecká**: Preparation of monoclonal antibodies against *Cryptosporidium muris*. *Supervisor: Bohumil Sak*, *consultant: Martin Kváč*
- **Jana Zikmundová**: Is there a soldier caste in freshwater echinostome trematodes? *Supervisor: Aneta Kostadinova*

Teaching abroad and at international courses

2011

- **POSTICK** – Spring School on Tick Biology and Ecology, České Budějovice, 30 May – 3 June, 2011:
  Burešová V. – Tick Infection (workshop)
  Erhart J. – Tick Laboratory Colonies (workshop)
  Grubhoffer L. – Ticks Physiology I. – Ontogenesis and Reproduction (lecture)
  Hönig V. – Detection of Tick-Borne Pathogens (workshop)
  Hönig V. – Tick Sampling (workshop)
  Hypša V. – Tick Biology and Phylogeny (lecture)
  Kopáček P. – Ticks Physiology IV. – Innate Immunity (lecture)
  Kotsyfakis M. – Ticks Physiology II. – Tick-Host Interface (lecture)
  Kotsyfakis M., Konvičková J., Rozkošná P. – Ticks Physiology (workshop)
  Martinů J. – Tick Taxonomy (workshop)
  Růžek D. – Tick Borne-Pathogens I. – Viral Agents (lecture)
  Sojka D. – Ticks Physiology III. – Bloodmeal Digestion (lecture)
  Vancová M. – Functional Morphology and Anatomy of Ticks (lecture)
  Vancová M. – Scanning Electron Microscopy in Ticks (workshop)
  Vancová M. – Tick Dissection (workshop)
  Vancová M. – Transmission Electron Microscopy (workshop)
- **Petr Kopáček**: PhD defence of Chenglin WU: Innate immune proteins in a crustacean *Pacifastacus leniusculus*, University of Uppsala, Sweden 2011 (PK – principal reviewer)
- **Jana Nebesářová**: Practical EMBO Course on Electron Microscopy and Stereology in Cell Biology, 14–24 June 2011, Strassbourg, France

Stays of foreign students

2010

- **Eva Bazsalovicsová**: Parasitological Institute, Košice, Slovakia (18. – 31. 10. 2010)
  Supervisor: J. Štefka
- **Marta Carreras-Aubets**: Autonomous University of Barcelona, Spain (1.5 months)
  Supervisor: A. Kostadinova
- **Maria Constenla Matalobos**: University of Barcelona, Spain (1.10. – 15. 11. 2010)
  Supervisor: I. Dyková
- **Borislav Kostič**: Parasitological Institute, Košice, Slovakia (14. – 26. 3. 2010; 11. – 29. 11. 2010)
  Supervisor: J. Nebesářová
- **Lindsay McDonald**: University of Glasgow, UK (10 months)
  Supervisor: J. Lukeš
- **Marianna Reblánová**: Parasitological Institute, Košice, Slovakia (18. – 31. 10. 2010)
  Supervisor: M. Orosová
- **Christian Selbach**: University of Duisburg-Essen, Germany (2 weeks)
  Supervisors: A. Kostadinova and *A. Faltýnková*

2011

- **Samir Jawda Bilal**: Erbil, Iraq (5.–27. 9. 2011)
  Supervisor: T. Scholz
- **Ana Born-Torrijos**: University of Valencia, Spain (28. 10.–30. 11.2011)
  Supervisor: A. Kostadinova
- **Fred Chibwana**: University of Dar es Salaam, Tanzania (3 months)
  Supervisor: A. Kostadinova
- **Joanna Cielocha**: University of Kansas, Lawrence, USA (17. 10.–3. 11. 2011)
  Supervisor: A. Yoneva
- **Ashlie Hartigan**: University of Sydney, Australia (28. 2.–31. 3. 2011)
  Supervisor: I. Dyková
- **Katerzyna Lis**: Munich, Germany (several stays)
  Supervisor: L. Grubhoffer
- **Lindsay MacDonald**, Glasgow University, UK (10 months)
  Supervisor: Julius Lukeš
- **Douniazed Marzoug**: Université d'Oran Es – Senia, Algeria (1.–17. 4. + 12.–22. 10. 2011)
- **Supervisor**: *A. Kostadinova*
- **Sneha Patra**: Calcutta, West Bengal, India (3. 11. 2011–6. 1. 2012)
  Supervisor: A. Holzer
- **Christian Selbach**: University of Essen, Germany (8.–13. 5. 2011)
  Supervisor: A. Kostadinova
- **Susanne Schlesinger**: University of Würzburg, Germany (2 weeks)

Stays of foreign researchers

2010

- **Juan Alfonzo**: University of Ohio, Columbus, USA (9.–14. 9. 2010)
- **John Andersen**: NIH, Rockville, USA (1.–7. 11. 2010)
- **Francisco Ayala**: University of California, Irvine, USA (10.–14. 5. 2010)
- **Magdaléna Bruňanská**: Parasitological Institute, Košice, Slovakia (11.–29. 11. 2010)
- **Alain de Chambrier**: Natural History Museum, Geneve, Switzerland (7.–19. 3. 2010)
- **Shivaji Chavan**: College of Arts, Commerce and Science, Parbhani, Maharashtra, India (30. 10.–27. 11. 2010)
- **David Bruce Conn**: Berry College, Mount Berry, Georgia, USA (8. 5.–17. 6. 2010) (Fulbright Senior Fellow)
- **Edit Eszterbauer**: Veterinary University, Budapest, Hungary (9.–11. 9. 2010)
- **Mirabela Dumitrache**: University of Agricultural Sciences and Veterinary Medicine, Cluj, Romania (12. 4.–12. 7. 2010)
- **Mark van der Giezen**: University of Exeter, UK (10.–12. 9. 2010)
- **David González-Solís**: ECOSUR, Unidad Chetumal, Mexico (2. 5.–15. 9. 2010)
- **Vladimíra Hanzelová**: Parasitological Institute, Košice, Slovakia (8.–13. 11. 2010)
- **John S. Mackiewicz**: State University of New York at Albany, USA (17.–30. 7. 2010)
- **Dmitrij Maslov**: University of California, Riverside, USA (September 2010–February 2011)
- **Jim McKerrow**: University of California, San Francisco, USA (15.–19. 4. 2010)
- **Mikuláš Oros**: Parasitological Institute, Košice, Slovakia (7.–20. 11. 2010)
- **Martina Orosová**: Parasitological Institute, Košice, Slovakia (7.–20. 11. 2010)
- **Ana Pérez-del-Olmo:** Autonomous University of Barcelona, Barcelona, Spain (20. 7.– 1. 8. 2010)
- **Antonio J. Pierik**: Philipps University, Marburg, Germany (8.–12. 9. 2010)
- **Marien Rubio**: University of Ohio, Columbus, USA (9.–14. 9. 2010)

- **Rui Sá:** Cardiff University, UK (4.–8. 10. 2010)
- **Joseph Schrével**: Muséum national d'histoire naturelle, Paris, France (8.–12. 11. 2010)
- **Sunit K. Singh**: Centre for Cellular and Molecular Biology, Hyderabad, India (3. 5.–3. 6. 2010)
- **Margarita Smirnov**: Central Fish Health Laboratory, Israel (2.–7. 5. 2010)
- **Marta Špakulová**: Parasitological Institute, Košice, Slovakia (8.–13. 11. 2010)
- **Aneta Yoneva**: Bulgarian Academy of Sciences, Sofia, Bulgaria (4. 5.–4. 11. 2010)

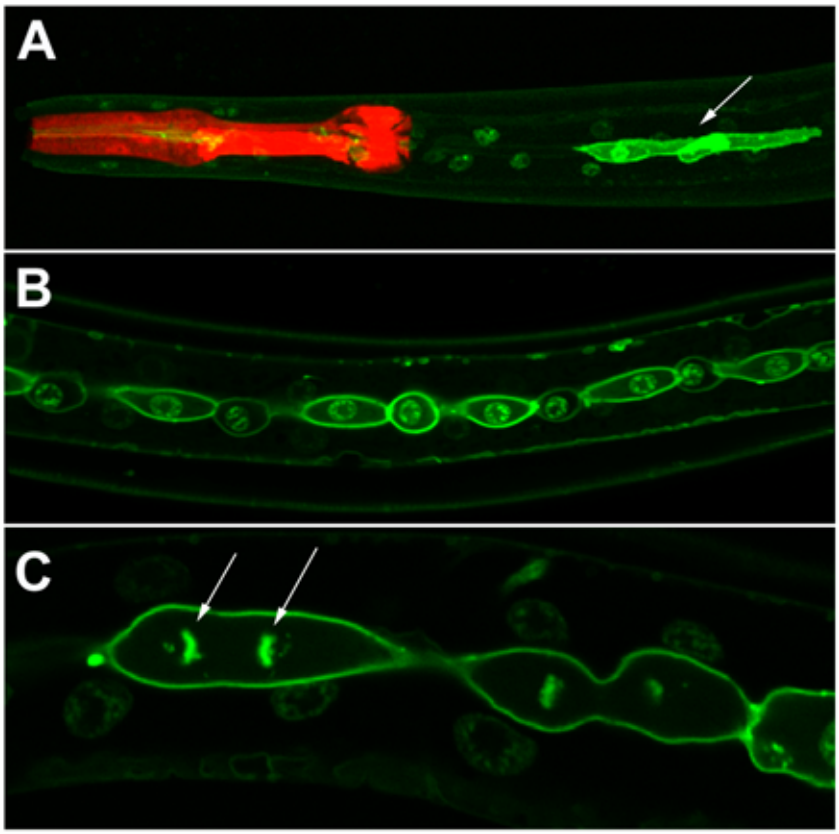
2011

- **Rogelio Aguilar-Aguilar**: Facultad de Ciencias, UNAM, Mexico (19.–23. 7. + 30.7.–3.8. 2011)
- **Michelle Ammerman**: State University of New York, Buffalo, USA (5.–9. 10. 2011)
- **Lesley Bell-Sakyi**: University of Edinburgh, Scotland, UK
- **Tran Thin Binh**: Institute of Ecology and Biological Resources, Hanoy, Vietnam (18. 3.–18. 4. 2011)
- **Daniel R. Brooks**: University of Ontario, Toronto, Canada (4.–11. 5. 2011)
- **Magdaléna Bruňanská**: Parasitological Institute, Košice, Slovakia (26. 9.–7. 10. 2011)
- **Brian Crowe**: BAXTER BioSciences, AG, Orth/Donau, Austria
- **Bernhard Eckel**: University of Vienna, Austria (18.–28. 10. 2011)
- **Sandra Essbauer**: Bundeswehr Institute of Microbiology, Munich, Germany
- **Oliver Donoso Mantke**: Robert Koch Institute, Berlin, Germany
- **Alain de Chambrier**: Natural History Museum, Geneve, Switzerland (16.–26. 5. 2011)
- **Erik De Clercq**: Rega Institute of Medical Research, Catholic University, Leuven, Belgium
- **José de la Fuente**: University Castilia la Manche, Ciudad Real, Spain & Oklahoma State University, Stillwater, OK, USA
- **Ivo Francischetti**: NIH, Rockville, USA (26.–29. 4. 2011)
- **Michael Ginger**: University of Lancester, UK (26.–28. 4. 2011
- **Jeremy Gray**: University of Dublin, Ireland, UK
- **Sara Gremillion**: Armstrong Atlantic State University, Savannah, GA, USA (July 2011)
- **Martin Kalbe**: Max – Planck Institute, Plön, Germany (29.–31. 5. 2011)
- **Beata Malčeková:** University of Veterinary Medicine and Pharmacy in Košice, Slovakia (23.–27. 5.; 7.–11. 2011)
- **Karen Mansfield**: Animal Health and Veterinary Laboratories Agency, UK (6. 6.–10. 6. 2011)
- **Dmitrij Maslov**: University of California, Riverside, USA (September 2010–May 2011)
- **Rosaura Mayén Estrada**: Facultad de Ciencias, UNAM, Mexico (19.–23. 7. + 30.7.–3.8. 2011)
- **Miloš V. Novotný**: Indiana University, Bloominghton, IN, USA
- **Norbert Nowotny**: Vienna Veterinary Medicine University, Austria
- **Mikuláš Oros**: Parasitological Institute, Košice, Slovakia (31. 10.–15. 11. 2011)
- **Martina Orosová**: Parasitological Institute, Košice, Slovakia (31. 10.–15. 11. 2011)
- **Lygia Passos**, **Kurt Pfister + Stefan Schumacher**: LMU, Germany
- **Ana Pérez-del-Olmo:** Autonomous University of Barcelona, Barcelona, Spain (14. 8.– 1. 9. 2011)
- **Petra Ravaszová**: University of Veterinary Medicine and Pharmacy in Košice, Slovakia (2.–8. 5. 2011)
- **Laurie Reed**: State University of New York, Buffalo, USA (5.–9. 10. 2011)
- **Jordan Ward**: University of California, San Francisco, USA (20. 9.–6. 10. 2011)
- **Aneta Yoneva**: Institute of Ecology and Biodiversity, Sofia, Bulgaria (31.10.–21.11.2011)
- **Zeng Huan Zhou**: Southern Medical University, Guangzhou, China (14. 11. 2011)

Survey of lectures and courses (2010–2011) (hours/year)[1]

Name	Course	2010	2011
M. Asahina-Jindrová	Developmental biology	8	8
M. Asahina-Jindrová	Intercellular signalling in development and disease	-	52
M. Asahina-Jindrová	Cell regulation and signalling	4	4
O. Ditrich	Medical parasitology and diagnostic methods I	85	-
O. Ditrich	Medical parasitology and diagnostic methods II	-	85
O. Ditrich	Biology of marine invertebrates		26
O. Ditrich	Biology of molluscs	52	-
O. Ditrich	Diagnostics in medical parasitology	16[5]	16[5]
O. Ditrich	Medical parasitology		50[3]
O. Ditrich	Parasitology for laboratory assistants	26[2]	26[2]
O. Ditrich	Parasitology for public health assistants	26[2]	26[2]
I. Dyková	Pathology of parasitic diseases	32[5]	-
I. Fiala	Field parasitology	40	-
L. Grubhoffer	Biochemistry	60	60
L. Grubhoffer	Biochemistry 1 (CB + Linz)	65	65
L. Grubhoffer	Biochemistry 2 (CB + Linz)	65	65
H. Hashimi	Cell regulation and signalling	39	39
V. Hypša	Biology of parasitism	26	26
V. Hypša	Biology of marine invertebrates	26	-
V. Hypša	Molecular phylogenetics	26	26
V. Hypša	Biology of parasitic arthropods	-	39
V. Hypša	Molecular ecology	26	26
J. Kopecký	Immunology	40	40
J. Kopecký	Parasite immunology	20	20
J. Kopecký	Cell and tissue cultures	20	20
J. Kopecký	Parasite immunology	10[5]	10[5]
M. Kostka	Food microbiology	70[6]	70[6]
M. Kostka	Microbiology	56[6]	28[6]
M. Kostka	Microbial biotechnology	28[6]	
M. Kostka	Biology of parasitic protozoa		36
B. Koudela	Biology of parasitic protozoa	-	80[3]
R. Kuchta	Special zoology of invertebrates	10	10
M. Kváč	Zoohyg. & prevention of diseases of farm animals	122[6]	122[6]
M. Kváč	Animal health	56[6]	56[6]
M. Kváč	Veterinary parasitology	53[6]	53[6]
J. Lukeš	Biology of parasitic protists	-	80
J. Lukeš	Biochemistry and molecular biology of parasites	30	-
J. Lukeš	Principles of molecular biology	10	10
J. Nebesářová	Electron microscopy for biologists I	96	-
J. Nebesářová	Electron microscopy	36[2]	36[2]
J. Nebesářová	Biological electron microscopy	36[4]	-
J. Nebesářová	Electron microscopy	-	12[3]
J. Nebesářová	Electron microscopy	-	36[6]
M. Oborník	Introduction to bioinformatics	-	24
M. Oborník	Molecular taxonomy	-	56[6]
D. Růžek	Medical virology	48	48
B. Sak	Cell biology methods	40[2]	40[2]
T. Scholz	Biology of parasitic helminths	78	-
T. Scholz	Special zoology of invertebrates	-	3
J. Vávra	Biology of parasitic protists	-	39
J. Vávra	Biology of parasitic protists	-	9[5]

[1] Faculty of Science, University of South Bohemia, České Budějovice, unless otherwise stated; [2] Faculty of Health and Social Studies, University of South Bohemia, České Budějovice; [3] Faculty of Science, Masaryk University, Brno; [4] Faculty of Education, University of South Bohemia, České Budějovice; [5] Faculty of Science, Charles University, Prague; [6] Faculty of Agriculture, University of South Bohemia, České Budějovice; (CB+Linz) crossborder curriculum of Biological Chemistry (Univ. of South Bohemia & Johanes Kepler Univ. in Linz)



Transgenic *Caenorhabditis elegans* generated for the study of asymmetric cell division and cell differentiation.

A – Pharyngal muscle gene (*myo-2*) fused with tdTomato is used as a transformation marker shown in red and epidermal seam cells are marked with *wrt-2promoter::PH::GFP* (expressed at cell membrane) and *wrt-2promoter::H2B::GFP* (expressed at chromatin) transgenes shown in green (arrow). B – Example of asymmetric cell divisions of epidermal seam cells. C – Dividing epidermal seam cells marked with same transgenes in A and B. Arrows indicate segregating chromosomes in dividing cells. Confocal (Olympus FV1000) images by Masako Asahina-Jindrová.

Institute of Parasitology, Biology Centre of the Academy of Sciences of the Czech Republic, v.v.i.

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